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LIBERA UNIVERSITÀ INTERNAZIONALE DEGLI STUDI SOCIALI

PhD THESIS

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Thesis Title:
Essays on fiscal coordination in the EMU

Keywords:

Fiscal policy, Risk sharing, European union

PhD in Economics

XXVIII Cycle

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Introduction

The recent crisis has shed light on the weaknesses and the drawbacks of the European Monetary Union. In particular, many economists and commentators have suggested the need to complement the existing common monetary policy and stability pacts with some kind of *fiscal union*, i.e., enhanced supranational fiscal space and coordination, as a way to limit the impacts of idiosyncratic shocks and provide more risk sharing.

The economic literature has proposed many solutions along this line, such as the institution of a European Minister of Finance, a central fiscal authority, Eurobonds, or a coordinated scheme of unemployment insurance. More specifically, the notion of fiscal union may imply the development of European revenue sources for the EMU budget, the harmonization of taxation within the EMU, a mechanism to increase fiscal discipline at both the union and national levels, building up a union-wide insurance mechanism against financial turbulence, including debt mutualization.

Examples of these proposals are Ubide (2015) and Corsetti et al. (2015) which propose Stability Bonds that would give proceeds to member states and could be used to enact counter-cyclical fiscal policies in the Euro Area. Sapir and Wolff (2015) recommend the creation of a Eurosystem of Fiscal Policy (EFP) with two goals: fiscal debt sustainability and an adequate area-wide fiscal position. Guiso and Morelli (2014) propose the creation of a European Federal Institute to which member states would transfer part of their budget, equal to some agreed-upon share of the value of the EFI's accumulated debt. Further, Clayes et al. (2014) claim that the EMU should adopt a common system of partially centralized unemployment benefits, coming from the need for counter-cyclical horizontal transfers, which should act as mutual insurance. Moreover, the European Commission (2012) advances the idea of building a centralized Eurozone fund which would provide member states with automatic but temporary fiscal transfers in the case of adverse idiosyncratic shocks (repaid in good times). Many of these proposals are on the table with the goal of reinforcing the overall EU governance.

In this work we address two fundamental issues concerning the general Euro Zone architecture and its prospect. One relates to the implementation of a common EMU fiscal policy, its ability to stimulate growth during periods of downturns and to smooth out the effects of adverse shocks, reacting to them at business cycle frequency (aggregate demand management and fiscal multipliers). The other regards shock absorption across state borders

and the strengthening of financial markets' integration (private risk-sharing) and national governments' intervention into credit markets or supranational institutions arrangements (public risk-sharing).

What comes to light is that a unique European fiscal policy may not be as beneficial as it is often claimed, because the fiscal transmission mechanisms are quite different across member states. Indeed, in the first paper of this thesis we show that fiscal multipliers are different across EMU countries (the analysis concerns Belgium, France, Germany, Italy and Spain). The study detects instability in the magnitude of the multipliers and in the slopes of the impulse response functions, both across countries and times, using standard VARs and time varying parameter VARs (TVP-VAR). We claim that the differences are due to transmission mechanisms (in the paper they are captured by the beta coefficients of the TVP-VAR) and driving forces rather than the magnitude and the volatility of national fiscal shocks per se (in the paper they are captured by the standard deviations of the TVP-VAR residuals). We argue that the observed degree of heterogeneity in the fiscal multipliers and in the other response coefficients across EMU countries casts some doubt on the real ability of EMU governments to coordinate their fiscal actions when needed and on the effectiveness of a common EMU fiscal policy in stimulating real economic activity.

In the second paper of this dissertation, instead, we study the mechanisms, extent and characteristics of risk sharing across the EMU. How well do international financial markets allow for consumption smoothing in member countries facing idiosyncratic shocks? How effective are public national and supranational institutions in improving risk sharing? Our analysis extends the work and methodology pioneered by Asdrubali et al (1996) by updating results up to 2014 and by identifying the role of the European institutions (like the European Financial Stability Facility (ESFS) or the European Stabilization Mechanism (ESM)) created right after the great recession with the objective of assisting countries with limited market access. As a matter of fact, we find that the role played by public official transfers from these institutions to more vulnerable countries in order to smooth consumption during the great depression is noteworthy: the ESFS and the ESM have increased the amount of risk sharing within the EMU.

More specifically, we use the method of variance decomposition first implemented by Asdrubali et al (1996) to identify the main channels of risk sharing (net factor income, international transfers and credit markets) and we split the credit market channel into two parts: smoothing achieved through private institutions (markets) and the public sector

(national governments and official European institutions). We find that the European institutions have largely compensated the reduced role of national governments during the recent financial crisis.

Based on these contributions, we derive some fiscal policy suggestions and conclusions. First, we think that there are reasons to be skeptical about the effectiveness and feasibility of a common fiscal policy for the purpose of stabilizing the business cycle. The reasons are that the fiscal transmission mechanisms are different among countries; countries need their own fiscal counter-cyclical measures in order to absorb idiosyncratic shocks, and, last but not least, European countries are not ready and willing to give up their sovereignty. Secondly, we suggest another type of coordination for EMU fiscal governance that is based on sharing resources at central level, through well-functioning and participated European institutions (along the lines of the ESM), that provide transfers to countries in exceptional circumstances and during period of downturns.

Detecting Heterogeneity in EU Fiscal Multipliers

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Abstract

We analyze fiscal multipliers both across countries and time. Standard VARs and a Time-Varying Parameter VARs (TVP-VAR) are employed. Our analysis relies on five major EU countries (Belgium, France, Germany, Italy and Spain). The time-invariant analysis detects instability in multipliers magnitude and in impulse response functions slopes for the majority of the countries. Our TVP-VAR results suggest that the time-variation is not due to heteroskedasticity of fiscal shocks, but to differences in the transmission mechanism, which are captured by the time-varying coefficients. We also investigate on the driving forces of the multipliers and find that they differ substantially across countries. We conclude by arguing that the observed degree of heterogeneity in the fiscal multipliers and in the other response coefficients casts some doubt on the real ability of EU governments to coordinate their fiscal actions when needed.

Keywords: Government Spending Shocks, TVP-VAR, Fiscal Multiplier

JEL Codes: C32, E62, H30, H50

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1 Introduction

The EU sovereign debt crisis has called for more research on the effectiveness of fiscal policies and, in particular, on the size of the fiscal multiplier. This urge emerges as a result of the set of fiscal stimulus packages – mainly based on increases in government expenditure – adopted by several EU countries to stabilize the economy after the severe fall in the aggregate demand produced by the earlier subprime crisis. In fact, the mild economic performance observed in some of the countries (and in the EU as a whole) casts some doubts on the real effectiveness of standard fiscal policies in particular scenarios.

Given the high degree of uncertainty concerning the effectiveness of a rise in government spending in stabilizing the EU economic activity, we examine the effect of government spending shocks on the main macroeconomic variables and on the financial credibility and creditworthiness in five different EU countries over time. The underlying idea is that time variation and cross-country heterogeneity in the fiscal multiplier and other response coefficients may reveal new facts about the global impact of a coordinated fiscal stimulus. In other words, this study asks the following questions: (i) Does the expansionary effect of fiscal policy vary over time? (ii) Do the fiscal multipliers differ among countries? (iii) What is the effect of a government fiscal shock on financial credibility and creditworthiness? To address these issues, a standard time-invariant VAR and a Bayesian time-varying parameters VAR (TVP-VAR) analyses are used.[1] To the best of our knowledge, this is the first paper examining differences in the magnitude of the responses to a government spending shock both over time and among countries.

In line with recent studies (see, among others, Kirchner et al. (2010); Bachmann and Sims (2012)), we do not focus exclusively on the effects of a government spending shock on output. Instead, the effects on private consumption and long-term government bond yields are also analyzed. We consider output to explore whether and how government spending boosts the

[1] For a detailed discussions of the benefits of using a TVP-VAR, see Primiceri (2005) and Kirchner et al. (2010).

economy. Moreover, the inclusion of private consumption puts us into the debate on the transmission mechanism of fiscal policy. In particular, we relate to the literature focusing on the effect of a government spending shock on private consumption.[2] The inclusion of the long-term bond yield allows us to study the effect of fiscal policy on market confidence, an issue which has not been deeply explored. With this study, we also aim to fill this gap at least to some extent.[3] We stress that this additional empirical investigation sheds light on the trade-off between expansionary policies and creditworthiness.

Our analysis relies on the following EU countries: Belgium, Germany, France, Italy and Spain. The choice of employing this set of countries is motivated by two main factors. First, data in these countries are collected using common statistical standard (ESA95) and available for the common period 1996:1Q-2014:2Q. In this respect, they are easily comparable. Second, and most importantly, the employed economies share a common currency allowing us to examine the effects of cross-country fiscal policies conditional on a common monetary policy. This means that the differences that we find in the effect of government spending should go beyond monetary policy decisions. We are then able to study whether the differences are due to the transmission mechanism not relying on monetary policy decisions, the size of government shocks or other specific factors.

In this study, we first run a time-invariant VAR analysis and then use the TVP-VAR.[4] The time-invariant VAR estimations give rise to heterogeneous impulse response functions (IRFs) of output, consumption and yields among countries. For example, we observe a maximum impact output multipliers of 1.18 and 0.07, respectively in France and Germany. A sub-sample analysis suggests that the IRFs tend to vary also through time. The TVP-

[2]Notice that, on the one side, neoclassical models predict a decline in consumption in response to a rise in government expenditure. Differently, the textbook IS-LM model and new-Keynesian models predict an opposite effect.

[3]In this respect, our work is closely related to Born et al. (2014) who study the effects of cuts of government consumption (i.e. austerity) on output and yield spreads.

[4]We stress that a TVP-VAR specification allows us to compare the employed countries with respect to both the volatility and the size of a government shocks (this by looking at the diagonal elements of the variance covariance matrix of the reduced form) and the transmission mechanism of the fiscal policy (looking at the time varying coefficients of the VAR).

VAR analysis confirms our preliminary results. For example, the average impact output multiplier in France is equal to 0.57 whereas in Germany is 0.11. Similarly, the average effects of a rise in government spending to long-term bond yields and private consumption are not equal among countries. Finally, we examine whether there is a common driving force time-variation of the fiscal multiplier among the five EU countries. To this end, we run a regression of the estimated fiscal multipliers on a bunch of selected factors, which are meant to be important drivers of the fiscal transmission mechanism: (i) degree of trade openness; (ii) the level of government debt, (iii) consumer confidence; (iv) business confidence and (v) a recession indicator. Results suggest that there is no common driving force across countries. In other words, the observed time variation in output multipliers in different countries is captured by different forces.

Overall, our paper contributes to the debate on whether a common European fiscal policy is needed. In particular, it argues that a relatively high degree of heterogeneity among EU countries' multiplier undermines the real effectiveness of a common fiscal stimulus.

The remainder of the paper is organized as follows. Section 2 reviews part of the related literature. Section 3 describes the data and methodology. Section 4 presents the results. In Section 5 we identify the potential determinants underlying the observed time variation in fiscal multipliers. Section 6 concludes.

2 Related literature

Our work is related to recent empirical and theoretical papers focusing on the magnitude of government spending multipliers during periods of economic expansion and recession (see, among others, Christiano et al. (2011); Auerbach and Gorodnichenko (2012); Ilzetzki et al. (2013); Berg (2014); Born et al. (2014); Zubairy (2014)). More closely, we link to Kirchner et al. (2010) and Berg (2014) who examine the impact of government spending shocks on output over time by using a TVP-VAR approach. Differently from these works, which focus

on a single country, we examine fiscal multipliers' dynamics in 5 different European countries. To the best of our knowledge, this represents the first attempt to examine heterogeneity in fiscal multipliers both across countries and through time. An exception is Jones et al. (2015) who examine whether or not positive and negative tax shocks have asymmetric effects on the US and UK economies.[5]

Our paper is also connected to a growing literature examining the effects of fiscal policies on market confidence (Bachmann and Sims (2012); Born et al. (2014); Beetsma et al. (2014)). This part of literature assesses the fact that confidence rises after an increase in spending during periods of economic slack, multipliers are much larger than in normal times and also that, during times of fiscal stress, spreads rise in response to the spending cuts. So the question is: Does a government spending shock influence market confidence? To address this issue, we include a measure of market confidence in our VAR.

In addition, we are also close to recent works examining the effects of globalization on macroeconomic conditions, and, in particular, on policy's effectiveness (Bianchi e Civelli (2015); Ilzetzki et al. (2013)). The idea is that globalization may alter the transmission mechanism of monetary and fiscal authorities' actions and thus expected macroeconomic outcomes in the aftermath of a policy action.

Finally, our empirical strategy allows us to bridge the literature examining output multipliers' dynamics with the one focusing on consumption multipliers (Perotti (2007); Galí et al. (2007); Ramey (2011)).

3 Empirical strategy

In this section, we first describe the data employed to examine the impact of government spending shocks on macroeconomic aggregates. Then, we review both the VAR and TVP-VAR methodologies. In line with other studies, our empirical approach relies on a Bayesian

[5]We stress that there are several differences between their work and ours. First, we focus on government spending multipliers. Second, we search for asymmetric effects both across countries and time. Third, we rely on a set of countries ruled by a unique monetary authority.

approach a la Primiceri (2005) which is well known to provide a flexible estimation framework (see Kirchner et al. (2010)).

3.1 Data

Our baseline VAR and TVP-VAR analyses include data on government expenditure, GDP, consumption and long-term government bond yield for the following countries: Belgium, France, Germany, Italy and Spain. Data are from the OECD and run from 1996Q1 to 2014Q2. Since 1995, each country collects the data according to the standard methodology European System of Account (ESA95).[6] We stress that these common rules guarantee cross-country homogeneity and ensure that data are collected at quarterly frequency.[7] Government spending is represented by the general government final consumption expenditure.[8]

Additional information on the data can be found in the Appendix.

3.2 The Model

The time-invariant VAR is the following:

$$y_t = c + B_1 y_{t-1} + ... + B_k y_{t-k} + u_t \qquad t = 1, .., T \tag{1}$$

[6]The European System of National and Regional Accounts is an internationally compatible accounting framework for a systematic and detailed description of a total economy (that is a region, country or group of countries), its components and its relations with other total economies. Indeed, for the compilation methods of national accounts all countries use the following rules: (i) quarterly data shall be based on direct information available from basic sources, such as for example public accounts or administrative sources, representing, for each category, at least 90 per cent of the amount of the category; (ii) direct information shall be completed by coverage adjustments, if needed, and by conceptual adjustments; (iii) the quarterly data and the corresponding annual data shall be consistent. *Source*: OECD.

[7]Why do we need data collected at quarterly frequency? As suggested by Ilzetzki et al. (2013): "*Data reported at a quarterly frequency but collected at annual frequency may lead to spurious regression results. One common method of interpolating government expenditure data that was collected at annual frequency is to use the quarterly seasonal pattern of revenue collection as a proxy for the quarterly seasonal pattern of government expenditure. This method of interpolation creates a strong correlation between government expenditure and output by construction*".

[8]Notice that our G does not include: total sales and payments for non-market output, subsidies on production (receivable), subsidies (payable), interest (payable), taxes (payable), social benefits other than social transfers in kind, current transfers and capital transfers (payable), adjustment for the net equity of households in pension funds reserves, gross capital formation and net acquisition of non-financial non-produced assets. *Source*: OECD.

where y_t is the vector of the quarter to quarter growth rate of government expenditure, GDP and private consumption (in real terms) and of the long-term government bond yields, which instead enter in the VAR in levels. We assume the vector of the innovation u_t to be Gaussian white noise with mean zero and variance covariance matrix Ω.

On the other hand, the TVP-VAR specification is:

$$y_t = c_t + B_{1,t}y_{t-1} + ... + B_{k,t}y_{t-k} + u_t \qquad t = 1, .., T \tag{2}$$

where y_t is the same vector as above, c_t and $B_{i,t}, i = 1, ..., k$, are, respectively, an $n \times 1$ vector and k $n \times n$ matrices of time varying coefficients, u_t are unobservable errors with variance covariance matrix Ω_t. We consider $k = 2$ for both models.

In the time varying case, we consider the following triangular decomposition of Ω_t:

$$A_t \Omega_t A_t^{'} = \Sigma_t \Sigma_t^{'} \tag{3}$$

where A_t is the lower triangular matrix

$$A_t = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ \alpha_{21,t} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ \alpha_{n1,t} & \cdots & \alpha_{nn-1,t} & 1 \end{bmatrix}$$

and Σ_t is the diagonal matrix

$$\Sigma_t = \begin{bmatrix} \sigma_{1,t} & 0 & \cdots & 0 \\ 0 & \sigma_{2,t} & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_{n,t} \end{bmatrix}$$

Let α_t be the vector of non-zero and non-one elements of A_t (stacked by rows), σ_t be the vector of the diagonal elements of Σ_t, and B_t be the vector containing all the coefficients of the TVP-VAR, again stacked by rows. The time varying parameters are assumed to evolve as follows:

$$B_t = B_{t-1} + \nu_t \qquad \nu_t \sim N(0, Q); \tag{4}$$

$$\alpha_t = \alpha_{t-1} + \zeta_t \qquad \zeta_t \sim N(0, S); \tag{5}$$

$$log\sigma_t = log\sigma_{t-1} + \eta_t \qquad \eta_t \sim N(0, W); \tag{6}$$

where the innovation terms are independent of each other. Thus, the elements of B_t and A_t are modeled as driftless random walks, while the stochastic volatilities in Σ_t follow a geometric random walk, as in the original paper by Primiceri. We also keep the assumption that S is block diagonal, to simplify inference and increase the efficiency of the estimation algorithm[9].

3.3 Priors

Given the limited number of observations, we calibrate the prior distributions for the initial states using the whole sample.[10] Following Primiceri (2005), we assume that the initial states for the coefficients (B_0), the contemporaneous relations (A_0), the stochastic volatilities (σ_0) and the hyperparameters (Q, S, W) are independent of each other. For the coefficients and contemporaneous relations we specify normal priors of the following form:

$$B_0 \sim N(\hat{B}_{OLS}, 4 \cdot V(\hat{B}_{OLS}))$$

$$A_0 \sim N(\hat{A}_{OLS}, 4 \cdot V(\hat{A}_{OLS}))$$

[9]Time invariant VAR estimation are performed with the VAR Toolbox by Ambrogio Cesa-Bianchi, available at sites.google.com/site/ambropo/. Bayesian inference is carried out using the Matlab codes discussed in Koop and Korobilis (2010), available at personal.strath.ac.uk/gary.koop/bayes_matlab_code_by_koop_and_korobilis.html. The latter take into account the corrigendum of Primiceri and Del Negro (2013) to Primiceri (2005).

[10]We thank Primiceri for helpful discussion on this point.

Moreover, we assume a log-normal prior for the stochastic volatilities:

$$log\sigma_0 \sim N(log\hat{\sigma}_{OLS}, I_n)$$

The priors on the hyperparameters are

$$\begin{aligned} Q &\sim IW(k_Q^2 \cdot 71 \cdot V(\hat{B}_{OLS}), 71) \\ W &\sim IW(k_W^2 \cdot 5 \cdot I_n, 5) \\ S_1 &\sim IW(k_S^2 \cdot 2 \cdot V(\hat{A}_{1,OLS}), 2) \\ S_2 &\sim IW(k_S^2 \cdot 3 \cdot V(\hat{A}_{2,OLS}), 3) \\ S_3 &\sim IW(k_S^2 \cdot 4 \cdot V(\hat{A}_{3,OLS}), 4) \end{aligned}$$

where S_1, S_2 and S_3 denote the three blocks of S, while $\hat{A}_{1,OLS}$, $\hat{A}_{2,OLS}$ and $\hat{A}_{3,OLS}$ stand for the corresponding blocks of $\hat{A}_{OLS}$. The results are obtained using $k_Q = 0,01$, $k_S = 0,1$, $k_W = 0,01$. Defined this way, the priors are diffuse and uninformative.

The model is estimated using Bayesian methods as in Primiceri (2005). In particular, we use a Gibbs sampling algorithm to simulate the joint posterior of $(B^T, A^T, \Sigma^T, Q, S, W)$.

3.4 Identification

The structural form of the VAR is the following:

$$y_t = X_t' B_t + \Theta_t \epsilon_t$$

where ϵ_t is the vector of the structural shocks.

We identify government spending shocks by assuming that government spending is predetermined in a system with output, consumption and long-term yields. We rely on Blanchard and Perotti (2002) who estimate a recursive VAR where government spending

is ordered first and where the innovation in the first equation of the VAR is interpreted as a structural government spending shock. To this end, we use a Cholesky decomposition and assume that $\Theta_t\Theta_t^{'} = \Omega_t$. with Θ_t lower triangular. This means that all the variables in the VAR are allowed to respond contemporaneously to government spending shocks but government spending does not react within a quarter to shocks to other variables in the system. Therefore, within a given quarter, government consumption is predetermined relative to other variables. This is plausible because government expenditure is unlikely to respond automatically to the cycle and to be adjusted instantaneously in a discretionary manner by policy makers (see also Born et al. (2014); Kirchner et al. (2010), among many others).

4 On the behavior of EU fiscal multipliers

In this section, we first present the results of our cross-country time-invariant VAR analysis. This sheds light on the magnitude of the fiscal multipliers and other response coefficients among countries. A sub-sample analysis will then offers us a preliminary overview on the behavior of the impulse responses over time. Then, in order to capture time variation effects of government spending shocks, we report the results from the TVP-VAR. In both specifications, we construct the multiplier as an "Impact Multiplier" as follows:

$$IM_k, t = \frac{y_{k,t}}{g_{0,t}} / \left(\frac{g}{y}\right)_t$$

where $y_{k,t}$denote the output response at horizon k in period t, $g_{0,t}$ the government spending response at horizon 0, and $(g/y)_t$ the government spending share of output at time t.

4.1 Evidence from time invariant VARs

We estimate the VAR using different windows (i.e. expanding window). The first sample covers the period 1996:Q1-2006:Q4, the second 1996:Q1-2007:Q4. The subsequent samples

are thus computed by sample adding one year at a time. For brevitys sake we only report the results for three benchmark sub-samples. Figure 1 and 2 depict the impulse responses to a 1% government spending shock of the four variables in our VAR. We study the responses for 20 quarters after the shock and for different periods of time (the figures show the subsamples 1996:Q1-2006:Q4; 1996:Q1-2012Q4; 1996:Q1-2014:Q2). The behavior of the GDP impulse response seems very heterogeneous, both across countries and across the time dimension.

Figures 1 and 2 suggest that heterogeneity through time is more pronounced in some countries than others and, in particular, for Germany, Italy and Spain the IRFs show differences in their slopes for different subsamples, while for Belgium and France these differences concern more multipliers magnitudes rather than IRFs slopes.

Turning our attention to GDP impulse responses it is worth noting that for Belgium and France they are quite stable through time; indeed, for Belgium output always rises on impact, but we can see that since 2008 the effect of a government spending shock fades away after 7-8 quarters. For France output response is positive on impact and, except for the second quarter, the effect is persistent. The situation is different for Germany, Italy and Spain because the slopes change through time. For Germany, GDP response to an expansionary shock is low and negative on average. For Italy, GDP responses to a government shock are above zero on average and rise in the long run. For Spain, the effect of a positive shock to government expenditure has a negative and persistent effect until 2010. After that, there is a negative effect on impact but a positive and significant one in the long run (after 5 quarters). Moreover, the behavior of the impulse responses of GDP and consumption is very similar in all the subsamples and this pattern is common for all countries. For Belgium, consumption is crowded-in by the spending shock; for Italy, consumption is crowded-out until 2010 and then reacts positively to the shock; for Germany, consumption is crowded-out from 2007 on. Looking at long term interest rate impulse responses, Belgium and France share the same behaviour, that is IRFs rise on impact but from 3 quarters on they tend to zero, while the effects are negligible for Italy and Germany. On the contrary, for Spain the effect on long

term rates is always negative.

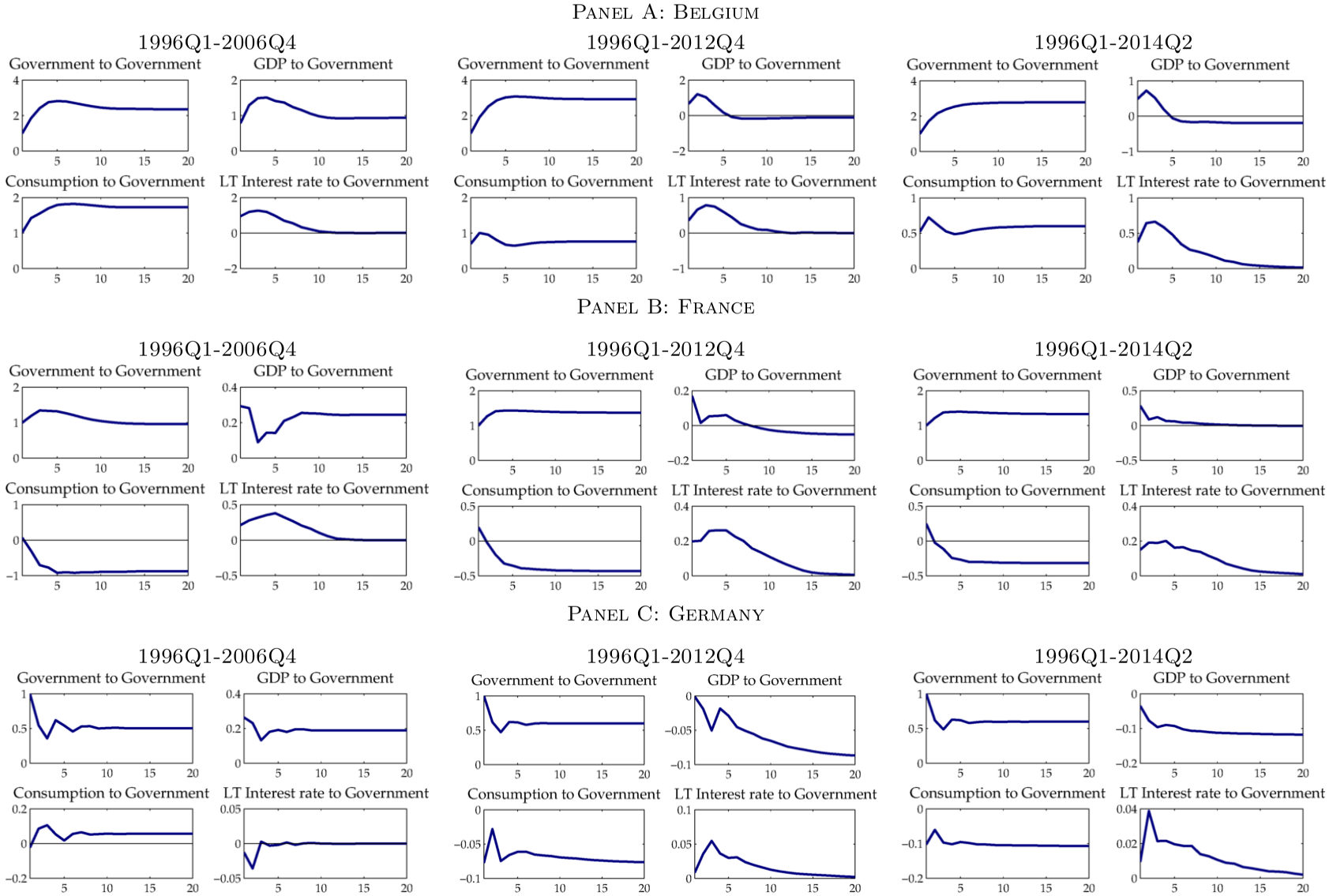


Figure 1: Impulse Responses to a Gov. Spending Shock: Time-Invariant VAR

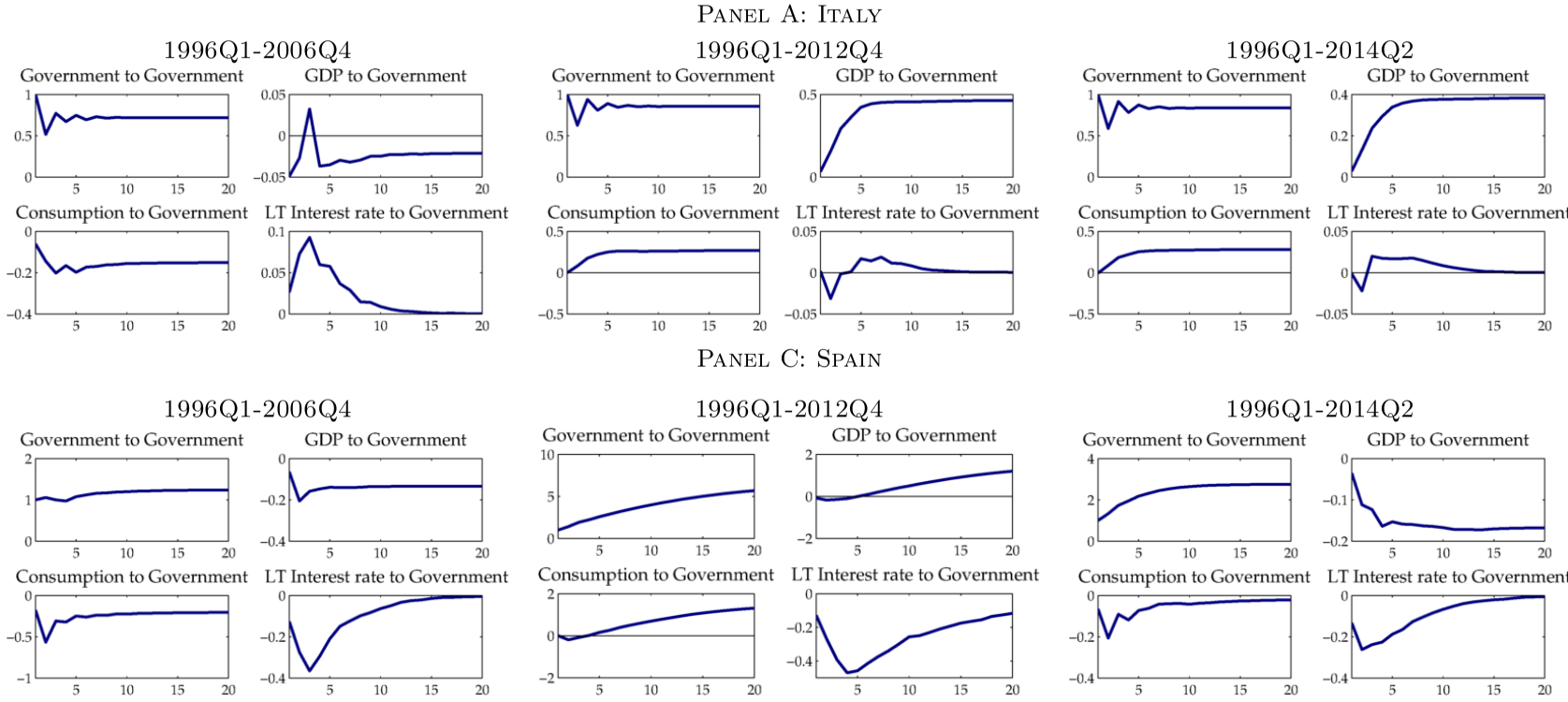


Figure 2: Impulse Responses to a Gov. Spending Shock: Time-Invariant VAR

Overall, these results indicate that, on average, government spending shocks have had expansionary effects on output for all countries except for Germany and the magnitude of the fiscal multiplier has varied through time.

For each country, the multipliers differ among samples. This means that the response of output to a government spending shock changes according to the period considered. There is no stability through time in the size of multipliers as well as in the slope of the IRFs.

In Table 1 we report GDP multipliers, showing the minimum and the maximum multiplier for each country. It is interesting to note that magnitudes differ across countries: indeed, on the one hand GDP multipliers are big for Belgium, Italy and France, for which the maximum multipliers are 3.25, 2.55, and 1.18 respectively (for Italy even the minimum multipliers is positive, an amount of 0.15); on the other hand they are small and even negative for Germany and Spain (respectively 0.07 and -0.22).

Multiplier	Belgium	France	Germany	Italy	Spain
Max	3.25	1.18	0.07	2.55	-0.22
Min	-0.29	0.17	-0.28	0.15	-0.63

Table 1: TIME INVARIANT GDP MULTIPLIERS . *Notes*: This table reports the minimum and maximum values of the impact multiplier for each country.

4.2 Evidence from TVP-VARs

We present the results and we extrapolate some evidence on common features and paths of the macroeconomic variables responses.

As shown in the analysis above, time variation is less pronounced for Belgium and France (Figures 3 and 4). Indeed, for Belgium, the impulse response of GDP to a government spending shock on impact is positive for the whole period and its magnitude is greater in the first part of the sample than in the second part; it declines starting from 2005. However, in the long run the positive effects of government spending decline and the impulse responses go into a negative area from one year on. The shape of the impulse responses is pretty stable

through time, but there are differences between the IRFs before 2003 and after 2003. Most important, GDP multipliers are quite high on impact: they are near 2, even if there is a little decline of their magnitude through time. For France, the IRFs are quite stable over time as well. The government spending shock has expansionary effects on GDP on impact, but there is no evidence of positive impulse responses in the long run. The multiplier is just below unity on impact and it becomes negative for horizons greater than one year.

Contrary to Belgium and France, time variation in GDP IRFs is prominent for Germany, Italy and Spain. For Germany, time variation of the IRFs is conspicuous. On impact, the responses of GDP are greater than the responses in the long run. In addition, we can see that the response of GDP has lost persistence, in particular from the crisis period on. Indeed, looking at the multipliers, it is noteworthy that, on impact, they are positive before the crisis (even if their magnitude is not remarkable) and, starting from 2007, they are near zero. For Italy, the GDP responses to a government shock are positive and increase with the horizon: multipliers are above zero on impact and they rise in the long run. In particular, looking at long-run multipliers, they are quite large in the years before the crisis and, even if they continue to be positive and large also thereafter, they decrease in the last years of the sample. For Spain, there is evidence of expansionary effects of government spending, and also of their countercyclical effects. Indeed, the shape of GDP IRFs varies through time in a way that demonstrate how, during the crisis, a government spending shock has positive effects on output not only on impact but also (and in a more pronounced way) in the long run. In fact, the GDP multipliers are relatively increasing with time on impact; this pattern is much more clear in the long run, revealing that the output response has gained persistence during the last years.

What about consumption? Consumption responses to a government spending shock follow the GDP ones; this behavior is not confirmed only in the case of Belgium: indeed, consumption responds positively to a government spending shock on impact and the effects do not disappear with time; in the long run the IRFs continue to be positive. There is

evidence of time variation in IRFs, with a breaking point in the 2003.

Concerning long interest rate there are some countries (France, Belgium and Germany) where a government spending shock rises bond yields, but only in the short run. In particular, for France it increases in the first horizon (the first year) and then it tend to decrease, remaining positive until the last horizon. The effects are more pronounced in the first part of the period, that goes from 1996 to 2005. For Germany, the bond yield increases for short horizons and tends to return to the impact level in the long run; the maximum reaction of bond yield on impact is of 100 bp in 2007. For Italy, the only noticeable fact is that it increases on impact and in the first horizons (this pattern is more noticeable in the first part of the sample than in the years of the crisis). On the other hand, for Spain the results show no increase in the yield as a consequence of a government spending shock, neither on impact nor in the long run.

In order to sum up the magnitude of the GDP multipliers and to compare them across countries, Table 2 shows the average of impact GDP multipliers for all the countries in the analysis. The biggest one is Belgium's (0.87); for France, Germany and Italy they are 0.57, 0.11, 0.24 respectively and for Spain it is negative (-0.20).

Country	Belgium	France	Germany	Italy	Spain
Multiplier	0.87	0.57	0.11	0.24	-0.20

Table 2: Posterior median of GDP multipliers. *Notes*: This table reports the average of the impact multipliers. The time span is 1996Q1 - 2014 Q2.

Even if the analysis shows different behavior among countries, it is possible to observe some important common features that arise from the study.

First of all, as we said before, we include in our VAR specification the main component of GDP, i.e private consumption, and we do that in order to investigate the relation between its IRFs and output IRFs. Our results are in line with the new-Keynesian model that states that the two macroeconomic variables should display a similar behavior. More precisely,

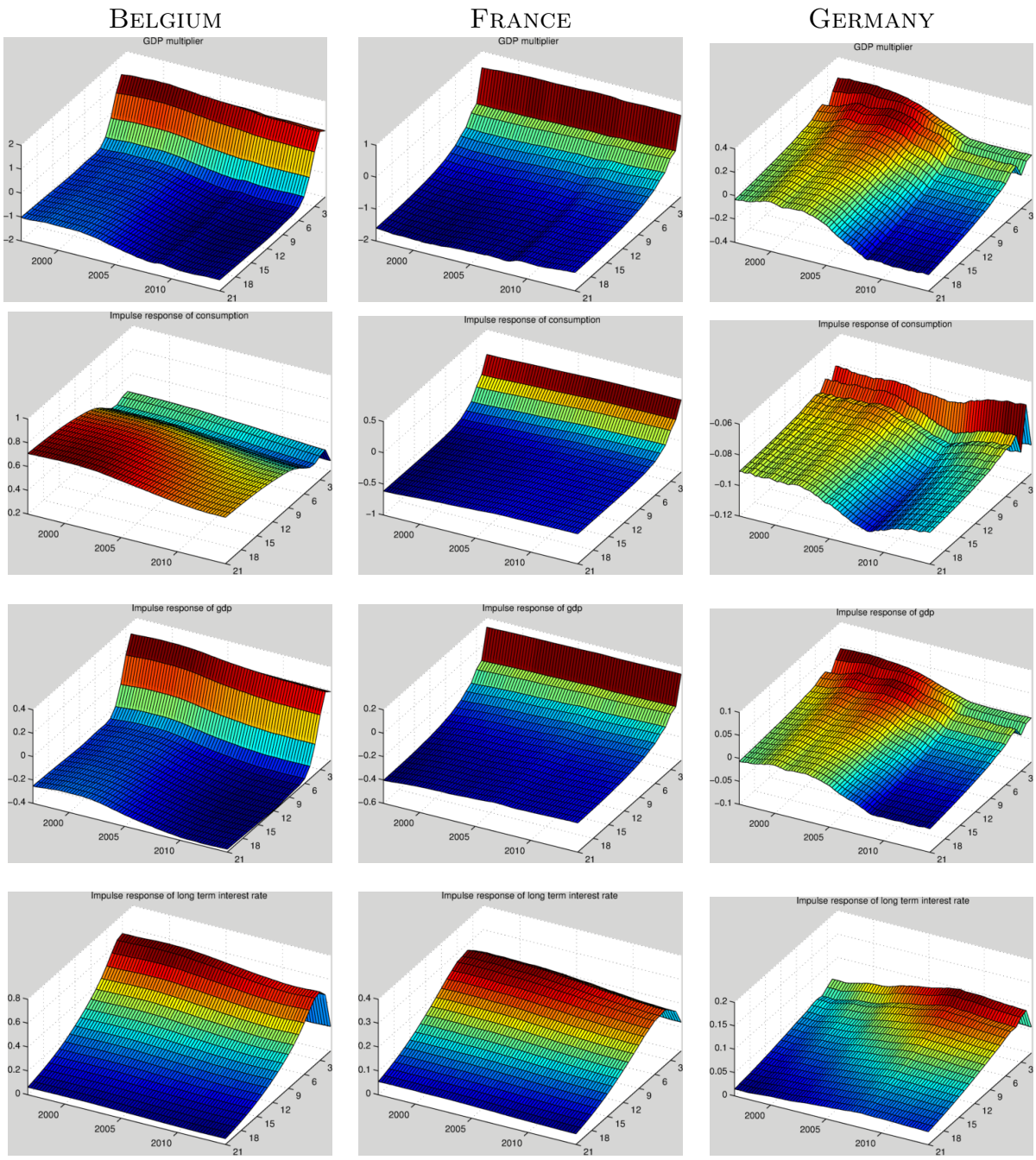


Figure 3: Impulse Responses to a Gov. Spending Shock: TVP-VAR.

the results for all countries show a co-movement between GDP and private consumption, according to the theory mentioned above. The only exception is Belgium.

Secondly, we also include a measure of market confidence, i.e the long-term government bond yield, to explore the effects of fiscal expansion on the financial credibility of a country.

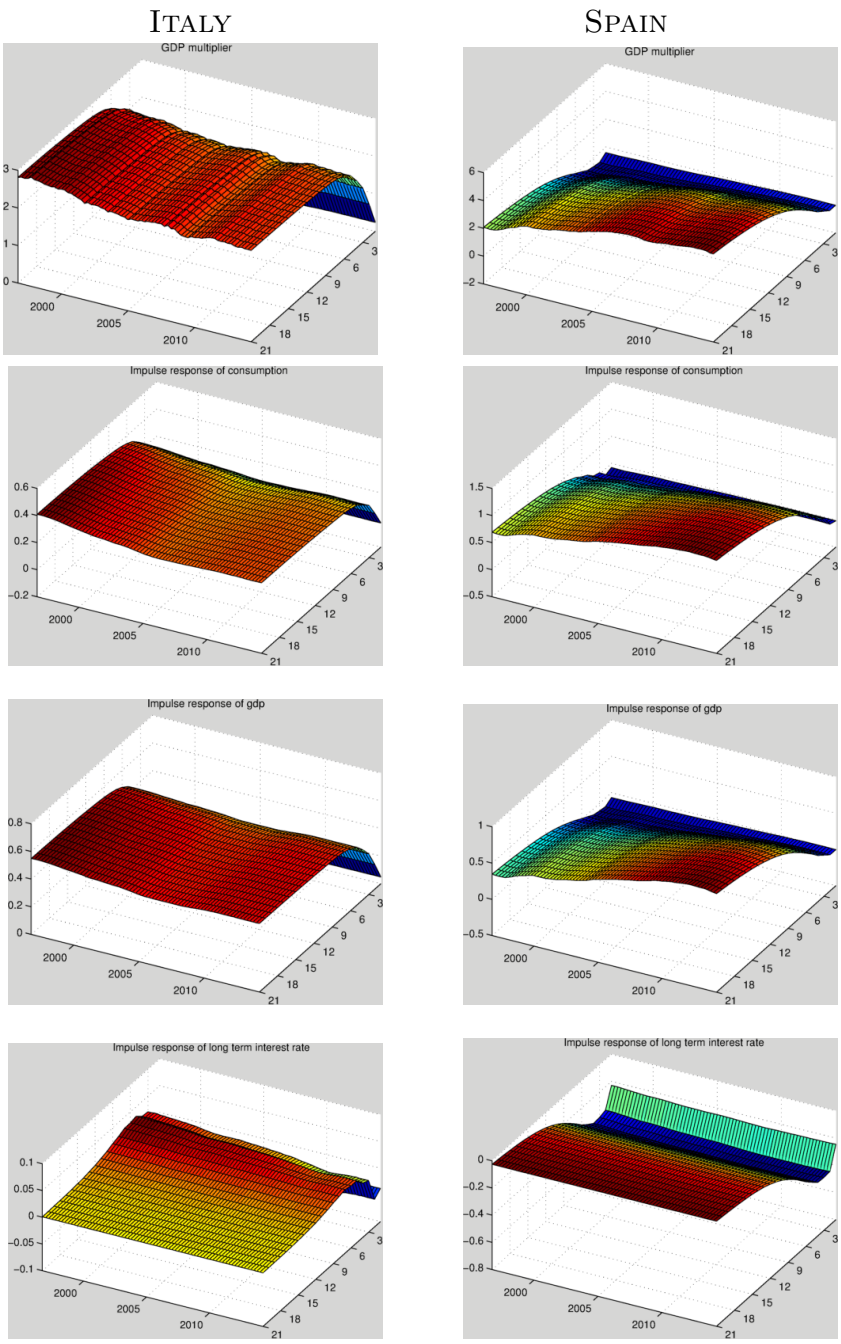


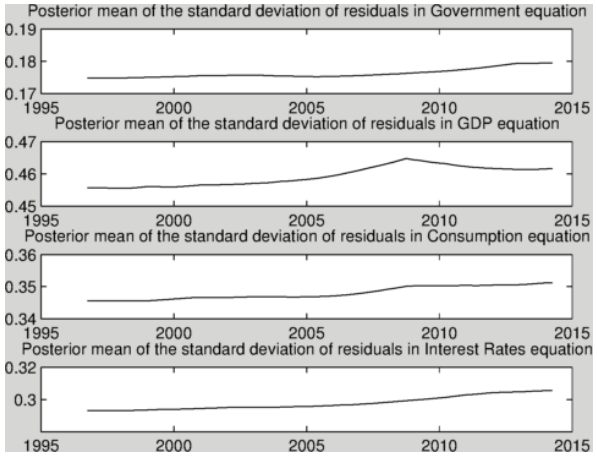
Figure 4: IMPULSE RESPONSES TO A GOV. SPENDING SHOCK. TVP-VAR.

From our empirical findings, we can underline an important result that goes in the opposite direction with respect to the feelings that are spread out in the last years: in the long-run, a government spending shock does not affect the government bond yield. In addition, if we look at those countries that are considered to be less reliable on the market - Italy and Spain

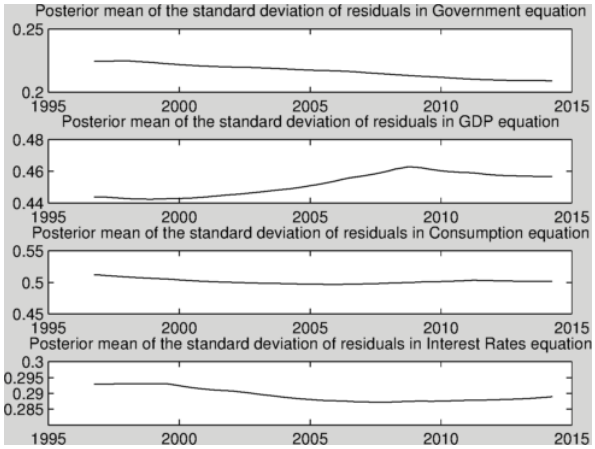
- we can state the following: an expansionary fiscal policy does not induce an increase in long-term bond yield, not even in the short-run. On the contrary, in the short-run the bond yield IRFs for Spain are even in the negative area.

The last important common result relies on the particular specification of the TVP-VAR and it is very interesting. In Figure 5 we plot the posterior mean of the standard deviation of residuals in the government equation. Since our identification assumption relies on a Cholesky decomposition, these plots represent the usual additive shocks through time. So, the plots show the time-variation of fiscal policy shocks for each country: in fact, the fiscal shocks are not very volatile for none of the examined countries. From this evidence, it is possible to assert that IRFs changes are due to the transmission mechanism (i.e. time-varying parameters) and not to the heteroskedasticity of residuals (i.e shocks volatilities).

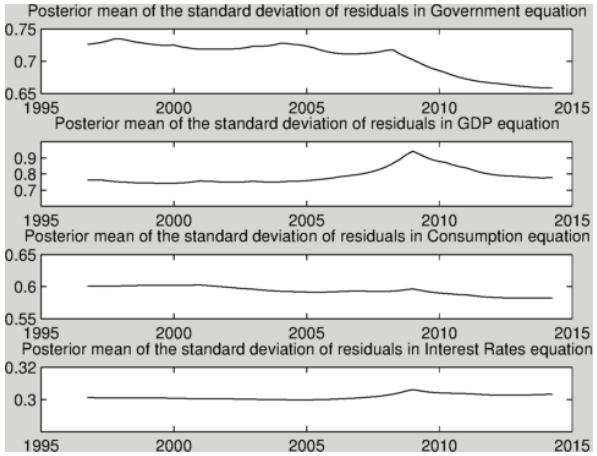
BELGIUM



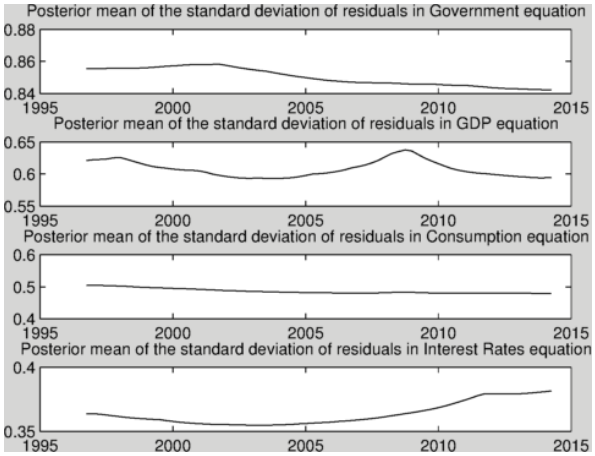
FRANCE



GERMANY



ITALY



SPAIN

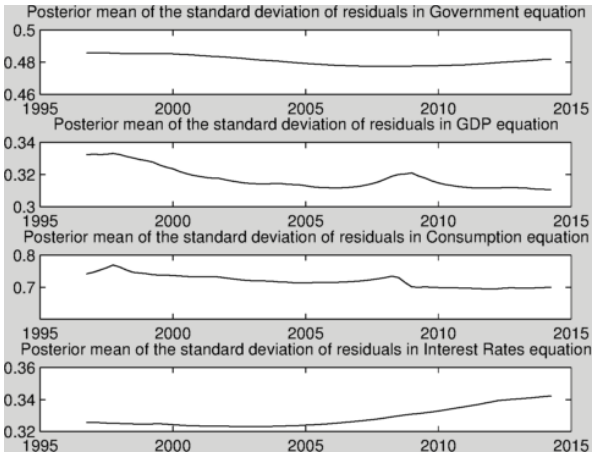


Figure 5: POSTERIOR MEANS

5 Is there a common driving force?

The different magnitude and the different behavior of fiscal multipliers across countries can be accounted for by the time variation of the coefficients in the TVP-VAR. Indeed, the transmission mechanism of fiscal policy is different through time and also across countries. In this section we investigate which mechanism can explain how fiscal policy affects output and we explore the relation between several macroeconomic indicators and the estimated fiscal multipliers. We run an OLS regression in which the dependent variable is the estimated impact output multiplier and the regressors are: import-to-gdp ratio, debt-to-gdp ratio, two confidence indicators, one that explains the business confidence on the manufacturing sector and the other that captures the consumers sentiment on economic activity, and a dummy that represents periods of recession/expansion.

We consider import-to-gdp ratio because we want to test the mechanism for which a country with high degree of trade openness tends to have lower fiscal multipliers, according to the Keynesian approach: this is because the boost that an expansionary fiscal policy gives to national demand is reduced by the fact that a large part of the stimulus is absorbed by imports. Moreover, we want to investigate how the debt burden impacts the size of the fiscal multipliers. In addition, we take into account consumer and business confidence indicators, since positive expectations on economic activity are expected to push up the expansionary effect of government spending. Finally, we link to the existing literature on business cycles in that we consider a dummy variable (recession/expansion) to account for the size of multipliers. We lag the first two indicators (import-to-gdp and debt-to-gdp) in order to exclude the possibility that the dependent variable (the multiplier) causes the two factors and not the other way around (reverse causality).

Tables 3 shows the results. The figures represent a 1% change in the multiplier given by a 1% change in ratios (import-to-gdp and debt-to-gdp) and indicators (consumers and business) considered (see the Data appendix for further details). The above mentioned channel on import-to-gdp ratio is relevant for Belgium, Germany and Italy for which a 1% rise in

the import-to-gdp ratio decreases output multiplier of, respectively, 0.66%, 2.52%, 0.19%. Moreover, the debt-to-gdp ratio coefficient is not negative, except for France. For Italy and Spain (countries with high debt-to-gdp ratio) an increase of 1% in debt-to-gdp ratio leads to an increase of the output multiplier of, respectively, 0.09% and 0.39%. These results rule out the negative effect that the debt burden is expected to have on fiscal multipliers magnitude. Results on recession indicator are not easy to comment: only for Belgium the figure confirms the findings of the literature on the business cycles: in recession periods multipliers are higher than in expansion. The only channel that seems to be common for all countries is the consumer confidence indicator: its coefficients are all positive and statistically significant. This means that positive expectations on the state of economy by economic agents tend to push up the effect of fiscal stimulus in each country.

In summary, we do not find a common channel for all countries; the deep differences in economic structures and environment of each country leave us with the open issue of how to find a coordination in the European policy that could lead to a uniform effect on output.

Dependent Variable:	**Impact Output Multiplier**					
Panel A: BELGIUM	"(1)"	"(2)"	"(3)"	"(4)"	"(5)"	"(6)"
Imports/GDP (-1)	-0.78***					-0.66***
	[0.07]					[0.05]
Debt/GDP (-1)		0.32***				0.00
		[0.07]				[0.03]
Consumer Sentiment			0.48***			0.35***
			[0.08]			[0.05]
Business Confidence				0.09		-0.08**
				[0.12]		[0.03]
Recession Indicator					0.86	1.08**
					[2.58]	[0.53]
Constant	141.73***	52.90***	89.75***	87.27***	86.72***	134.83***
	[5.22]	[7.19]	[1.03]	[1.48]	[1.64]	[6.68]
Obs	*71*	*71*	*71*	*71*	*71*	*71*
$Adj.R^2$	0.75	0.39	0.39	0.01	-0.01	0.91
Panel B: FRANCE	"(1)"	"(2)"	"(3)"	"(4)"	"(5)"	"(6)"
Imports/GDP (-1)	0.60***					1.02***
	[0.15]					[0.09]

Debt/GDP (-1)		0.05				-0.14***
		0.04				0.03
Consumer Sentiment			0.10*			0.12***
			[0.06]			[0.03]
Business Confidence				0.03		-0.02***
				[0.02]		[0.01]
Recession Indicator					-0.34	-1.04***
					[0.88]	[0.39]
Constant	41.79***	52.90***	58.52***	56.69***	56.87***	44.83***
	[3.66]	[3.60]	[1.11]	[0.58]	[0.71]	[1.26]
Obs	*71*	*71*	*71*	*71*	*71*	*71*
$Adj.R^2$	0.53	0.03	0.09	0.04	-0.01	0.89
Panel C: GERMANY	"(1)"	"(2)"	"(3)"	"(4)"	"(5)"	"(6)"
Imports/GDP (-1)	-1.87***					-2.52***
	[0.14]					[0.23]
Debt/GDP (-1)		-1.12***				0.15
		[0.13]				[0.14]
Consumer Sentiment			-0.17			0.23***
			[0.26]			[0.06]
Business Confidence				-0.07		-0.04
				[0.15]		[0.03]
Recession Indicator					0.49	1.09
					[4.34]	[1.30]
Constant	68.95***	82.74***	9.28***	10.75***	10.37***	82.21***
	[4.65]	[9.11]	[3.35]	[2.65]	[3.31]	[4.19]
Obs	*71*	*56*	*71*	*71*	*71*	*56*
$Adj.R^2$	0.90	0.68	0.01	0.00	-0.01	0.94
Panel D: ITALY	"(1)"	"(2)"	"(3)"	"(4)"	"(5)"	"(6)"
Imports/GDP (-1)	-0.37***					-0.19**
	[0.08]					[0.08]
Debt/GDP (-1)		0.07**				0.09***
		[0.03]				[0.02]
Consumer Sentiment			0.08**			0.04**
			[0.03]			[0.02]
Business Confidence				0.03***		0.03***
				[0.01]		[0.01]
Recession Indicator					0.57	0.35
					[0.50]	[0.25]
Constant	32.62***	16.17***	25.11***	23.89***	23.52***	19.41***
	[2.07]	[3.43]	[0.53]	[0.30]	[0.39]	[3.18]

Obs	*71*	*71*	*71*	*71*	*71*	*71*
$Adj.R^2$	0.46	0.14	0.27	0.16	0.03	0.74
Panel E: SPAIN	"(1)"	"(2)"	"(3)"	"(4)"	"(5)"	"(6)"
Imports/GDP (-1)	2.48***					2.36***
	[0.45]					[0.43]
Debt/GDP (-1)		0.14				0.39***
		[0.21]				[0.10]
Consumer Sentiment			-0.97***			-0.75***
			[0.16]			[0.12]
Business Confidence				-1.06***		-0.17
				[0.27]		[0.17]
Recession Indicator					-0.22	-5.58***
					[5.57]	[1.88]
Constant	-84.75***	-28.42**	-32.83***	-15.09***	-19.66***	-112.06***
	[12.86]	[11.92]	[2.38]	[2.79]	[4.08]	[16.87]
Obs	*71*	*71*	*71*	*71*	*71*	*71*
$Adj.R^2$	0.27	0.01	0.61	0.32	-0.01	0.84

Table 3: OLS Regressions: Impact Output Multiplier

Notes: The dependent variable in each country is represented by the impact output multiplier. HAC standard errors are given in parenthesis. All entries are multiplied by 100 except for the adjusted R-squared. ***, ** and * denotes significance at the 1, 5 and 10 percent level, respectively.

6 Concluding remarks

We investigate the time varying impact of a public spending shock on output, consumption and market confidence in five different EU countries over the period 1996Q1-2014Q2. Via time-invariant VARs and TVP-VARs, we support recent studies showing that fiscal multipliers embody a strong time-varying component. Moreover, we show that the impact of a government spending shock on main macroeconomic aggregate as well as on market confidence not only varies over time but also among countries. The observed degree of heterogeneity in the fiscal multipliers and in the other response coefficients casts some doubt on the effectiveness of a common EU fiscal policy in stimulating EU real economic activity when needed. The cross-country search for a common driving force in the fiscal multiplier confirms our main major concern that a coordinated fiscal stimulus when needed may be

challenging to be attained. An important issue for future research would be to deeply examine the specific characteristics of each EU member state with the ultimate goal of explaining the observed degree of heterogeneity among EU fiscal multipliers. We leave this challenge for future research.

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A Data

A.1 VAR and TVP-VAR

All data are from OECD.

- Final consumption expenditure of general government, from Quarterly National Account (P3S13). Government final consumption expenditure consists of expenditure, including imputed expenditure, incurred by general government on both individual consumption goods and services and collective consumption services; in addition, it does not include: total sales and payments for non-market output, subsidies on production (receivable), subsidies (payable), interest (payable), taxes (payable), social benefits other than social transfers in kind, current transfers and capital transfers (payable), adjustment for the net equity of households in pension funds reserves, gross capital formation and net acquisition of non-financial non-produced assets.

- Gross domestic product, from Quarterly National Account (B1-GE).

- Private final consumption expenditure, from Quarterly National Account (P31S14-S15);

- Long term bond government yield. It is the long-term interest rate in MEI (Monthly Monetary and Financial Statistics); long-term (in most cases 10 year) government bonds are the instrument whose yield is used as the representative interest rate for this area. Generally the yield is calculated at the pre-tax level and before deductions for brokerage costs and commissions and is derived from the relationship between the present market value of the bond and that at maturity, taking into account also interest payments paid through to maturity.

Measure

LNBQRSA: Millions of national currency, chained volume estimates, national reference year, quarterly levels, seasonally adjusted (for all countries the national reference year is 2010).

A.2 OLS Regressions

All data are from OECD, except for the Recession Indicator (FRED).

- Imports are Imports of goods and services, from the Quarterly National Account;
- Debt is from Quarterly National Account. In particular, the Public Sector Debt database includes quarterly detailed information on all liabilities which constitute debt instruments, by initial and residual maturity, which are held by the government, and more broadly the public sector. The debt instruments are those instruments that require the payment of principal and interest or both at some point(s) in the future. All liabilities are considered debt, except liabilities in the form of equity and investment fund shares and, financial derivatives and employee stock options. For Germany the data start from 2000Q1.
- The business tendency survey indicator for manufacturing is from Monthly Economic Indicators. In particular, the business tendency survey results reflect businessman's judgments on developments experienced in the recent past, the current situation and prospects for the next few months for their own enterprise. The survey questions relate to prospects for the industrial sector, production, orders and stocks of finished goods. Most survey responses are qualitative. OECD provides the data at quarterly frequency.
- The consumer confidence indicator is from Monthly Economic Indicators. It is based on answers to four questions with five answer alternatives to each question (a lot better, a little better, the same, a little worse, a lot worse): Expected change in financial situation of household, in general economic situation, in unemployment and in savings

of household over next 12 months. It is expressed as the balance of positive over negative results (percentage). OECD provides data on a monthly base; the series is converted in quarterly frequency by taking averages across periods.

- Recession is a dummy from Federal Reserve Economic Data.

Risk Sharing in the Euro Zone: the Role of European Institutions

Valentina Milano*

Abstract

We study risk sharing in the Euro Area (EA) and compare it to the US federation. Using the method of variance decomposition first implemented by Asdrubali et al. (1996), we update and revisit the main channels of risk sharing (net factor income, international transfers and credit markets). We contribute to this literature by splitting the credit market channel into two parts: smoothing achieved through private institutions (markets) and the public sector (national governments and official European institutions). We find that the role played by European institutions (i.e., public lending from the ESFS, ESFM, ESM and the European Commission) has been quite relevant during the recent financial crisis and largely compensated the reduced role of national governments.

Keywords: Risk sharing, Euro Area, European transfers, income insurance, international financial integration

JEL Codes: E2, E6, F15, G15

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1 Introduction

To what extent countries or regions that are facing idiosyncratic risks are able to achieve consumption smoothing through markets and public policies implemented at national or supranational level? This issue has received a lot of attention in the academic literature and policy circles and it is part of more general debate about the costs and benefits of financial and political integration across countries. In particular, the great recession and the European sovereign debt crisis have fueled a concern that risk sharing in the EMU is well below the desirable level, both because of market failures and lack of public insurance, and this problem may destabilize the currency union or call for a return to exchange rate flexibility.

It is quite established that some federations share idiosyncratic shocks better than others. In their celebrated study of risk sharing across US states from 1963 to 1990, Asdrubali et al. (1996) find that about 75% of state level idiosyncratic shocks are smoothed via markets or public policies. In particular, about 62% of these shocks are smoothed via capital and credit markets and 13% through federal taxes and transfers. Some other studies have found similar evaluations for the US, Germany and Canada (Sala-i-Martin and Sachs (1991); Buttner (2002); Bayoumi and Klein (1997), Von Hagen and Hepp (2013)). Based on these contributions, there is now a general consensus that risk sharing across countries belonging to the EU or the EMU is much more limited than in other federations. For instance, according to Sorensen and Yosha (1998), only 40 percent of GDP shocks is smoothed across the EU, and this degree of risk sharing is mainly achieved through government and private savings. Furthermore, channels of risk sharing in existing federations are quite different: indeed, in the US, the most effective channel is the one arising from net factor income flows, while, in Europe, it is the one arising from the credit market, which is, in turn, mostly driven by governments' net lending (Sorensen and Yosha (1998)).

The financial crisis has highlighted some relevant facts. There was a crunch in international markets that has reflected into a paralysis of the traditional risk sharing mechanisms (Alcidi

et al (2016)). The austerity measures imposed to some European countries (PIGS) have reduced the room for the intervention of national governments into credit markets through their budgets deficits and, as a consequence, have reduced risk sharing (Kalemli et al (2014)). Yet, a huge amount of transfers and loans have been flowing from European institutions, such as the European Commission, the European Financial Stabilization Mechanism (EFSM), the European Financial Stability Facility (ESFS), or the European Stabilization Mechanism (ESM) to more vulnerable countries. These policies have been put in place with the purpose of helping Periphery countries to recapitalize their banks, regain access to credit markets (lowering their cost of funding) and mitigate the effects of the recession. The relevance of these policies for risk sharing across the EMU has so far received little attention.

In this paper, we try to address this and some other related issues, with special reference to the role that European supranational institutions have played to improve risk sharing in Core and Peripheral economies. In particular, we arise the following questions: (i) how much has the crisis affected risk sharing in Europe? (ii) how much have private agents, on the one hand, and public sector, on the other hand, contributed to risk sharing? (iii) what is the amount of risk sharing that can be imputed to the intervention of national governments and to the European central institutions? (iiii) what have been the different responses between Periphery and Core countries?

First, we compare risk sharing in Europe and US, taking into account the crisis period (2007-2014). Then, we split the credit market channel into two parts, the private and the public sector. In addition, we disentangle the latter quantifying the degree of smoothing achieved through national governments savings and through public lending from European institutions. Finally, we examine the linkage between these two channels for two sub-sets of countries (Periphery and Core).

Our main results underline that, during the crisis, risk sharing increases in Europe (from 23% of shocks to GDP smoothed for the period 1999-2006 to 31% for the period 2007-2014) whereas it falls in the US (from 70% to 60%). Moreover, in Europe, the public sector plays

a prominent role for consumption smoothing. Generally, the national governments channel, that is, counter-cyclical public borrowing and lending, is the main mechanism of risk sharing. Nevertheless, from the great recession on (2007-2014), this channel acts in a very different way for the two groups of countries considered. Indeed, for Periphery countries it generates dis-smoothing due to the limits on the size of government lending and efforts to contain the expansion of public debt. However, EU policies (loans and transfers from European institutions) largely replace national policies in enhancing risk sharing. Namely, due to austerity measures, national government policies produce 63% of dis-smoothing, whereas transfers from European institutions generates 86% of smoothing. Opposite conclusions emerge for Core countries, for which the national governments savings channel plays a fundamental role (with a percentage of consumption smoothing of 73%).

The rest of the paper is organized as follow: section 2 explains methodology and data; section 3 provides a comparison between Europe and US; section 4 focuses on the savings channel, splitting it into the contribution from private and public sector and, in turn, splitting the latter into national governments savings and European institutions net lending; section 5 underlines the differences for Periphery and Core countries. Section 6 concludes.

2 The Model

2.1 General Framework

Risk sharing within a set of countries affected by idiosyncratic income shocks can be achieved through three main channels: (i) insurance via international capital markets obtained by private agents through the capital income flows from a diversified portfolio of international assets (income from all claims); (ii) saving and borrowing via international financial markets; (iii) fiscal transfers from a supranational authority.

For instance, households or financial intermediaries holding claims to output produced in other countries may smooth out their consumption stream in the face of a volatile national

product because their capital income co-moves with the aggregate output of the union or federation. This type of risk sharing is reflected in the capital income flows mechanism. Moreover, consumption smoothing may be achieved by different agents (households, firms and governments) through savings, that is, inter-temporal reallocations of consumption and investment, which give rise to negative or positive net financial flows. Finally, supranational fiscal institutions can provide cross-country income insurance via taxes and transfers.

Thus, the major difference between the net factor income flows mechanism and the savings one is the following. The former refers to income from investments in contingent claims. The savings mechanism, instead, refers to the change in the net asset position of an agent. Notice that the latter is reflected in a changing pattern of investment and current account. Hence, consumption smoothing through savings may occur either by adjusting domestic or international investment spending, or by borrowing and lending in international credit markets.

In order to measure the degree of risk sharing we rely on the following framework. Considering a set of countries (alternatively, states or regions) belonging to a union, or a federation, indexed by $i = 1, .., n$, we write the (private and public) consumption level of each country at time t as

$$c_t^i = k^i \theta_t^i c_t^{av},$$

where the superscript av means that the level of consumption is the average across the countries belonging to the union. The term k^i is a time-independent factor measuring the relative position of the country in the union in terms of consumption level and θ^i is a time-dependent component that may be affected by idiosyncratic taste shocks. We say that there is full risk-sharing when, if we ignore taste shocks, variations of a country-specific consumption are fully explained by variations in the aggregate (or average) consumption of the union. The full risk sharing representation may be derived rigorously from a linearization of the first order conditions characterizing the Pareto optimal consumption allocation within the union when the welfare of each country is represented by a time separable utility of

consumption (cfr. Cochrane (1991)).

Essentially, risk is fully shared among countries if the consumption of a country co-moves with average consumption but does not co-move with country specific shocks. Thus, if there is full risk sharing, correlation of consumption across countries should be equal to 1. And, if there is full risk sharing, consumption in country i does not respond to idiosyncratic income shocks in country i.

2.2 Empirical strategy

We rely on the cross-sectional variance decomposition of shocks to GDP first implemented by Asdrubali et al. (1996). Consider the identity, for any period t:

$$GDP_t^i = \frac{GDP_t^i}{GNI_t^i}\frac{GNI_t^i}{NI_t^i}\frac{NI_t^i}{DNI_t^i}\frac{DNI_t^i}{C_t^i}C_t^i$$

where all the magnitudes are in per capita terms and i is a country index and where GDP is Gross Domestic Product, GNI is Gross National Income, NI is Net National Income, DNI is Net National Disposable Income, C is consumption and:

- $GNI = GDP+$ net factor income;
- $NI = GNP-$ capital depreciation;
- $DNI = NI+$ international transfers;
- $C = DNI-$ total net savings.

Taking logs and differences on both sides, multiplying both sides by $\Delta log\, GDP$ and taking cross-sectional average, it follows that:

$$\begin{aligned} var[\Delta log\, GDP] = cov[\Delta log\, GDP - \Delta log\, GNI, \Delta log\, GDP] \\ + cov[\Delta log\, GNI - \Delta log\, NI, \Delta log\, GDP] \\ + cov[\Delta log\, NI - \Delta log\, DNI, \Delta log\, GDP] \\ + cov[\Delta log\, DNI - \Delta log\, C, \Delta log\, GDP] \\ + cov[\Delta log\, C, \Delta log\, GDP] \end{aligned}$$

Dividing all components by $var[\Delta log\, GDP]$, we get:

$$1 = \beta_f + \beta_d + \beta_t + \beta_s + \beta_u$$

where, for instance,

$$\beta_f = \frac{cov[\Delta log\, GDP - \Delta log\, GNI, \Delta log\, GDP]}{var[\Delta log\, GDP]}$$

is the ordinary OLS estimate in the regression $\Delta log\, GDP - \Delta log\, GNI$ on $\Delta log\, GDP$ or

$$\beta_u = \frac{cov[\Delta log\, C, \Delta log\, GDP]}{var[\Delta log\, GDP]}$$

is the ordinary OLS estimate in the regression $\Delta log\, C$ on $\Delta log\, GDP$. By definition, full risk sharing corresponds to $cov[\Delta log\, C, \Delta log\, GDP] = 0$ and $\beta_u = 0$. If full risk sharing is not achieved, consumption in country i varies positively with idiosyncratic shocks to country's i output and $\beta_u > 0$. Moreover, if full risk sharing is achieved via net factor income flows, then $cov[\Delta log\, GDP - \Delta log\, GNI, \Delta log\, GDP] = var[\Delta log\, GDP]$ and $\beta_f = 1$; but, if full risk sharing is not achieved via net factor income flows, then $\beta_f < 1$. And so on and so forth regarding the other channels and the other betas. Thus, the interpretations of the betas are

the following: β_u is the fraction of shocks to GDP that is not smoothed; the other betas, i.e. $\beta_f, \beta_d, \beta_t, \beta_s$ are interpreted as the fraction of shocks absorbed respectively through net factor income flows, capital depreciation, international transfers and savings.

The betas can be estimated by running the panel regressions:

$$\begin{aligned}
\Delta log\, GDP_t^i - \Delta log\, GNI_t^i &= \nu_{f,t} + \beta_f \Delta log\, GDP_t^i + \epsilon_{f,t}^i, \\
\Delta log\, GNI_t^i - \Delta log\, NI_t^i &= \nu_{d,t} + \beta_d \Delta log\, GDP_t^i + \epsilon_{d,t}^i, \\
\Delta log\, NI_t^i - \Delta log\, DNI_t^i &= \nu_{t,t} + \beta_t \Delta log\, GDP_t^i + \epsilon_{t,t}^i, \\
\Delta log\, DNI_t^i - \Delta log\, C_t^i &= \nu_{s,t} + \beta_s \Delta log\, GDP_t^i + \epsilon_{s,t}^i. \\
\Delta log\, C_t^i &= \nu_{u,t} + \beta_u \Delta log GDP_t^i + \epsilon_{u,t}^i
\end{aligned}$$

We use differenced data at annual frequency. While estimating all the equations, we assume that output shocks are not persistent and long lasting.

Differently from previous contributions that have exploited this methodology, we pay particular attention to the savings channel and split it into its main components. Specifically, we divide the channel into contribution given by private agents (households and firms) and the public sector (national governments and European institutions). To this end, we proceed as follows. Considering that:

$$\beta_s = \frac{cov[\Delta log\, DNI - \Delta log\, C, \Delta log\, GDP]}{var[\Delta log\, GDP]}$$

and

$$\Delta log\, DNI - \Delta log\, C = \Delta log\, (1 + \frac{S}{C}) \approx \Delta(\frac{S}{C}),$$

we run the following regressions[1]:

$$\Delta(\frac{S^{i,t}_{corp}}{C^i_t}) = \nu_{scorp,t} + \beta_{scorp}\Delta log\, GDP^i_t + \epsilon^i_{scorp,t},$$
$$\Delta(\frac{S^{i,t}_{hous}}{C^i_t}) = \nu_{shous,t} + \beta_{shous}\Delta log\, GDP^i_t + \epsilon^i_{shous,t},$$
$$\Delta(\frac{S^{i,t}_{public}}{C^i_t}) = \nu_{spublic,t} + \beta_{spublic}\Delta log\, GDP^i_t + \epsilon^i_{spublic,t}.$$

The first two equations estimate the role of private agents, whereas the third reflects the role of the public sector.

Additionally, for the crisis period (2007-2014), we split the public sector into two parts: the one gives rise to net lending versus the European institutions and the other versus any other private or public entities. To achieve this objective, we compute European institutions' loans and we subtract the European flows from the total public savings, that is, we hypothesize that for each country: Governments Savings versus any other entities = Total public savings - EU flows.[2] Then, we run the following regressions:

$$\Delta(\frac{S^{i,t}_{gov}}{C^i_t}) = \nu_{sgov,t} + \beta_{sgov}\Delta log\, GDP^i_t + \epsilon^i_{sgov,t}$$
$$\Delta(\frac{S^{i,t}_{EU}}{C^i_t}) = \nu_{EU,t} + \beta_{EU}\Delta log\, GDP^i_t + \epsilon^i_{EU,t}$$

The first regression captures how much national governments are able to smooth consumption through borrowing/lending in international credit markets; the second regression only captures risk sharing achieved through loans and aids provided by European institutions. Throughout the paper we refer to the first beta (β_{sgov}) as the national governments channel

[1] We also run regressions in the form: $\Delta log\, DNI^i_t - \Delta log\,(DNI^i_t - savings_k) = \nu_{sav_k,t} + \beta_{sav_k}\Delta log\, GDP^i_t + \epsilon^i_{sav_k,t}$ where k is the $k-th$ sector (corporate, households, public). Results hold up to this change.

[2] EU flows include either loans from EU institutions to national governments either contributions from EMU countries to EU institutions.

and the second beta (β_{EU}) as the European institutions channel.

2.3 Data

Data are from various sources. GDP, GNI, NI, DNI, C and sectoral savings data are from OECD, Annual National Account, Main Aggregates and Detailed Tables; the period covered is 1970-2014. We examine the Euro Zone countries: Austria, Belgium, Finland, France, Germany, Italy, the Netherlands (Core countries) and Greece, Ireland, Portugal, Spain (Periphery).

Transfers from European institutions are from IMF data, EU countries' Balance of Payments, Financial Account[3](see Appendix A.2 for further details); the period covered is 2007-2014.

US data are from Bureau of Economic Analysis (BEA) and Federal Reserve Economic Data (FRED) (see Appendix A.3 for a detailed explanation of sources and construction method).

All data are in nominal terms and are transformed into real terms using CPI deflator; they are transformed in per-head terms using the population data from OECD.

3 Results

Table 1 shows the results for the main channels of risk sharing in the period (1970-2014). We can summarize them as follows. First, in the EMU the percentage of shocks to GDP that are smoothed is 23%. This result is in line with the existing literature that has quantified the amount of risk sharing in Europe; even if previous studies do not take into account the crisis period, results are quite similar. The decomposition of income smoothing shows that the net factor income and the transfers channels are almost nil. A little impact is given by the capital depreciation channel (with an estimated beta equal to -0.05) and this means that

[3]Financial Account provides data divided by sectors (central banks, governments, financial institutions, other sectors).

capital depreciation provides dis-smoothing, that is, it helps amplifying shocks to output instead of smoothing them out. The only remarkable channel is the savings one: 27% of shocks to GDP are smoothed through credit markets.

3.1 The introduction of the euro currency

Since 1999 European countries have established a common currency area. It is well know (Mundel (1961)) that a common currency area needs some main features to guarantee a good functioning and sufficient risk sharing. The latter is one of the most debated issues in the literature. In this section, we address this controversial topic. Some (Furceri (2004)) have argued that a unique monetary policy, as the one adopted by EMU countries from 1999 on, is able to contrast common shocks, but it is useless in hindering idiosyncratic shocks. In this vein, national fiscal policies and common monetary policies should have different tasks in order to absorb output shocks: the ECB's common policy should act to absorb symmetric shocks, while national governments policies should absorb country-specific shocks.

Our analysis may contribute to the debate about the costs and benefits of currency unions by studying the extent and the composition of the risk sharing channels. In particular, we split our sample into two periods, the years before (1970-1999) and after (1999-2014) the introduction of the euro currency. Results are shown in the second and the third column of table 1. Differences regarding the net factor income and the transfers channels are not significant: beta estimates are very small for both sub-samples. This shows that the integration of capital markets accomplished with the currency union did not generate large benefits in term of risk sharing. The depreciation channel works as a dis-smoothing factor, since this beta is equal to -0.05 for the two sub-periods. Some differences across periods can be found with respect to the total amount of risk sharing and the role of the savings channel. EMU countries are more able to share their risk after 1999: 78% of shocks to GDP are not smoothed during the period 1970-1999, while this percentage decreases to 71 during the period 1999-2014. This improvement can be almost entirely attributed to the savings

channel. For the period 1970-1999, the beta savings is 0.27, while for the other sub-sample (1999-2014) it increases to 0.30. To this extent, the introduction of the euro seems to have a positive effect on the total amount of risk shared among member countries.

Has this improvement occurred before or after the financial crisis? To address this question, we split the period 1999-2014 into two parts, 1999-2006 and 2007-2014; results are presented in table 2. For the pre-crisis period, beta un-smoothed is equal to 0.77, while for the crisis period is 0.69. This means that during the crisis risk sharing increased. Thus, the increase in risk sharing highlighted for the period 1999-2014 mainly refer to the crisis period: this casts some doubts on the real effectiveness of the common currency in helping risk sharing.[4] Moreover, before the crisis (1999-2006) the beta savings has a lower impact; the two estimates are 0.15 and 0.39 respectively for the pre-crisis and crisis period. Hence, it seems that credit markets have contributed to share risk within the union during the crisis. To investigate better this issue, a detailed analysis on the savings channel will be presented in section 4.

	1970-2014	**1970-1999**	**1999-2014**
EMU			
Factor Income (βf)	1	2***	3
	[1]	[1]	[2]
Capital Depreciation (βd)	-5***	-5***	-5***
	[1]	[1]	[1]
Transfers (βt)	0	2*	0
	[1]	[1]	[1]
Savings (βs)	27***	27***	30***
	[2]	[3]	[5]
Not Smoothed (βu)	77***	78***	71***
	[2]	[3]	[3]

Table 1: Smoothing via main channels; Euro Zone; pre and post euro. *Notes*: Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. ***, **, * denote significance at 1, 5, 10 percent levels, respectively.

[4]The results are in line with some recent literature (Villaverde et al. (2013); Picco (2016))

	1999-2006	2007-2014
EMU		
Factor Income (βf)	7	2
	[5]	[4]
Capital Depreciation (βd)	-2	-12***
	[2]	[2]
Transfers (βt)	1	0
	[1]	[1]
Savings (βs)	15*	39***
	[9]	[8]
Not Smoothed (βu)	77***	69***
	[6]	[6]

Table 2: Smoothing via main channels; Euro Zone; pre and post crisis. *Notes*: Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. ***, **, * denote significance at 1, 5, 10 percent levels, respectively.

3.2 A comparison with the US

We compare our results with the US federation and we report the results for the main channels of risk sharing in the US in Table 3. We expand the sample period that has been taken into account by the literature, running the analysis for the years 1999-2014. Total amount of risk sharing in the US (57%) is higher than the one in the EMU and the channels that prevail are different in the two unions. Indeed, US capital markets play the largest role in risk sharing (27% in the entire period), while the credit markets channel exhibits a minor role (12%). The transfers channel could be explained in the following way. The tax-transfer system of the US central government is a vehicle for further income smoothing (since the US are a political union and have federal taxes and transfers almost not existing in the EMU, the third component of smoothing displayed in Table 3 is not directly comparable with the β_t in the EMU). This channel provides a non negligible amount of income smoothing: for the period 1999-2014 the estimated beta is 0.19.

As for the EMU analysis, we split US results into two sub-samples, pre-crisis and crisis period. In the US the crisis has decreased the total amount of shocks to GDP smoothed and has hindered the functioning of the main channels of risk sharing: indeed, beta un-smoothed for the period 1999-2006 is equal to 0.30, while it is 0.40 for the period 2007-2014. Moreover,

the net factor income channel has lost its power: β_f decreases from 0.40 to 0.22. Vice versa, the tax-transfers system and the savings channel have had greater impact in the crisis period rather than before: beta transfers increases from 0.19 to 0.22 and beta saving from 0.10 to 0.15. Regarding the first channel, it is likely that during the crisis more federal transfers, from the center to each state, have been provided: this mechanism could have helped risk sharing. Credit markets have had an important role too, probably as a consequence of the Federal Reserve intervention that has avoided a paralysis of the markets.

	1999-2014	**1999-2006**	**2007-2014**
USA			
Factor Income (βf)	27***	40***	22***
	[3]	[4]	[4]
Transfers (βt)	19***	19***	22***
	[2]	[3]	[2]
Savings (βs)	12***	10***	15***
	[2]	[3]	[3]
Not Smoothed (βu)	43***	30***	40***
	[1]	[2]	[1]

Table 3: Smoothing via main channels; USA. *Notes*: Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. ***, **, * denote significance at 1, 5, 10 percent levels, respectively.

We sum up some relevant differences between the two unions. First of all, country specific GDP shocks are only partially smoothed, both in the EMU and the US. Between 1999 and 2014, the degree of smoothing $(1 - \beta_u)$, is about 29% in the former and about 57% in the latter. In the EMU, risk sharing is almost entirely accomplished through the savings channel (which includes cross border borrowing and lending by the private and the public sector), whereas, in the US, it is accomplished through a diversified range of mechanisms: net factor income flows (27%), direct transfers (19%) and savings (12%). After the big recession, the percentage of idiosyncratic national GDP shocks smoothed through the available channels increases (from 23% in the 1999-2006 period to 31% in the 2007-2014 period) in the EMU, whereas it falls in the US (from to 70% to 60%). Furthermore, these changes hide some notable modifications in the way they have been accomplished. In particular, in the US the

channel that drops the most is the net factor income (from 40 to 22%), while the contributions of savings and direct transfers to income smoothing increase by a modest amount (from 10 to 15% and from 19 to 22% respectively). In the EMU, instead, there is a big increase in the amount of risk sharing achieved through savings (from 15 to 39%).

The main differences underlined above could be explained as follow. The important role of the savings channel in the EMU could be considered as the consequence of the possibility for European governments to implement budget deficits, whereas lack of political union in the EMU implies a non significant role of direct transfers. On the contrary, US member states satisfy balanced budget rules (their governments do not borrow/lend into credit markets to achieve risk sharing), but they could exploit federal transfers from the center.

4 The savings channel and the role of European institutions

In this section we focus on the savings channel, that is the most important mechanism of risk sharing in the Euro Zone. Based on the previous analysis it can not be established whether the major part is played by savings from the private or the public sector. Here, we investigate this topic for the period 1999-2014.[5] In order to catch the role of each component we run the regressions in the form presented in the section 2.2. Results are shown in table 4.

Looking at the whole period (1999-2014), the most important component of the channel is the public savings' one, indeed the beta estimated is equal to 0.28; besides, corporate savings provide a significant source of smoothing (11% of shocks to GDP are smoothed through them). On the contrary, the households savings beta is negative. This means that households provide dis-smoothing through their behavior on credit markets.

[5]Savings data by sectors are available starting from 1996.

Is this composition of the savings channel confirmed for the crisis period? In the second column of table 4 we present results for 2007-2014 sample. The savings channel as a whole increases its power: beta-total savings is equal to 0.39. As above, the role of public savings is the most prominent one, with an estimated beta of 0.38. An important contribution is due to corporate savings as well (16% of shocks smoothed). Households savings have the same behavior highlighted for the other sample period: they dis-smooth income with a beta of -0.12.

We go further in the analysis and split the amount of shocks absorbed through public savings into government lending position versus European institutions, on the one hand, and versus any other entities, on the other hand, as explained in section 2.2.

Before presenting regressions results, we provide some descriptive data on EU official flows

	1999-2014	**2007-2014**
EMU		
Not Smoothed (βu)	71***	69***
	[4]	[6]
Savings (βs)	30***	39***
	[5]	[8]
Public savings ($\beta spubl$)	28***	38***
	[5]	[9]
Corporate savings ($\beta scorp$)	11***	16**
	[4]	[7]
Households savings ($\beta shous$)	-7**	-12**
	[3]	[5]

Table 4: Smoothing via savings channel: private vs public savings; Euro Zone. *Notes*: Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. ***, **, * denote significance at 1, 5, 10 percent levels, respectively.

and governments savings. During the recent crisis, the increase of government bonds yields for some countries, such as Greece, Ireland, Spain, has obstructed traditional governments borrowing from markets; this is one of the reasons why European institutions have provided aids to that governments and have helped some of them to borrow at lower rates. Figure 1 shows the spread between the cost of funding for the Periphery countries, i.e. the long-term

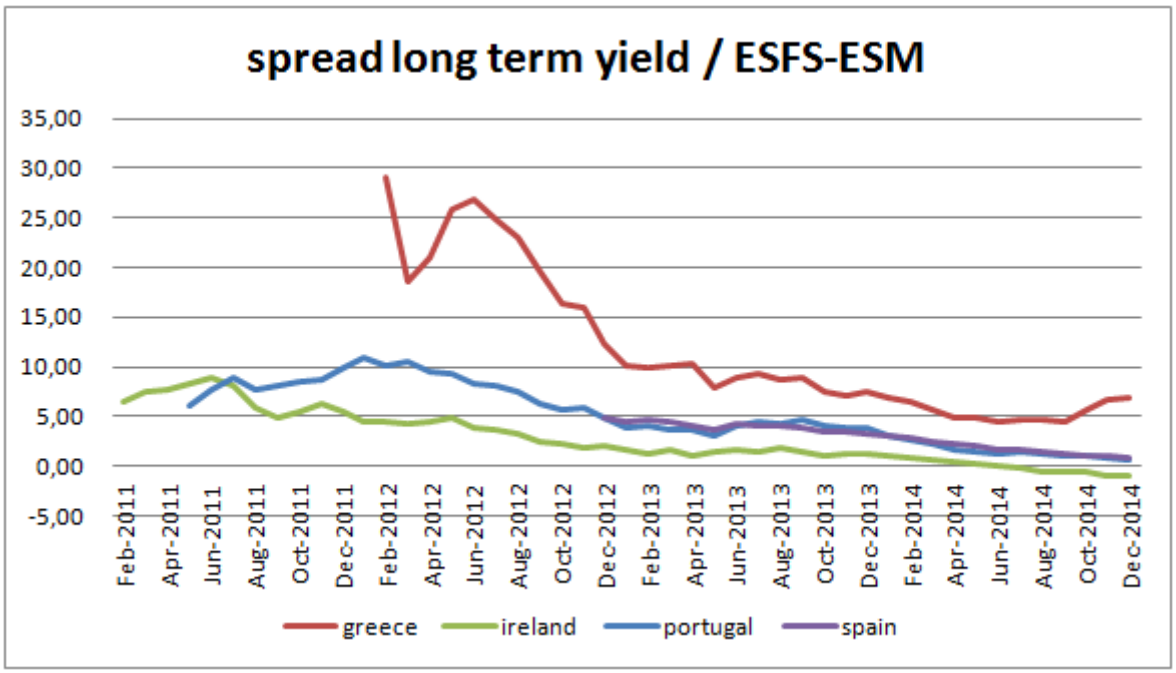

Figure 1: Cost of funding: spread between long-term yield and ESFS/ESM rates

government bond yield (10 years), and the rate at which ESFS and ESM have provided loans to these countries for the period February 2011 - December 2014.[6]

Furthermore, it is interesting to look at the trend of EU institutions flows and governments' savings in the Euro Zone. Figure 2 shows the pattern of the total net lending from European institutions and governments savings of all EMU countries in the period 2007-2014. First, during the crisis, a prominent amount of loans flow from European institutions to member countries and, from 2012, national governments start to repay these loans. Differently, governments savings show the following trend: from 2007 to 2009 they drop; then, they start to grow. This means that only from 2010 on they exhibit a counter-cyclical pattern (this is mainly due to austerity measures imposed to PIGS). Thus, during the period 2007-2009 national governments expand their budgets and enact fiscal expansionary measures (a big fiscal stimulus affects the entire EMU); then, they start to save and receive aids from EU institutions in order to be helped repaying their debts. The trends plotted in figure 2 are in line with the regressions results reported in table 5. Zooming into public

[6]Source: ESM Annual Report 2014.

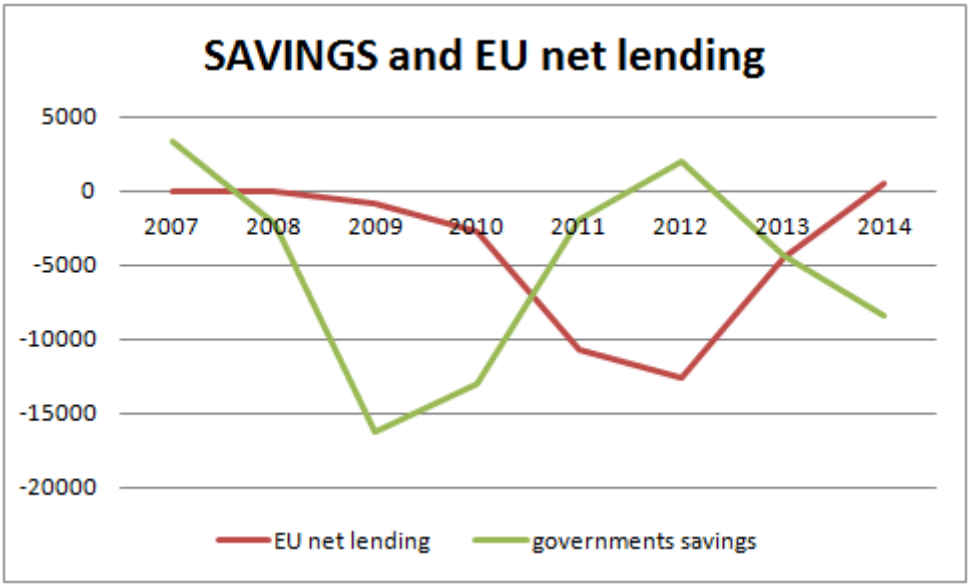

Figure 2: Government savings and EU net lending; 2007-2014. Euro per capita.

	2007-2014
EMU	
Not Smoothed (βu)	69***
	[6]
Private Savings ($\beta spriv$)	4**
	[5]
Public savings ($\beta spubl$)	38***
	[9]
Governments ($\beta sgov$)	-17*
	[30]
EU institutions (βsEU)	55*
	[30]

Table 5: Smoothing via savings channel: national governments vs European institutions; Euro Zone. *Notes*: Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. ***, **, * denote significance at 1, 5, 10 percent levels, respectively.

sector, it is noteworthy that the major role in sharing risk is played by net lending from European institutions: β_{EU} is 0.55. Conversely, the counter-cyclical pattern exhibited by governments savings reflects into a negative β_{sgov} (-0.17). Thus, during the crisis period, national governments lose their power in sharing risk, but this role is largely compensated by EU supranational mechanisms. In the next section we will show how this result comes from different behaviors among EMU countries.

5 Core versus Periphery countries

In this section we show the main differences in risk sharing mechanisms between Core and Periphery countries. First, we present results on the main channels of risk sharing for the whole period, 1999-2014, and the crisis period, 2007-2014; then, we perform the key exercise of the paper, i.e. the splitting of the β_s into its components, emphasizing that the trends underlined above (austerity measures, counter-cyclical governments' savings pattern and European institutions interventions) have changed risk sharing mechanisms within the EMU during the crisis.

Table 6 shows percentages of smoothing achieved through the main channels of risk sharing for the two sub-samples, 1999-2014 and 2007-2014. Some interesting results arise. Looking

	1999-2014		**2007-2014**	
	Periphery	**Core**	**Periphery**	**Core**
Factor Income (βf)	8	5	-1	11*
	[7]	[3]	[7]	[6]
Capital Depreciation (βd)	-3	-12*	-9***	-20***
	[2]	[1]	[2]	[2]
Transfers (βt)	1	0	1	-2*
	[1]	[1]	[3]	[1]
Savings (βs)	15***	65***	31***	79***
	[6]	[7]	[11]	[12]
Not Smoothed (βu)	77***	41***	77***	26***
	[10]	[5]	[9]	[7]

Table 6: Smoothing via main channels: Periphery and Core. *Notes*: Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. ***, **, * denote significance at 1, 5, 10 percent levels, respectively.

at the whole period, it is noteworthy that β_u is much higher for the Periphery than for the Core (0.77 versus 0.41). This significant difference is mostly driven by the savings channel: indeed, for the first group beta-total savings is equal to 0.15, whereas for the second it is equal to 0.65. Thus, since the inception of the euro currency, the two groups of countries exhibit different behaviors: in particular, the net adjustment of the asset holdings is significant for the Core, whereas it is weak for the Periphery. A plausible explanation could be the following. Core countries have saved in expansion (before 2007); this has allowed them to expand their budgets during the great depression: the traditional consumption smoothing mechanism has worked well. On the contrary, Periphery countries have increased public liabilities during the boom (1999-2006) and consolidated their fiscal positions during the bust (2007-2014), obstructing the consumption smoothing mechanism.

The crisis period analysis reveals other important features. For the Core countries the total amount of risk sharing is higher than in Periphery ones (74% versus 23% respectively). The net factor income channel gives a remarkable contribution to risk sharing only for Core countries: indeed, its percentage of smoothing is 11. On the contrary, for the Periphery this beta is not significant.[7] As for the whole period, main differences concern the savings channel: for the Core β_s is equal to 0.79, while for the Periphery it is equal to 0.31.

The savings channel is better investigated and decomposed further: table 7 shows its composition for the period 2007-2014. Looking at the two components of the channel, private and public, it is noteworthy that the former exhibits a similar pattern for the two groups: beta private saving is 0.05 for Core and 0.13 for Periphery. More remarkable differences concern public savings. First, the beta public savings for Core is 0.77 whereas for Periphery is 0.23. This means that public sector in Core has had a fundamental role in smoothing consumption and this could be imputed to two mechanisms: the adjustment through investment and borrowing/lending in international markets.[8] Secondly, figures are very different also with

[7] These results could be partially explained by the sudden stop (cfr. Gros and Alcidi (2015)).

[8] As underline by some literature (Kalemli et al. (2014)) "*for Core countries self-insurance in the form of pro-cyclical real investment at home provided substantial risk sharing.*" Our results do not hinder this conclusion.

	Periphery	Core
Not Smoothed (βu)	77***	26***
	[9]	[7]
Total Savings (βs)	31***	79***
	[11]	[12]
Private Savings ($\beta spriv$)	13*	5*
	[9]	[10]
Public savings ($\beta spubl$)	23*	77***
	[17]	[10]
Governments ($\beta sgov$)	-63*	73***
	[30]	[12]
EU institutions (βsEU)	86*	3
	[30]	[9]

Table 7: Smoothing via savings channel: Periphery and Core. *Notes*: Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. ***, **, * denote significance at 1, 5, 10 percent levels, respectively.

respect to the splitting into beta-national governments and beta-European institutions. As said before, Periphery countries' governments have been constrained by austerity measures reducing public spending in the crisis period. This is reflected into a negative β_{sgov} (-0.63). Conversely, they benefited from huge loans by European institutions: their effects on risk sharing are reflected in a high β_{EU} of 0.86. On the contrary, Core countries have not been constrained on their budgets and they show a very high beta national government savings (0.73) and a β_{EU} of 0.03.

In figure 3 we plot government savings and EU net lending trends for PIGS and non-PIGS: less pro-cyclical savings for PIGS have lead to a decrease in risk sharing for this group of countries; the conclusion is opposite for the Core.[9]

To sum up, the most interesting result is the following: on the one hand, for the first group of countries (PIGS) the percentage of risk sharing achieved through the European institutions' loans is high, while for non-PIGS this channel does not provide any smoothing. On the other hand, results are opposite regarding the national government savings channel: for

[9]This findings are in line with Kalemli-Ozcan et al. (2014): "*Risk sharing collapsed in Greece, Ireland, Italy, Portugal and Spain in 2010. This was the result of government austerity programs.*" and with Balli and Sorensen (2007): "*in the EU risk sharing has been declining due to less pro-cyclical saving*".

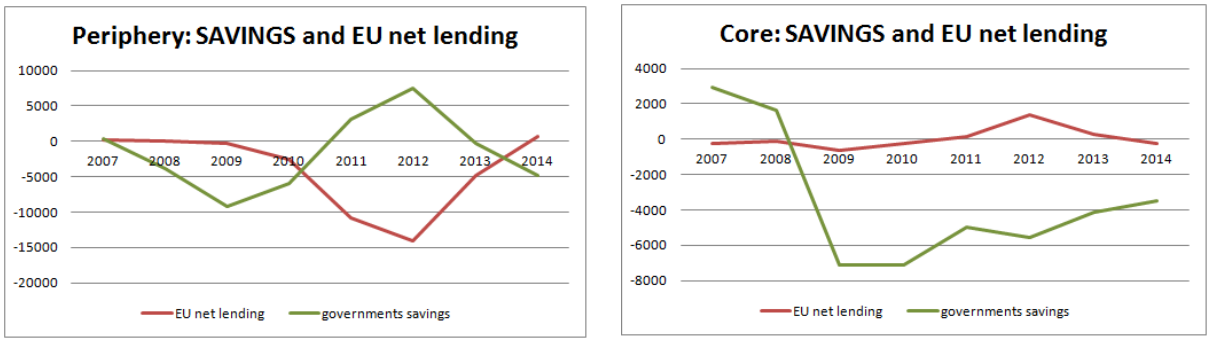

Figure 3: Government savings and EU net lending: Periphery and Core; 2007-2014. Euro per capita.

PIGS this channel provides dis-smoothing, while for non-PIGS this channel is fundamental. For PIGS austerity measures have impacted negatively on risk sharing,[10] but this mechanism has been replaced by a significant amount of transfers from the center; vice versa, the national government channel continues to be an important channel for Core countries.[11]

These results bring to the following conclusion. As suggested by some literature (Furceri and Zdzienicka (2015)) in order to increase risk sharing in the EMU a system of temporary transfers could be needed; such a system has been handed out by transfers from the EFSF and the ESM or by bilateral loans across EMU countries; our results show that these transfers were able to increase risk sharing.[12]

[10] Kalemli-Ozcan et al (2014) find that government savings for PIIGS countries in 2010 provide dis-smoothing (their beta estimate is -0.38).

[11] "*The ability of national government to smooth consumption by running budget deficits may be limited by law. The 1992 Maastricht requirements regarding government debt suggest that similar restrictions are likely to be imposed in a future EMU. This will shift the burden of smoothing consumption from the national government to private sector or to the EC budget.*" Sorensen and Yosha (1998). We add: *or to some other centralized mechanism, such as ESM.*

[12] "*Today, risk sharing between euro area countries occurs to a considerable extent through public institutions and only to a limited extent through markets. This has constituted an optimal response to a temporary malfunctioning of markets. [...] Official assistance packages have provided elements of ex post cross-country risk-sharing to Greece, Ireland and Portugal, which had been cut off from international markets.*" Benoit Coeure, Member of the Executive Board of the ECB; speech at Princeton University, 20 April 2012.

6 Concluding remarks

Could European union be considered a federation able to achieve good functioning of risk sharing mechanisms as other federations? In order to answer this question it is useful to compare some results obtained for the EMU and for the US. First of all, the major differences between the two are that in the US risk sharing is generally higher than in Europe and that in the US the private sector drives consumption smoothing, while in the EMU the public sector does most of the job. As a consequence of this fact, an important argument that arises is why so little risk sharing is achieved through factor markets in the EMU. Evidently, the answer is that both labor and financial markets are much more fragmented. In other words, although the EMU is highly integrated in terms of commodities trading, it is very fragmented with respect to services and financial trading. If, between 1999 and 2014, in the EMU net factor income flows had contributed to risk sharing as much as they did in the US in the same time interval, the overall degree of risk sharing in the EMU would have been about 50%, compared to 57% in the US. This may suggest that a full implementation of a financial market union along with a much more integrated market in services and a free movement of workers may largely compensate for the lack of a political union.

Nevertheless, even if the EMU relies very little on financial markets, it relies largely on public sector; this feature allowed European union to respond to the recent crisis in a particular way: in the US big recession decreased the degree of consumption smoothing, whereas in Europe risk sharing increased. What happened? Crisis has shown pros and cons of the EMU. Indeed, on the one hand austerity measures have pushed in the direction of a decrease in risk sharing, less pro-cyclical government savings have had negative effects and the traditional and most important government savings channel has lost its power; on the other hand, good mechanisms of risk sharing, such as the creation of the ESFS and the ESM, have been put in place and they have revealed their strength. During the crisis the contribution to consumption smoothing from national government savings has been negative (-0.17) whereas the contribution from official EU lending has been remarkable (0.55). For PIGS the national

government savings channel has provided dis-smoothing (-63%), but official EU lending has been a suitable substitute (86% of smoothing through European institutions). Thus, we agree with some recent literature (Kalemli-Ozcan et al. (2014)) for which risk sharing from government savings declined during the crisis, but we add and stress a very important result, that is, consumption smoothing increased due to the intervention of central European institutions.

We conclude that central mechanisms help the good functioning of risk sharing in the EMU providing coordination among member states without necessarily driving the members' fiscal policy decisions - that should be national prerogatives - and without going towards a fiscal union that would cancel out sovereignty at national level.

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A Data

A.1 National Accounts

GDP, GNI, NI, DNI, C and sectoral savings data are from OECD Annual National Account, Main Aggregates and Detailed Tables; the period covered is 1970-2014.
All data are in nominal terms and are transformed into real terms using CPI deflator; they are transformed in per-head terms using the population data from OECD.

- B1 GA: Gross Domestic Product (GDP);
- B5 GS1: Gross National Income (GNI);
- B5 NS1: Net National Income (NI);
- B6 NS1: Net National Disposable Income (DNI);
- SS1: Total Net Saving (corporation; general government; households)

Reference year is 2010 for all countries.

A.2 European transfers

European public transfers data are from IMF data; Balance of Payments (BPM6); Financial account, Other investment, Loans, Net acquisition of financial assets - Net incurrence of liabilities, General government.
Data from Balance of Payments are compared with the official data and documents from European Commission and from the following institutions: European Financial Stability Facility (ESFS), European Financial Stabilization Mechanism (EFSM), European Stability Mechanism (ESM).
Loans are financial assets that are (a) created when a creditor lends funds directly to a debtor, and (b) evidenced by documents that are not negotiable. This category includes all loans,

including mortgages, financial leases and repo-type operations. All repo-type operations, i.e. repurchase agreements, sell/buy-back operations and securities lending (with exchange of cash as collateral), are treated as collateralised loans, not as outright purchases/sales of securities, and are recorded under Other investment, within the resident sector that carries out the operation. Definition of loans from Commission Regulation (EU) No 555/2012 of 22 June 2012.

A.3 U.S. data

1. GDP. GDP is available from BEA.

2. SI: State income

   State income is constructed as follow: State personal income

   + federal nonpersonal taxes

   + state and local nonpersonal taxes

   - direct transfers

   State personal income is available from BEA (SA1);

   Direct transfers is available from BEA (SA35);

   Federal nonpersonal taxes is constructed as follow:

   Federal corporate income taxes

   + federal excise taxes.

   Total federal corporate income taxes and federal excise taxes are available from FRED; the incidence by state is not known and has been imputed using weights; the weight for a state is the share of the state in U.S. GDP.

   State and local nonpersonal taxes is constructed as follow:

   State and local tax revenue

   - state and local personal taxes

   State and local tax revenue is from OECD; for the weights see above.

   State and local personal taxes are from BEA (SA50).

3. DSI: Disposable state income

   Disposable state income is constructed as follow:

   State income

   + federal transfers to individuals

   - federal nonpersonal taxes

   - federal personal taxes

   Federal transfers to individuals is from BEA (SA35) and include the following components: railroads retirement and disability payments; workers compensation; supplemental Social Security (SSI); veterans benefits; medical benefits.

   Federal nonpersonal taxes: see 2.

   Federal personal taxes is from BEA (SA50).

4. State consumption

   State consumption is constructed as follow:

   Total personal consumption expenditure

   + state and local government consumption

   Total personal consumption expenditure is available from BEA.

   State and local government consumption is constructed as follow:

   State and local government expenditure

   - state and local transfers

   State and local government expenditure and state and local transfers are available from FRED; for the weights see above.