BRUEGEL WORKING PAPER 2014/04

CROSS-COUNTRY INSURANCE MECHANISMS IN CURRENCY UNIONS: AN EMPIRICAL ASSESSMENT

NANCY VAN BEERS*, MICHIEL BIJLSMA** AND GIJSBERT ZWART†

Highlights

- Countries in a monetary union can adjust to shocks either through internal or external mechanisms. We quantitatively assess for the European Union a number of relevant mechanisms suggested by Mundell's optimal currency area theory, and compare them to the United States.
- For this purpose, we update a number of empirical analyses in the economic literature that identify (1) the size of asymmetries across countries and (2) the magnitude of insurance mechanisms relative to similar mechanisms and compare results for the European Monetary Union (EMU) with those obtained for the US.
- To study the level of synchronisation between EMU countries we follow Alesina *et al* (2002) and Barro and Tenreyro (2007). To measure the effect of an employment shock on employment levels, unemployment rates and participation rates we perform an analysis based on Blanchard and Katz (1992) and Decressin and Fatas (1995). We measure consumption smoothing through capital markets, fiscal transfers and savings, using the approach of Asdrubali *et al* (1996) and Afonso and Furceri (2007). To analyse risk sharing through a common safety net for banks we perform a rudimentary simulation analysis.

* Researcher at Netherlands Bureau for Economic Policy Analysis, n.j.c.van.beers@cpb.nl ** Bruegel Visiting Fellow, Head of Competition and Regulation at Netherlands Bureau for Economic Policy Analysis, Extramural Fellow Tilburg University, m.j.bijlsma@cpb.nl † Researcher at Netherlands Bureau for Economic Policy Analysis, g.t.j.zwart@cpb.nl. The authors thank Felipe Brugués and Nicky Hoogveld for valuable research assistance, and are grateful for discussions to Guntram Wolff, Gregory Claeys, Bas ter Weel, Arjan Lejour and participants in discussions at the Dutch Ministries of Finance, Economic Affairs and Foreign Affairs.

MARCH 2014

1. Introduction

Countries in a monetary union can adjust to shocks either through internal or external mechanisms. In this study we try to provide some measure of the size of selected external adjustment mechanisms suggested by Mundell's optimal currency area theory in the European Monetary Union (EMU) compared to those in the United States (US). We do so by updating a number of empirical analyses in the economic literature that identify (1) the size of asymmetries across countries or states and (2) the magnitude of insurance mechanisms in the EMU relative to similar mechanisms in the US, one of the most-studied currency unions. We also study how these mechanisms have changed over time.

When a country or state suffers an adverse economic shock, it enters a phase of adjustment towards equilibrium. Several mechanisms can play a role in mitigating idiosyncratic shocks: exchange rate adjustment, monetary policy, price and wage adjustment, labour mobility, saving and borrowing, diversified portfolio with external assets, and direct insurance. Some of these channels are available to countries in a monetary union; the first two, however, are not.

A first channel for adjustment that countries lose control of when entering a currency union is the exchange rate. A lower exchange rate effectively reduces wages and prices in comparison to trade partners, which contributes to restoring employment. In addition, currency depreciation reduces the burden of international debt, which is denominated in domestic currency. In this way, some of the costs of the economic shock are in effect shared by a country's trade partners or foreign holders of debt.

A country-specific monetary policy constitutes a second channel through which idiosyncratic shocks can be cushioned. When a country is hit by an adverse economic shock, its central bank can respond by lowering interest rates and if necessary resort to non-standard monetary policy tools as we have seen in the recent financial crisis. In this way, monetary policy aims to lower interest rates in financial markets as well as the loan rates set by banks, which stimulates economic activity.

By entering into a currency union, a country gives up both the exchange rate and the country-specific monetary policy as adjustment mechanisms. Therefore, these channels can no longer cushion idiosyncratic shocks.[1] This means that joining a monetary union may be costly because a larger

[1] To be sure, there are significant benefits of entering into a currency union that may well offset those costs. These include a reduction in trade barriers due to transaction costs, as well as a commitment to lower inflation. As e.g. Alesina and Barro (2002) point out, joining a currency union includes disciplining oneself to keep inflation in check, and hence lowers the price of credit. These benefits are not the focus of this study. Also, the extent to which exchange rate changes are effective

burden of recovery falls on the other adjustment mechanisms that may be less effective in mitigating shocks. One class of mechanisms is that of internal adjustment mechanisms, where countries reduce real wages compared to trade partners in order to regain competitiveness. This often coincides with prolonged periods of high unemployment. Another way of coping with shocks is by relying on external mechanisms.[2] If such channels of explicit or implicit risk sharing among countries are strong, giving up some monetary independence will be less costly.

Which external channels are available, and how relevant are they for determining the costs of joining the monetary union? The economic theory of optimal currency areas has identified several factors that determine the costs for union members of giving up their own currency. The literature starts with the seminal contribution by Mundell (1961), who addressed the question whether it is optimal that boundaries in currency areas typically coincide with national boundaries. A literature since Mundell has subsequently identified a number of criteria that affect the costs of sharing a single currency (see e.g. Krugman, 2012, for a recent summary). In this study, we quantitatively assess a number of the external channels of risk sharing among countries suggested by Mundell for the EU as well as for the US and compare them.

A first relevant factor is the extent to which the currency union partners experience a more or less similar economic evolution. Giving up individual monetary policy is not a problem if countries' economies develop in a symmetric way. When all countries in a monetary union are hit by a shock in the same way at the same time, the same monetary policy response will be suitable for each member of the union. In effect, similarity implies that joining a monetary union does not pose many restrictions on a country's adjustment possibilities after a shock. To study the level of synchronisation among EMU countries we apply a methodology as in Alesina et al (2002) and Barro and Tenreyro (2007).

A second factor is how mobile labour and capital are across borders. Adjustment of labour markets in response to macroeconomic shocks is easier when the labour force can move to neighbouring countries. A sudden local increase in unemployment will induce labourers to move to other countries, while a local shortage of labourers will attract foreign workers. These migration effects will reduce the need to regain full employment through an (often lengthier) process of real wage adjustment, and associated longer periods of large unemployment. To measure the effect of an employment shock on

---

instruments to create the flexible relative prices that are necessary to meet output shocks has been nuanced, e.g. in Dornbusch (2001).

[2] In practice, internal and external adjustment mechanisms are substitutes in the sense that a greater amount of internal adjustment reduces the need for external adjustment.

employment levels, unemployment rates and participation rates, we follow the methodology used in Blanchard and Katz (1992) and Decressin and Fatas (1995).

A third factor relates to the extent to which countries can insure against economic shocks by diversifying themselves financially. If part of the assets in a country is held by foreign investors, economic shocks are borne partly by these investors, and only partly impact upon the host country. And similarly, if a country has a geographically diverse portfolio of assets, shocks are diversified as well. In addition, financial integration also contributes to the smoothing of consumption shocks. If countries have access to external capital markets and banks, saving and borrowing helps in reducing the responsiveness of consumption to output shocks. To study the amount of risk sharing by the different channels, we follow the empirical framework of Asdrubali et al (1996) and Afonso and Furceri (2007).

Finally, part of the burden of an economic shock can be shared through transfers among the countries. In a fiscal union, such as the US, the transfers between a state and the federal government will often depend on the position in the economic cycle the state is in. Such transfers involve both taxes towards the federal level, and contributions from the federal level to the state, for example social security payments. Wolff (2012) discusses in detail the possibilities in constructing a European budget. An additional transfer channel that has shown its importance in the financial crisis is that of financial assistance to banks. If other members of a currency union contribute to the bail-out of banks, or to the funding of deposit insurance, the flows involved could be sizable. To quantify this channel, we perform a very rudimentary study of risk sharing through a common safety net for banks as implied by the Bank Resolution and Recovery Directive (BRRD). Here, we necessarily neglect many features. Note, for example, that part of the burden of banking crises may be shared through integrated capital markets if foreign private financiers of banks share in the cost of banking failures.

Several disclaimers are in order. We will not address the issue whether current cross-border insurance mechanisms are too small, or too big, or just right. Also, we will not study why current mechanisms function the way they do, nor how policy could effectuate changes in these mechanisms. In order to address what optimal insurance mechanisms would look like, one would need to evaluate the costs and benefits of such mechanisms more closely. One crucial factor is of course how costly internal insurance mechanisms are, such as internal depreciation through a reduction in real wages. Other issues may involve how cross-border insurance may affect behaviour (moral hazard), and how averse countries are towards consumption uncertainty.

2. Co-movement of GDP, inflation and consumption

The need for insurance mechanisms across countries in a currency union is greater when the shocks to their economies are less correlated. When economic variables of countries within a currency union move more or less in sync, the costs of a common monetary policy are lower, because the optimal monetary policy response for these countries would also be similar. In that case a one-size-fits-all monetary policy has no great costs.

Problems may arise when business cycles within the various economies are not fully correlated, so that different economies would ideally have different monetary policies. If a particular economy in a currency union faces an idiosyncratic economic downturn, it cannot boost its economy by lowering relative wage costs through inflation or a devaluation of its currency. Instead, to regain equilibrium, real wages have to fall by other means. That, however, appears often easier said than done.

The costs of giving up individual monetary policy are therefore lower when economic variables such as gross domestic product (GDP) growth and inflation exhibit greater co-movement. In the run-up to the introduction of the euro, Bayoumi and Eichengreen (1993) compared co-movement of GDP growth and inflation among euro-area countries with those among US states. They noted a discrepancy between the core euro-area countries, and countries in the periphery. For the core, synchronisation of economic development was comparable to that among US states. For periphery countries, they found much more divergence.

Since Bayoumi and Eichengreen, many studies have reinvestigated the level of synchronisation among EMU countries. De Haan et al (2008) survey the literature. One observation from that literature is that the period of study matters: there have been both periods of convergence and of divergence. Since the nineteen-nineties, however, business-cycle synchronisation increased. As Imbs (2004) shows, such synchronisation is partly driven by similarity of industrial sectors among countries, and by financial linkages. Increased trade among countries is also in part responsible for correlation of business cycles. This trade effect is particularly strong for trade of intermediate goods within industries (di Giovanni and Levchenko, 2010).

Membership of a currency union may well affect the level of correlation among countries' economies. As Santos Silva and Tenreyro (2010) emphasise, what matters for determining the costs of joining a union is how similar countries are after they have entered into the currency union.

Barro and Tenreyro (2007) try to estimate the effect of joining a currency union on the level of similarity of shocks across many currency unions, using a methodology of Alesina et al (2002). They look at almost all countries in the world in the period 1960-1997 and find that the effect of joining a currency union is negative: overall, countries that have joined a currency union experience a somewhat reduced synchronicity in their economic output. They conjecture that this might reflect a mechanism put forward by Krugman (1993): countries within a currency union might gain by specialising into different sectors of the economy. This specialisation would expose them to different economic shocks.

Here we use the methodology of Alesina et al (2002) and Barro and Tenreyro (2007) to study how co-movement of output, inflation and consumption among euro-area countries has changed since the introduction of the euro. We estimate the co-movements of GDP, price levels and consumption between countries in the EMU and between states in the US over the period 1987-2012, and ask whether the distribution of outcomes for the two regions is markedly different. In particular, we study whether the introduction of the euro influenced the extent of co-movements of GDP between the countries in the EMU, by comparing with changes in US states' GDP co-movement over the same period.

2.1 Methodology

In line with Alesina et al (2002) and Barro and Tenreyro (2007), we compute for every pair of countries (i, j) the second-order autoregression

$$ln\frac{Y_{it}}{Y_{jt}} = b_0 + b_1 \cdot ln\frac{Y_{i,t-1}}{Y_{j,t-1}} + b_2 \cdot ln\frac{Y_{i,t-2}}{Y_{j,t-2}} + u_{tij} \qquad (1)$$

where Y_{it} denotes GDP for country i and Y_{jt} denotes GDP for country j in year t. The estimated residual, $\hat{u}_{tij}$, measures the relative GDP that could not be explained by the two lags of relative GDP. The extent of GDP co-movement in a certain time period is measured by the root-mean-square error:

$$VY_{ij} \equiv \sqrt{\frac{1}{T-3}\sum_{t=1}^{T}\hat{u}_{tij}} \qquad (2)$$

The interpretation of this measure of co-movement is that a lower VY_{ij} indicates greater correlation of GDP movements between two countries i and j.

The extent of co-movement of prices and the extent of co-movement of consumption are both calculated using the same method, by replacing Y_{it} with respectively P_{it} and C_{it}. Denoting the residuals that measure the unpredictable movements in relative prices by $\hat{\varepsilon}_{tij}$, and the residuals that measure the relative consumption that could not be explained by the two prior values of relative consumption by $\hat{\eta}_{tij}$, we define the measure of the extent of co-movement for prices as

$$VP_{ij} \equiv \sqrt{\frac{1}{T-3}\sum_{t=1}^{T}\hat{\varepsilon}_{tij}} \qquad (3)$$

and for consumption as

$$VC_{ij} \equiv \sqrt{\frac{1}{T-3}\sum_{t=1}^{T}\hat{\eta}_{tij}} (4).$$

Importantly, the lower VP_{ij}, the greater the co-movement of prices between countries i and j. Similarly, the lower VC_{ij}, the greater the co-movement of consumption between countries i and j.

2.2 Data

Data on GDP, prices and consumption for EMU countries is derived from the World Bank's World Development Indicators (WDI) and is in some cases complemented with data from the OECD. Combining both sources, we generate a panel of 12 EMU countries[3] with yearly data on GDP, prices and consumption for the period 1960-2012 (or shorter periods for prices and consumption). The panel for the US is composed of yearly data on GDP, prices and consumption from the Bureau of Economic Analysis and covers the period 1987-2012.

As a measure of prices in the euro-area countries, we follow the literature by using the purchasing power parity (PPP) conversion factor for private consumption divided by the US dollar exchange rate, which measures how many dollars buy one dollar worth of goods in the domestic country as compared to the US. As a measure of prices in US states, we use the GDP deflator, which measures the cost of goods produced in a state relative to the purchasing power of the dollar.

As an indicator for consumption we use real consumption per capita in 1995 euros for the EMU panel. This is household final consumption (formerly private consumption), which is the market value of all

[3] Consisting of the twelve European countries that adopted the euro as their national currency on January 1, 2002.

goods and services purchased by households, including durable products and excluding purchases of dwelling. The US lacks data on real consumption per capita on state level. However, we do have data on personal consumption expenditures on the national level and on personal income on both national and state level. This allows us to approximate the consumption at the state level. By multiplying personal income per state with the ratio of personal consumption expenditures to personal income at the national level we construct estimates of the personal consumption expenditures per state. Furthermore we correct for inflation and population size to obtain a variable on real consumption per capita in 1995 dollars per state. Table 2.1 on the next page shows some descriptive statistics of the data used.

Table 2.1: Descriptive statistics

Country	Average PPP conversion factor / US dollar exchange rate		Average Real GDP per capita		Average Real consumption per capita	
	1980-2001	*2002-2012*	*1960-2001*	*2002-2012*	*1970-2001*	*2002-2011*
Austria	0,98	0,88	18028	30664	11938	16536
Belgium	0,97	0,91	18145	29167	11096	15098
Finland	1,07	1,04	17032	30409	10209	15828
France	1,02	0,92	17995	27279	11513	15635
Germany	1,02	0,88	17936	28197	12089	16115
Greece	0,43	0,76	10515	17118	7726	12219
Ireland	0,91	1,04	14940	38263	9351	17826
Italy	0,73	0,88	15947	24120	10558	14386
Luxembourg	0,93	0,96	31414	65005	16611	23130
Netherlands	0,97	0,89	19739	32294	11390	15278
Portugal	0,53	0,73	8331	14722	6281	9587
Spain	0,65	0,78	12030	20808	7974	11944
EMU	0,85	0,89	16291	25909	10665	14719
US	0,79	1,05	28688	35305	22958	29601

Source: Bruegel, WDI.

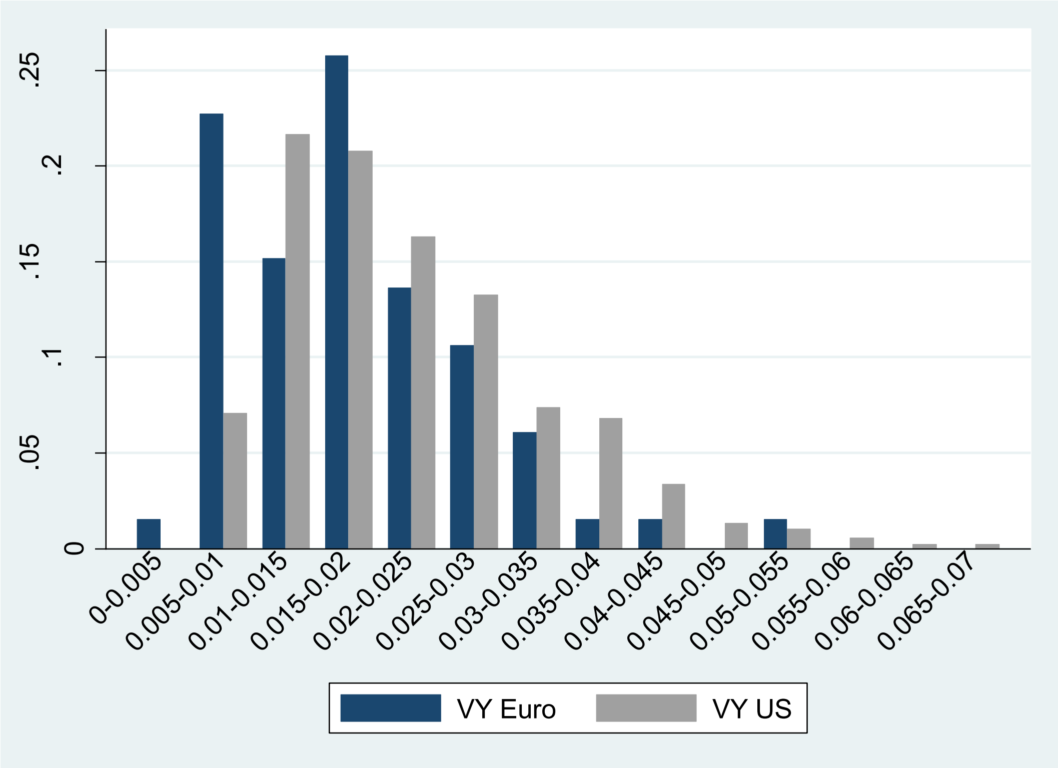
2.3 Results

We first consider the overall distribution of co-movements in real GDP per capita, VY_{ij}, of pairs of countries within the EMU, and compare this distribution with that of co-movements of pairs of states within the US[4]. We have 78 country pairs (66 country pairs and 12 pairs of each country with the EMU average) for the EMU and 1378 state pairs (1326 state pairs and 52 pairs of each state with the US average) for the US.

Figure 2.1 shows the distribution of co-movement of real GDP per capita among country pairs in the EMU and states in the US for the period after the introduction of the euro, that is, from 2002 until 2012. Recall that when two countries have a low VY_{ij}, their GDPs evolve relatively synchronous.

[4] We compare the period 1960-2012 in the EMU with the period 1987-2012 in the US.

Figure 2.1: Distribution of co-movement of real GDP per capita among country pairs in the EMU and states in the US for the period 2002-2012



Source: Bruegel, World bank and Bureau of Economic Analysis.
Note: the lower VY, the higher synchronicity.

Given the distributions, real GDP per capita co-movements are roughly similar between the two regions for this period, even though the EMU has a higher fraction of observations on the left-hand side of the distribution, which results in a lower average VY of 0.018 compared to 0.022 in the US. The results suggest that synchronisation of real GDP per capita was slightly higher among EMU member states than among states in the US during the last decade (recall that a low value corresponds to high co-movement). The t-value of the differences in means is equal to -3.42, which means the difference between the EMU and the US is significant at the 1 percent level.

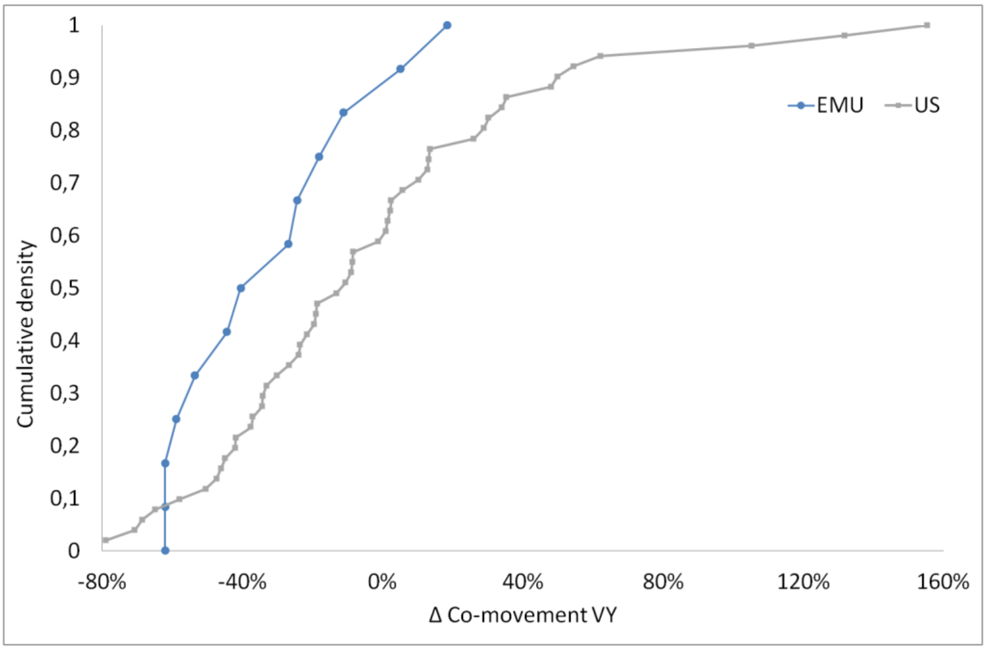
Let us next consider the evolution of co-movement in real GDP per capita over time. Table 0.1 in the Appendix displays the extent of co-movement of the individual countries with the average of the EMU before and after the introduction of the euro. Focusing on the left side of the table, the synchronisation of real GDP per capita, the degree of synchronisation has increased for all countries after the introduction of the euro, except for Germany and Greece. Luxembourg and Portugal experienced the largest average increase in synchronisation with the other euro-area countries. Furthermore, the country with the highest degree of synchronisation after the introduction of the euro is Greece, followed by, to a lesser extent, Ireland, Finland and Luxembourg.

Even though we find more co-movement in real GDP per capita after the introduction of the euro, this should not necessarily be attributed to joining the monetary union. As Gali et al (2013) note, a convergence in many economic indicators has occurred more widely in OECD countries, not only for those in the EMU.

To address this issue, we compare the change in the synchronisation of real GDP per capita before 2002 and after 2002 in EMU countries with the change in synchronisation in the period in the US. Thus, for each state or country we take the difference between the levels of co-movement for the period before 2002 and after 2002 (we call this co-movement). For each state or country this measures the change in synchronisation before and after the introduction of the euro. In the EMU, 10 out of 12 countries experienced an increase in co-movement since 2002, while in the US the extent of synchronisation increased for 30 out of 51 states during the same time period.

Next, we order the difference from small to large and plot them on a scale from zero to one. This gives an approximation of the empirical cumulative density distribution for the delta in co-movement. For US states we have 51 draws from this distribution, for EMU countries there are 12 draws. The results in Figure 2.2 show that the line for the EMU is shifted to the left, which shows that EMU countries experienced a larger increase in synchronisation than US states in that period. Whereas only 20 percent of US states experience a decrease of 40 percent or more in VY, roughly 50 percent of EMU experienced such a decrease. This rudimentary difference-in-difference analysis suggests that the introduction of the euro has played a role in the increase of the degree of synchronisation among the EMU countries.

Figure 2.2: Cumulative density distribution of the change in GDP synchronisation before and after introduction of the euro



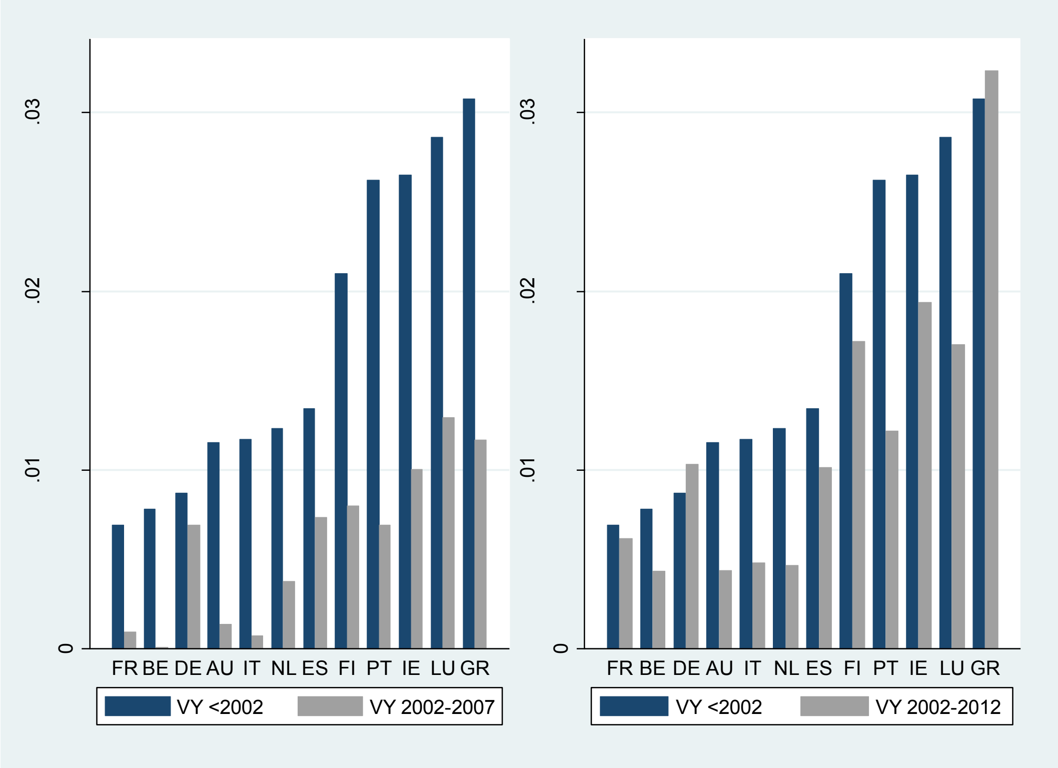
Source: Bruegel based on World bank and Bureau of Economic Analysis.

Although the co-movement of real GDP per capita since the introduction of the euro has increased, the financial crisis may also have affected synchronisation among countries. It is possible that countries have become more asymmetric due to the global shock because of country-specific differences in the terms of trade and fiscal imbalances. On the other hand, countries may have become more synchronised because all countries have ended up in a recession at the same time (Gaechter et al, 2012).

Although the time-series are rather short, the graph on the left in Figure 2.3 shows the difference in co-movement between the period before the introduction of the euro and the period 2002-2007, the years before the beginning of the crisis. With a t-value of 3.93 the difference in means between the before euro period and the 2002-2007 period is significant at the 1 percent level.

The graph on the right, on the other hand, includes the crisis years. It is clear that the synchronisation among euro-area countries has decreased since the start of the crisis. The difference in means between the before euro period and the 2002-2012 period is not statistically significant anymore (t-value of 1.48). This is in line with the finding of Gali (2013) of strong convergence in economic indicators in the first years of the EMU, but an interruption of the convergence progress among EMU countries after the onset of the financial crisis. Nevertheless, synchronisation is still larger than before the introduction of the euro.

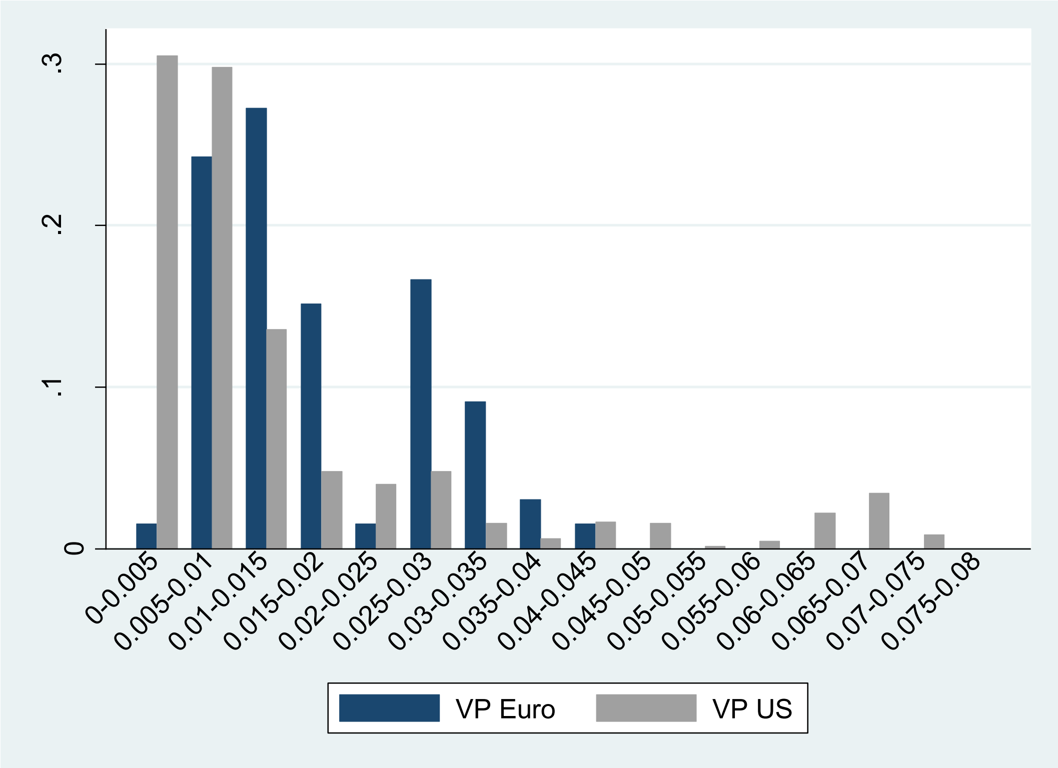
Figure 2.3: Co-movement in real GDP per capita of individual euro-area countries with average EMU before and after the introduction of the euro, for the period until the financial crisis (lhs) and including the financial crisis (rhs)



Source: Bruegel, World bank and Bureau of Economic Analysis.
Note: the lower VY, the higher synchronicity.

Asymmetries in GDP are relatively similar for the US and the EMU. If we look at price levels, we see a different picture. The bars on the left-hand side of the figure below are higher for the US than for the EMU, while the EMU has more observations at higher levels of asymmetry. This implies more synchronisation of prices among states in the US than among euro-area countries. The difference in sample means for the EMU and the US has a t-statistic of 2.27, so the difference is statistically significant at the 5 percent level.

Figure 2.4: Distribution of co-movement of price levels among country pairs in the EMU and states in the US for the period 2002-2012



Source: Bruegel, World bank and Bureau of Economic Analysis.
Note: the lower VP, the higher synchronicity.

Looking at the underlying data, we see that the larger number of observations at higher levels for the EMU are driven in particular by a small number of countries whose inflation rates have had markedly different dynamics from those of the rest of the EMU countries. These countries include Spain, Greece and Portugal, which had considerably lower than average price levels, and Finland and France, which had much higher than average price levels.

2.4 Conclusions

We find that co-movement of real GDP per capita among EMU countries in the period 2002-2012 is on average slightly stronger than that among US states. We also find that, on the whole, co-movement for individual countries was greater in the first years after the introduction of the euro, but has decreased again after the beginning of the crisis.

Co-movement of inflation in the EMU countries is a different story, however. Here we see a larger dispersion among countries than is the case among states in the US. In particular, inflation in periphery countries such as Greece and Ireland correlates less with the other EMU countries. This reflects continued higher inflation at the beginning of the century as these countries experienced strong growth and the subsequent problems that emerged with the crisis (see e.g. Gali et al, 2013).

A priori, more co-movement in real GDP per capita after the introduction of the euro should not necessarily be attributed to that event. As Gali et al (2013) note, a convergence in many economic indicators has occurred more widely in OECD countries. This period of low macroeconomic volatility in the developed world was termed Great Moderation (see e.g. CPB, 2009). When comparing the convergence among US states with the convergence among the EMU countries, we do see a bigger effect for EMU countries. This rudimentary dif-in-dif analysis suggests that increased co-movement is partly due to the monetary union.

3. Labour migration

Mundell (1961), in his seminal work on currency unions, already pointed out the relevance of labour mobility for assessing the costs of entering into a currency union. Countries experiencing an adverse economic shock will suffer a decrease in employment. Without the possibility to devaluate the currency and in that way decrease relative wages, real wages will have to decrease to restore employment. This often proves difficult. Alternatively, if the economic shock was in particular to one country, those in search of a job may move to neighbouring countries. In that way, emigration can help restore full employment.[5]

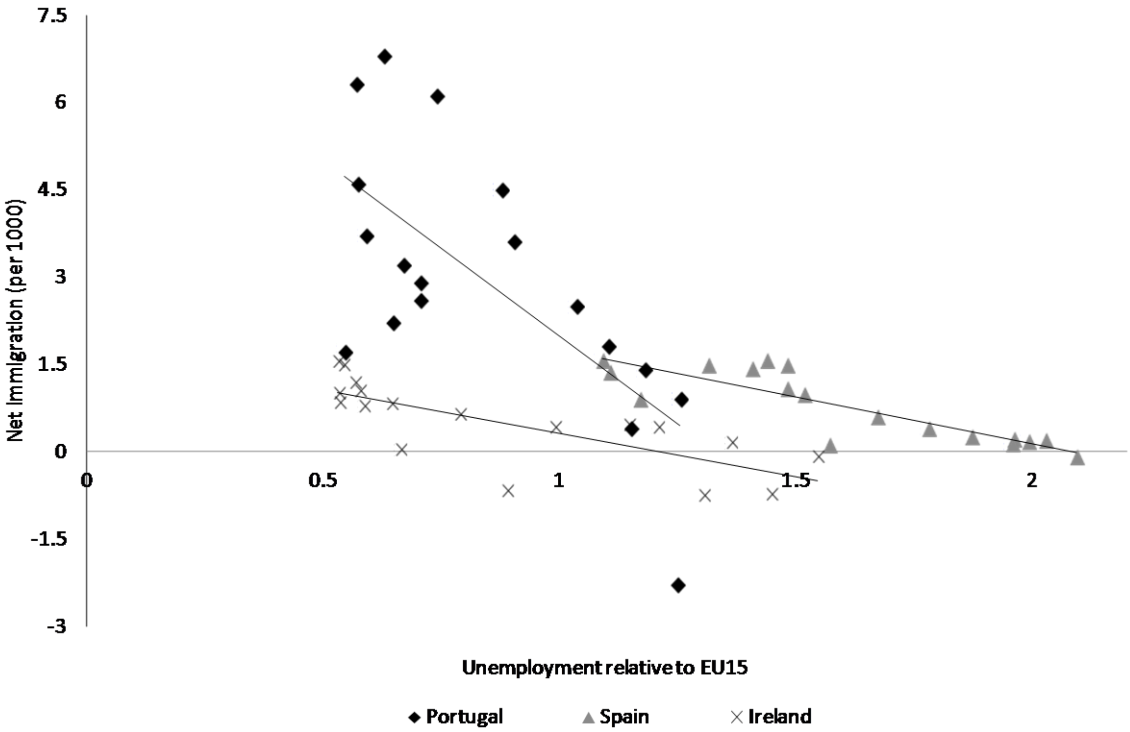
The level of migration among the EMU countries is lower than among states in the US. Gakova and Dijkstra (2008) in a paper for the EU, DG Regio, compare migration figures for 2006, for both US states and EU countries and regions. They find that US cross-state migration is roughly twice as large as cross-country migration in the EU. If one only considers the EMU, figures are even lower.

Note that it is not only migration of EMU citizens themselves that matter. A significant part of EMU migration involves migration from other parts of the EU into the EMU (e.g. from Eastern Europe), or immigration from non-EU countries. Relative changes in employment prospects in various EMU countries can affect those migration flows. Ahearne et al (2009) focus on the impact of the economic crisis on East-West migration within Europe. In a case study on Ireland, they show that immigration flows from EU accession countries rose sharply during the boom years, to drop again significantly as the crisis hit. They conclude that migrants absorbed a more than proportional share in the Irish labour market adjustment.

To see how responsive migration is to country unemployment levels, we have a look at the (net) immigration rates in a number of EU periphery countries. In Figure 3.1, we plot, for three countries, immigration rates (per thousand population), against relative unemployment. We define relative unemployment as the ratio of unemployment to average EU-15 unemployment. Hence, a value larger than one implies relatively high unemployment compared to EU-15, and low values correspond to years in which unemployment was relatively low. The data comes from Eurostat, and represents the years 1991-2011.

[5] A comment is that in the long-run emigration reduces the tax base and potentially leads to the departure of the most promising employees.

Figure 3.2: Net immigration versus relative unemployment, for three EU countries, 1991-2011



Source: Eurostat.

The negative regression lines indicate that total net immigration decreases with relative unemployment. Given the limited time frame of the data, most of the effect will be determined by the effect of the construction booms in the periphery countries after the adoption of the euro, and the economic downturns after 2007.

To get a longer term picture of the impact of employment shocks on migration, Blanchard and Katz (1992) introduced an indirect method of measurement. Suppose a state is hit by a shock in employment (e.g., less demand for the products the state specialises in). In response to, say, a drop in total employment, three things can happen: some people may get unemployed, average participation (hours worked) may drop, or part of the working age population may leave the country. Blanchard and Katz used this basic observation to measure labour migration as the residue of changes in employment, unemployment rate and labour participation.

We can illustrate the mechanism by using the example of Massachusetts from Krugman (2012). The US state of Massachusetts was hit by a severe economic downturn in the beginning of the nineties. Table 3.1 records, for three distinct years, Massachusetts' total employment as a share of total US employment, as well as unemployment rates both in the state and countrywide. We see that the shock in the beginning of the nineties decreased employment in Massachusetts, and led to an increase in the relative unemployment rate in the state. Five years later, there had been a recovery, with unemployment again at a lower than average level. However, total employment (as a share of US employment) had permanently decreased in 1996 compared to the pre-crisis level. The conclusion must be that part of the working population had migrated out of the state during the crisis.

Table 3.1: Massachusetts employment dynamics around its 1991 economic crisis

	Massachusetts share in US employment	Massachusetts unemployment rate	US unemployment rate
1986: pre-crisis	2.70	4.0	7.0
1991: crisis	2.48	8.8	6.8
1996: post-crisis	2.43	4.6	5.4

Source: Krugman, 2012.

Decressin and Fatas (1995) applied the Blanchard-Katz methodology to the EU, based on data up to 1987. As in Blanchard and Katz (1992), they measure the effects of an employment shock on subsequent employment levels, unemployment rates and participation rates. They focus on data on a regional level within the EU, including 51 regions, and study the time period up to 1987. Their main findings are that, in Europe, a larger share of employment shocks over their study period was met by changes in the labour participation rate. Migration played a smaller role in Europe than in the US.

Only few studies have since tried to update the Decressin and Fatas (1995) analysis with more recent data. An exception is L'Angevin (2007) who explores, within the framework used by Decressin and Fatas, how labour mobility has evolved over time. When comparing with data up to 2005, she finds that the role of migration in EU countries has become stronger in more recent years.

As in L'Angevin (2007), we are interested to see whether the role of labour mobility in the EU has changed over time. In the next section, we therefore analyse labour market adjustment in response to asymmetric shocks using the methodologies of Blanchard and Katz (1992) and Decressin and Fatas (1995). In particular, we study how shocks to national labour demand in the EMU are absorbed by changes in national unemployment, labour force participation and migration, compared to the US. First, we investigate the co-movement of employment, the unemployment rate and the participation rate between countries in the EMU and between states in the US and the portion of the variance in country (state)-specific variable changes that cannot be accounted for by EMU (US) wide macroeconomic shocks. Next, we analyse the persistence of shocks in employment, unemployment and labour participation. In order to investigate labour market adjustment dynamics in response to shocks to national labour demand, we analyze the joint behaviour of relative employment, relative unemployment and relative participation rates.

3.1 Method

We briefly describe the methodology of Blanchard and Katz (1992) and Decressin and Fatas (1995). The extent to which yearly changes in respectively employment, unemployment, and labour force participation rates are common to all countries in a particular monetary union (the level of co-movement), is measured by estimating the following regressions for each country/state i in the EMU and the US:

$$\Delta\, ln(N_{it}) = \alpha_i + \beta_i \Delta\, ln\,(N_{et}) + n_{it} \quad (5)$$

$$U_{it} = \alpha_i + \delta_i U_{et} + u_{it} \quad (6)$$

$$ln(P_{it}) = \alpha_i + \zeta_i\; ln(P_{et}) + p_{it} \quad (7)$$

Here N_i denotes employment in country/state i and N_e stands for employment in the EMU (US); P_i denotes the participation rate in country (state) i and P_e stands for the participation rate in the EMU (US); U_i stands for the unemployment rate in country (state) i; and U_e denotes the unemployment rate in the EMU (US).

To examine the persistence of regional labour market shocks, we study how quickly employment, unemployment and participation in a region return to their mean once the country (state) has experienced a shock. We do this by measuring, for example, the response of national employment relative to total EMU employment as a result of an asymmetric shock to employment. For this analysis we need the portion of the variance in regional changes in employment, the unemployment rate and the participation rate which cannot be accounted for by the monetary union wide macroeconomic shocks. These country/state-specific variables are given by the residuals of regressions (5), (6) and (7).

$$n_{it} = \Delta ln(N_{it}) - \beta_i \Delta\, ln(N_{et}) - a_i \quad (8)$$

$$u_{it} = U_{it} - \hat{\delta}_i U_{et} - a_i \quad (9)$$

$$p_{it} = ln(P_{it}) - \hat{\zeta}_i ln(P_{et}) - a_i \quad (10)$$

With these residuals we can estimate a univariate autoregressive adaptation process that describes the response to a shock for relative employment growth, relative unemployment and labour force participation with the following regressions:

$$\Delta n_{it} = \alpha_{1i} + \alpha_2 \Delta n_{it-1} + \alpha_3 \Delta n_{it-2} + \eta_{it} \qquad (11)$$

$$u_{it} = \alpha_{1i} + \alpha_2 u_{it-1} + \alpha_3 u_{it-2} + v_{it} \qquad (12)$$

$$p_{it} = \alpha_{1i} + \alpha_2 p_{it-1} + \alpha_3 p_{it-2} + \pi_{it} \qquad (13)$$

Here, n_i stands for the logarithm of employment in country/state i minus the β-adjusted logarithm of employment in the EMU (US) and a constant α_i, u_i is the unemployment rate in country/state i minus the β-adjusted unemployment rate in the EMU (US) and a constant α_i, and p_i equals the logarithm of the participation rate in country/state i minus the β-adjusted logarithm of the participation rate in the EMU (US) and a constant α_i (as defined in equations (8), (9) and (10)).

In the last part of this analysis we analyse the joint behaviour of relative employment, relative unemployment rates and relative participation rates in response to labour demand shocks. This allows us to decompose the response to a drop in total employment into the part that is absorbed by a rise in the unemployment rate, the part absorbed by a drop in the participation rate, and the residual that is covered by interregional migration. For this purpose, we estimate the following VAR regressions for both the EMU and the US, between 1983 and 2012:

$$\Delta n_{it} = \lambda_{i10} + \lambda_{11}(L)\Delta n_{it-1} + \lambda_{12}(L)e_{it-1} + \lambda_{13}(L)p_{it-1} + \epsilon_{i\rho t} \qquad (14)$$

$$u_{it} = \lambda_{i20} + \lambda_{21}(L)\Delta n_{it} + \lambda_{22}(L)u_{it-1} + \lambda_{23}(L)p_{it-1} + \epsilon_{i\sigma t} \qquad (15)$$

$$p_{it} = \lambda_{i30} + \lambda_{31}(L)\Delta n_{it} + \lambda_{32}(L)e_{it-1} + \lambda_{33}(L)p_{it-1} + \epsilon_{i\tau t} \qquad (16)$$

Here, n_{it}, u_{it} and p_{it} are the country specific shocks to employment, unemployment rate and participation, defined as in (11), (12) and (13), and L represents the lag operator. We run pooled OLS estimation where we allow for 2 lags for each variable and allow for region-specific fixed effects.

3.2 Data

Data on employment, unemployment rates and labour force participation rates for the EMU countries comes from the OECD Labour Force Survey. We generate a panel of 11 EMU countries[6] with yearly data for the period 1983-2012. For the US we generate a panel of 51 states that is composed of yearly data on employment, unemployment rates and labour force participation rates from the Bureau of Labor Statistics and covers the period 1976-2012. Table 3.2 below shows some descriptive statistics of the data used.

Table 3.2: Descriptive statistics

Country	*Employment (x1000)*		*Unemployment rate*		*Participation rate*	
	1983-2001	*2002-2012*	*1983-2001*	*2002-2012*	*1983-2001*	*2002-2012*
Belgium	3710	4322	9,1	7,8	61,4	66,9
Finland	2325	2458	9,0	8,0	75,4	76,0
France	22025	25255	10,6	8,8	68,2	70,4
Germany	32516	37710	7,4	8,4	69,8	75,8
Greece	3736	4310	8,7	11,7	62,0	68,0
Ireland	1266	1932	12,8	8,1	63,7	71,7
Italy	20880	22764	11,0	8,0	59,8	63,7
Luxembourg	162	205	2,4	4,5	62,0	67,4
Netherlands	6468	8183	7,6	4,2	67,4	77,9
Portugal	4713	5048	5,7	8,9	74,3	78,1
Spain	12980	18454	18,6	14,1	62,7	72,5
EMU	110780	130641	10,3	9,1	65,9	71,5
US	120851996	140887471	6,0	6,7	66,2	65,6

Source: Bruegel, OECD Labour Force Survey and Bureau of Labor Statistics.

[6] We exclude Austria because of a lack of data.

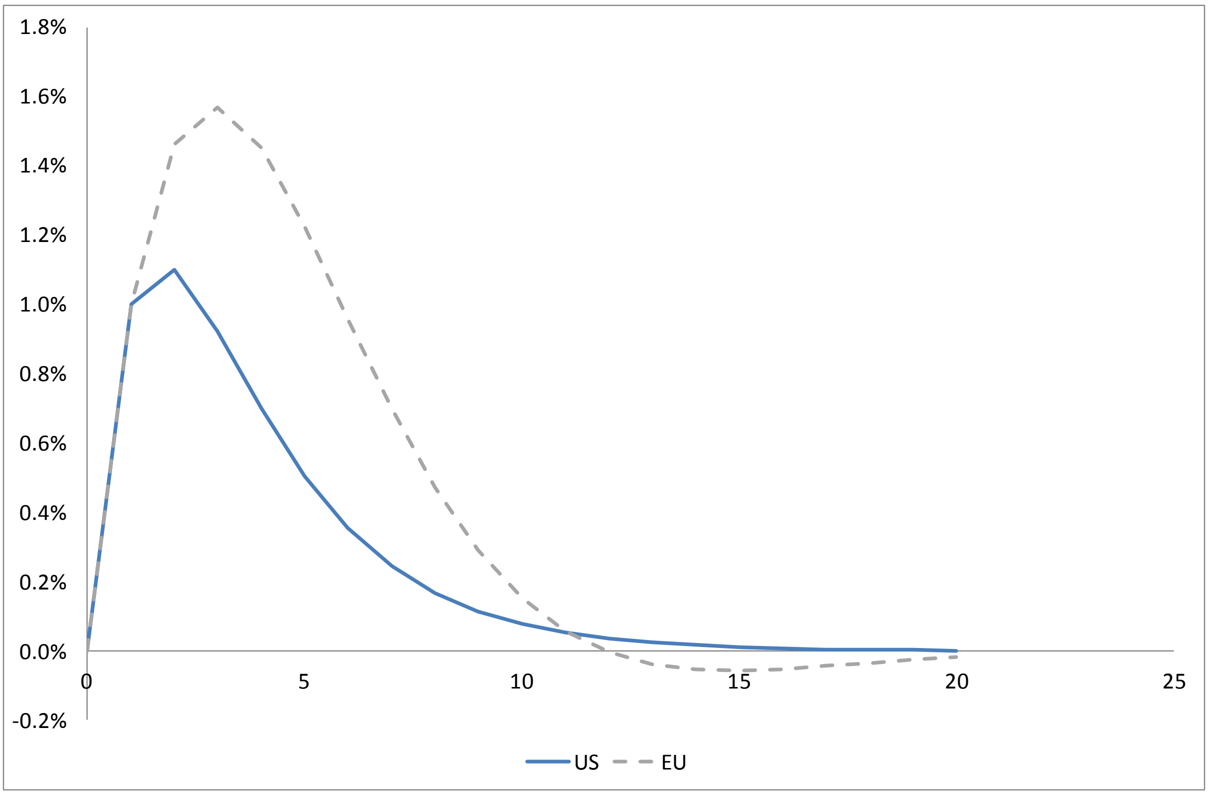
3.3 Results

As is common in the literature, we look at the results of the estimation through the lens of impulse responses: if employment in one region is hit by an unanticipated shock, how does the labour market return to equilibrium? We consider the period 1983-2012, for both the EMU and the US.

We first consider the univariate channels, equations (11), (12) and (13). Results of the estimations for all processes in both regions are presented in Tables 0.5, 0.6 and 0.7 in the Appendix. Let us focus here on the relative unemployment rate, equation (12). After a shock in relative unemployment, unemployment will gradually return to its equilibrium level. How fast does this occur and how do the US estimates compare with those in Europe?

Plugging in the estimates of the time series regression, Table 0.6, we can plot the evolution of unemployment in response to an unanticipated shock in unemployment of 1 percent. The results are shown in Figure 3.2.

Figure 3.2: Response of unemployment: EMU and US 1983-2012



Source: Bruegel, OECD Labour Force Survey and Bureau of Labor Statistics.

From Figure 3.2, we see that the same 1 percent initial shock to unemployment is resolved faster in the US than in the EMU.

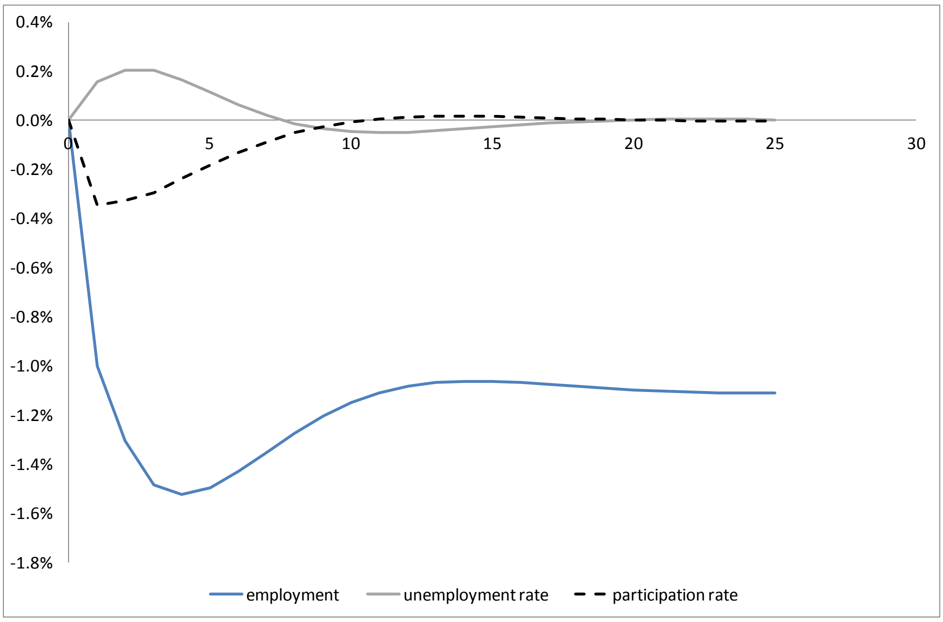
Next, we turn to the joint dynamics of employment, unemployment rates and participation rates. Again, we ask how these variables respond to a sudden deviation of employment in a single country from the joint trend. We investigate the dynamic response of these variables to a sudden 1 percent decline in relative employment. Figures 3.3 and 3.4 show the impulse responses for the EMU and the US, respectively. The graphs are derived from the results in Tables 0.8 and 0.9 in the Appendix.

The short run responses to an identical employment shock in the EMU and the US are fairly similar. In the EMU, a 1 percent shock to the labour demand raises the country relative unemployment rate by 0.16 percentage points and lowers the participation rate by 0.35 percentage points in the first year. So, within the first year of the shock, of every 100 workers that lose their job in the EMU, 16 workers become unemployed, 35 drop out of labour force and 49 workers migrate out of their country. In the US, a 1 percent shock to the labour demand raises the state relative unemployment rate by 0.17 percentage points and lowers the participation rate by 0.42 percentage points in the first year. This means that of every 100 workers that lose their job in the US, 17 workers become unemployed, 42 drop out of labour force and 41 workers migrate out of state within the first year.

In the longer run, equilibrium is restored by a change in the size of the labour force: total employment is permanently affected. This effect is larger for the US, where the relative employment level gradually moves to a long-run value of around -1.44 percent, compared to -1.11 percent in the EMU. As unemployment and participation rates return to their equilibrium paths, the remaining change in relative employment is driven by workers migrating to more prosperous regions.

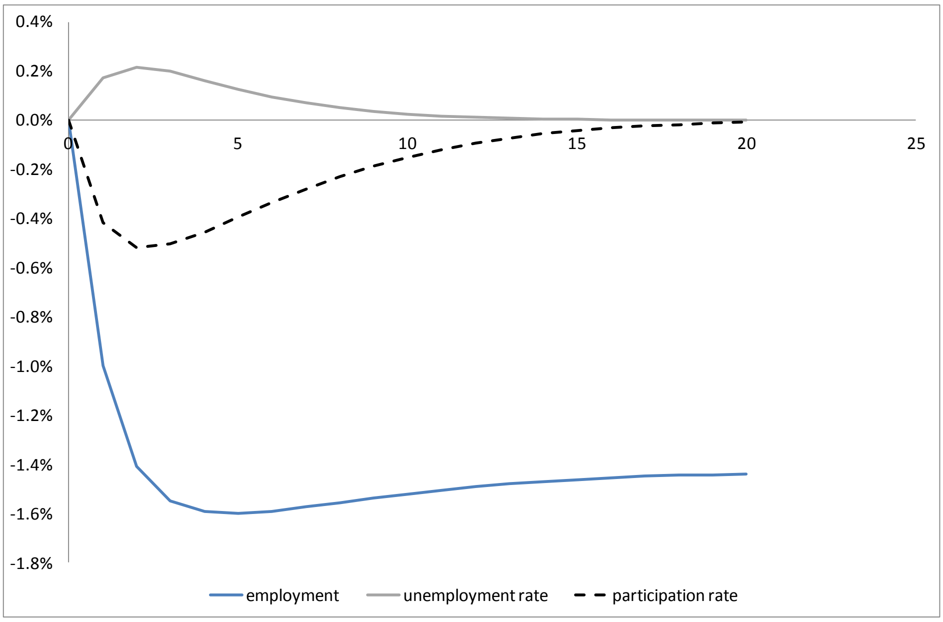
The evolution of the response functions for the EMU and the US are distinct, but there is a marked difference with the original results of Decressin and Fatas. In that study, covering a period until 1987, changes in the participation were the major component in absorbing the shock. In contrast, in the US migration was much more important as an employment shock absorber in that period. In the present study, we see a much less pronounced role for participation rates in meeting shocks in Europe. Migration has become more important, and Europe has started to resemble the US more in this dimension. This confirms the findings in L'Angevin (2007). A difference between Europe and the US that remains, though, is that in the long run, the final effect of migration in the US remains higher than it is in Europe.

Figure 3.3: Impulse response functions for the EMU 1983-2012



Source: Bruegel, OECD Labour Force Survey and Bureau of Labor Statistics.

Figure 3.4: Impulse response functions for the US 1983-2012



Source: Bruegel, OECD Labour Force Survey and Bureau of Labor Statistics.

3.4 Conclusions

We study to what extent interregional migration contributes to the restoration of employment after an idiosyncratic shock. We compare the situation for states in the US and countries in the EU.

The earlier literature (Blanchard and Katz, 1992, Decressin and Fatas, 1995) concluded that in the period up to the late 1980s, interstate migration was a far more important mechanism for labour market adjustment in the US than in the EU. In Europe, on the other hand, changes in labour participation were greater than in the US, with people reducing working hours or withdrawing from the labour market in adverse times.

Subsequent analyses have indicated that migration has increased in importance in the EU since then, and our analysis corroborates that view. Looking at data up to 2012, we find that the US still see larger migration in response to employment shocks than Europe, but the gap has decreased in more recent years.

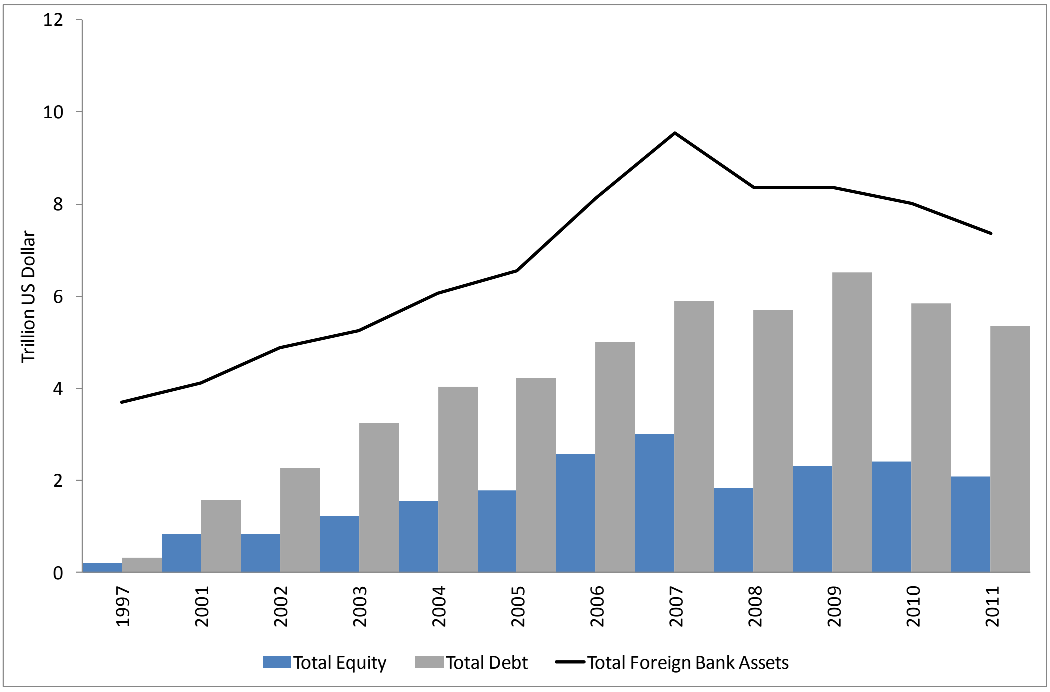
Migration among EMU countries does not necessarily contribute most to the smoothing of employment shocks. Also migration flows from outside the EMU into the EMU countries tend to respond to changing conditions in these countries. Indeed, periphery countries that suffered large shocks in employment recently, see large declines in net immigration rates, even though net immigration remains positive. Changing employment conditions will therefore partly be absorbed by outsiders, moving either to other EMU countries or refraining from entering the EMU altogether.

4. Capital market integration

Financial integration provides a second channel of risk sharing among countries within a union. If assets within a country are partially owned by outsiders, private foreign parties or foreign governments bear part of the changes in values of those assets. In this way, changes in domestic consumption are partially decoupled from changes in domestic output.

Cross-border asset ownership within the EMU has grown strongly since its creation. Figure 4.1 shows the evolution of intra-EMU cross-border holdings of equity and debt since 1997. Data comes from the IMF portfolio statistics. We see that in particular debt[7], but also cross-border equity holdings among EMU countries have grown tremendously.

Figure 4.1: Evolution of intra-EMU total cross-border holdings of equity and debt



Source: IMF CPIS and EMU banks' total foreign assets (BIS), authors' calculations.

Lane (2008) surveys the evidence that the institution of the monetary union itself has contributed to the development of more international debt and equity markets in the EU, including a stronger role for foreign direct investments. Such growth is not unique to the EMU, as global financial market integration has grown as well (see e.g. Santos Silva and Tenreyro, 2010, who compare cross-country portfolio holdings within the EMU with other OECD countries). Nevertheless, growth has been even stronger in the EMU.

[7] Bijlsma and Zwart (2013) show that EU corporate bond markets have grown explosively since the early 2000s.

Banks' foreign assets are an important component of the growth in cross-border holdings. The line in Figure 4.1 measures the size of EU banks' total foreign assets (i.e., including non-EU assets). Clearly, the growth and internationalisation of EMU banks has been a great contributor to sizes of cross-border equity and debt. As Sapir and Wolff (2013) point out, this has occurred mainly through the channel of interbank financing, and not so much through direct credit to consumers in other countries.

Easier access to credit from foreign banks can help in smoothing consumption, through greater opportunities for saving and borrowing. If banks can more easily fund themselves on international capital markets, they do not need to rely only on domestic savings to provide domestic credit. This decoupling of domestic saving and borrowing demands allows firms and households to smooth temporary output shocks.

Even if financial integration itself increases, we cannot automatically conclude that consumption shocks have attenuated as a result. Even leaving aside the risks of the sudden drying up of external debt financing[8], investments in debt are less conducive to cushioning asset shocks than equity is. Equity is fully loss absorbing, while debt only suffers when cash flows dry up sufficiently to endanger debt servicing. In addition, although gross cross-border holdings increase, these may be accompanied by offsetting increases in liabilities, for instance if financial intermediaries finance their foreign credit by issuing foreign debt themselves.

Santos-Silva and Tenreyro (2010) present some evidence that although consumption risk decreased in the direct aftermath of the euro introduction, this decrease in risk was not markedly different from non-EMU countries. The decrease in volatility in this period is of course well-known, as the Great Moderation (e.g., CPB, 2009). Lane (2008) provides some evidence that over longer periods, consumption risk sharing has not significantly increased as a result of the introduction of the euro.

A systematic way of decomposing the channels through which GDP shocks feed through into consumption risk has been provided by Asdrubali et al (1996). They disentangle, for US states, how relative changes in GDP are reflected in changes in interstate capital positions, in (fiscal) transfers among regions, borrowing and saving, and in consumption itself. For the US, Asdrubali et al (1996) find

[8] The growth of external credit can also have adverse consequences, as has been highlighted in the recent crisis. The EMU crisis has been preceded by a huge build-up of credit to both private and public sectors (see e.g. Lane, 2012). For a large part this credit was invested in non-productive assets, as witnessed by the real estate booms in, e.g., Ireland and Spain. When adversity hits, the dependence on external debt exposes countries to sudden stops in refinancing, worsening rather than insuring against shocks. During the "Great retrenchment" (Milesi-Ferretti and Tille, 2013), foreign creditors pulled back short term credit from financial intermediaries, inducing forced liquidations that had add-on effects on GDP for these countries.

a strong role for capital markets in cushioning individual state shocks: 40 percent of shocks are smoothed through capital markets, while credit markets (borrowing and saving) smooth another quarter of the shocks. Only a quarter of output shocks directly manifests itself in changes in consumption.

Subsequent research has explored the model for other regions, including the EU and the EMU (see also IMF, 2013, for an overview of results for various regions). Afonso and Furceri (2008) look at the EMU up to 2005 and find that a much larger proportion (over 60 percent) of output shocks has gone unsmoothed. Capital markets play much less of a role in the EMU than in the US, although their importance in smoothing consumption shocks has increased in the later part of their sample. Balli and Sorensen (2007) find similar results for the period up to 2003. The higher fraction of unsmoothed shocks is mostly a result of the lower smoothing through credit markets, in particular due to lower pro-cyclical saving by governments, rather than the private sector (Balli and Sorensen, 2007).

Quite recent contributions to this literature are Furceri and Zdzienicka (2013) and Kalemli-Ozcan et al (2014). These studies include the years up to 2010, for the EU and EMU. This means that these studies capture the start of the financial crisis and the sovereign debt crisis. Both studies indicate that in these crisis years, smoothing decreased. In particular, the increase of capital market smoothing documented in earlier work is found to reverse in the latest years, with lower or even negative smoothing through these channels during the crisis.

In the following, we carry out an analysis along these lines for the EMU, using data up to 2012.

4.1 Method

We decompose GDP into net national income (NI), disposable national income (DNI) and total private and public consumption (C+G). To quantify the amount of risk sharing among countries/states we distinguish three different channels through which smoothing of temporary shocks to GDP takes place. First, members of a country/state can share risk via cross-ownership of productive assets on capital markets (capital markets), which can be taken to equal the difference between GDP and NI. Second, the tax transfer system of the national government can further smooth income (fiscal transfers), which can be taken to equal the difference between NI and DNI. Third, consumption can be adjusted through lending and borrowing on credit markets (total saving), which can be taken to equal the difference between DNI and C+G.

We follow Asdrubali et al (1996) in decomposing country-specific shocks to GDP using the following "accounting identity":

$$GDP_{it} = \frac{GDP_{it}}{NI_{it}} \cdot \frac{NI_{it}}{DNI_{it}} \cdot \frac{DNI_{it}}{(C+G)_{it}} \cdot (C+G)_{it} \qquad (17)$$

Here, i denotes the country/state and t denotes year. If a country's GDP decreases in a specific year, this shock can be absorbed in different ways. One possibility is that total consumption, C+G, drops by the same percentage. The output shock is then completely unsmoothed. Alternatively, the ratio of disposable income to consumption decreases, signifying that consumers smooth part of the shock by lowering their saving. If national income, NI, drops faster than disposable income, DNI, this implies a change in the proportion of fiscal transfers. The second factor on the right-hand side captures such changes. The first factor represents the capital market channel: if GDP drops but national income decreases by a lower proportion, part of the output shock will be borne by foreign owners of productive assets.

To formalise these ideas, as in Asdrubali et al we take logs and first differences in (17) and multiply both sides by ΔlnGDP:

$$\begin{aligned} var\{\Delta lnGDP\} &= cov\{\Delta lnGDP, \Delta lnGDP - \Delta lnNI\} \\ &+ cov\{\Delta lnGDP, \Delta lnNI - \Delta lnDNI\} \\ &+ cov\{\Delta lnGDP, \Delta lnDNI - \Delta lnC\} \\ &+ cov\{\Delta lnGDP, \Delta lnC\} \qquad (18) \end{aligned}$$

Each of these covariances measures one of the shock absorption channels mentioned above. To estimate them, we run the following panel regressions:

$$\Delta lnGDP_{i,t} - \Delta lnNI_{i,t} = \alpha_t^c + \beta^c \Delta lnGDP_{i,t} + \varepsilon_{i,t}^c \qquad (19)$$

$$\Delta lnNI_{i,t} - \Delta lnDNI_{i,t} = \alpha_t^f + \beta^f \Delta lnGDP_{i,t} + \varepsilon_{i,t}^f \qquad (20)$$

$$\Delta lnDNI_{i,t} - \Delta ln(C+G)_{i,t} = \alpha_t^s + \beta^s \Delta lnGDP_{i,t} + \varepsilon_{i,t}^s \qquad (21)$$

$$\Delta ln(C+G)_{i,t} = \alpha_t^u + \beta^u \Delta lnGDP_{i,t} + \varepsilon_{i,t}^u \qquad (22)$$

where α_t are time fixed-effects, β^c is the estimate that measures the fraction of the shock that is smoothed by capital markets, β^f is the amount smoothed by fiscal transfers, β^s is the part smoothed by consumption and finally, β^u is the fraction of the shock that remains unsmoothed. Of course, since the total output shocks should be reflected in the sum of all four components, we should have

$$\beta^c + \beta^f + \beta^s + \beta^u = 1 \qquad (23)$$

If β^u = 0 there is full risk-sharing and the coefficients β^c, β^f and β^s sum up to 1. Moreover, the coefficients have no constraints which means that they can be either larger than 1 or negative if there is dis-smoothing. With time fixed effects we control for year-specific impacts on growth rates. Furthermore, we allow for autocorrelation in the residuals, as in Asdrubali et al (1996).

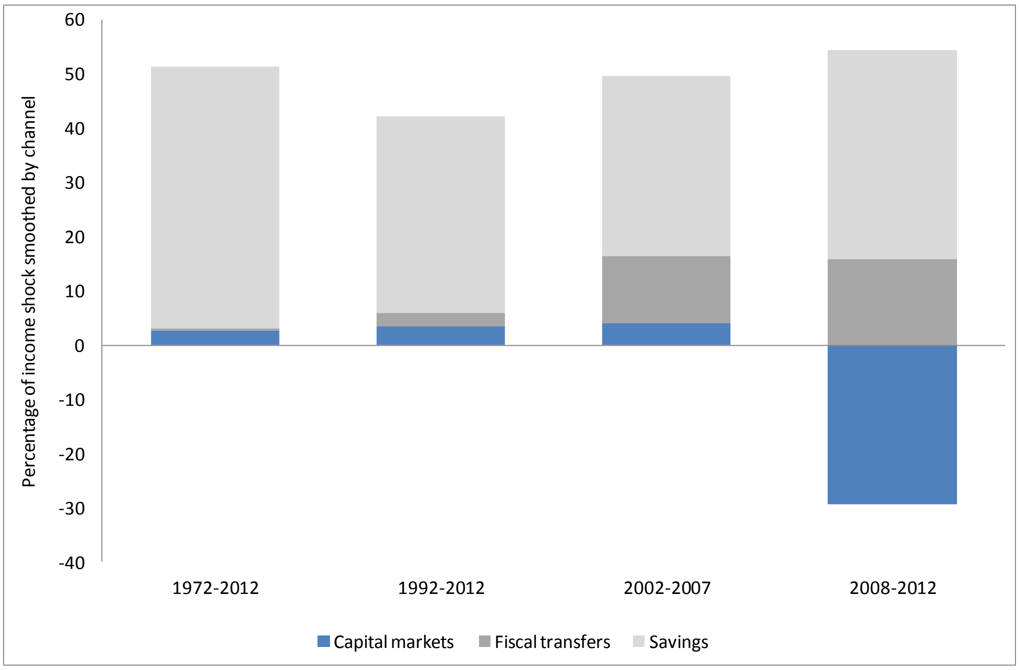
4.2 Data

Data for EMU countries are derived from the annual macro-economic database (AMECO). We generate a panel of 12 EMU countries with yearly data on income and other related aggregates for the period 1972-2012. For income we use gross domestic product (GDP) expressed in 2005 euros. As a measure of net national income (NI) we use national income at current market prices, which is the difference between gross national income and consumption of fixed capital. For disposable national income (DNI) we use national disposable income at current market prices which equals gross national disposable income minus consumption of fixed capital. As an indicator for consumption we use total consumption at current prices, which is the sum of final private consumption expenditure and final general government consumption expenditure. We use a price deflator to convert all variables into 2005 euros.

4.3 Results

Figure 4.2 gives an overview of the contribution of the different channels in the smoothing process for four different sub-periods in the EMU. For more detailed results see Table 0.10 in the Appendix. We find that the percentage of the shocks to GDP in the EMU that is not smoothed by the three channels is large and increases considerably over time, from 49 percent in the entire period 1972-2012 to 76 percent in the crisis years 2008-2012. The only smoothing channel that is statistically significantly different from zero over the entire time period seems to be savings.

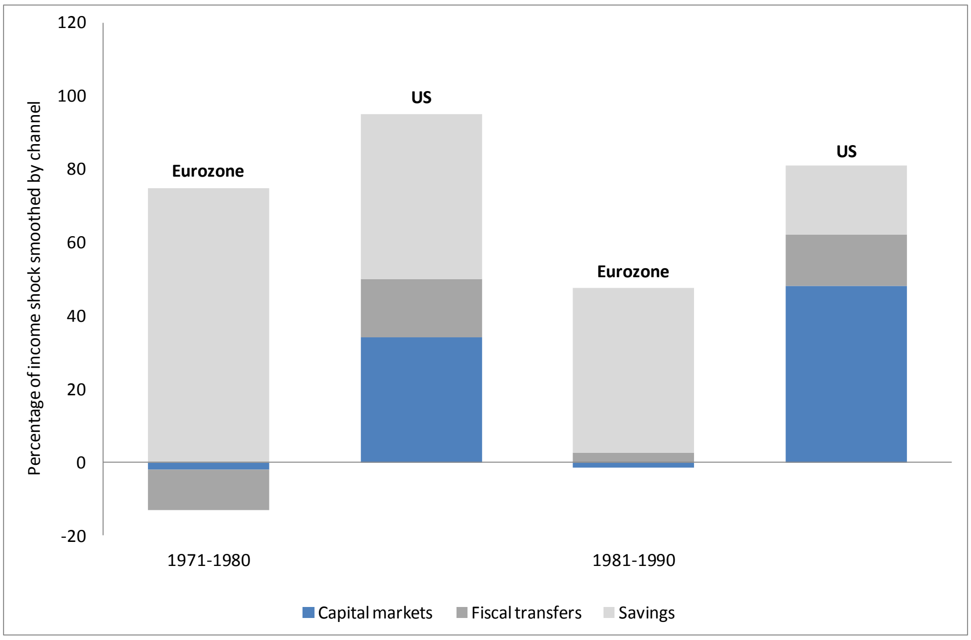
Figure 4.2: Development income smoothing process EMU over time



Source: AMECO, author calculations.

The part insured by this channel decreased until the start of the crisis, but savings became more important again during the crisis where they absorb around 39 percent of the shocks among EMU countries. Furthermore, the capital market channel does not significantly contribute to the absorption of shocks in the EMU, which could be explained by the high bias towards domestic assets (Wolff, 2012) in the EU. It is apparent that the home bias has come down in recent years and that capital markets in the EMU have been given an increasingly important role until the crisis (in line with Balli and Sorensen, 2003). Since the crisis, however, the effect of the capital market channel has been dis-smoothing. This is in line with recent research by Furceri and Zdzienicka (2013) (see also IMF, 2013a), who find negative smoothing in periods of financial crises of similar magnitude. Part of this dis-smoothing is explained by the role of capital depreciation, which tends to be negative as depreciation itself does not immediately decrease when GDP does (see e.g. Kalemli-Ozcan, 2013). But also foreign factor income contributes negatively in this period, as Furceri and Zdzienicka (2013) show. Kalemli-Ozcan et al (2014) look into this effect in more detail and demonstrate that the negative contributions occur mainly in 2010 (the last year in their panel), and in particular for the periphery countries. They explain the negative contribution in terms of increased interest payments on debt for these countries. Finally, the smoothing by fiscal transfers appears to have increased over the past decades but this effect is not statistically significant.

Figure 4.3: Comparison percentage of income smoothed by channel EMU and US



Source: AMECO, Asdrubali (1996), author calculations.

From the literature we know that the different channels in the EMU and the US operate in a different way. This is confirmed in Figure 4.3, in which we compare our results for the EMU with the results in Asdrubali (1996) for the US[9]. While capital markets in the EMU only started to get a more important role over the past two decades, in the US they have played a significant part in the smoothing process for a much longer time. Also savings have a significant effect on income smoothing in the US, though the role of this channel is smaller than in the EMU and got less important during the 1980s, when there was a shift away from savings into capital markets. Finally, there is a difference in the operation of the fiscal transfers channel. While fiscal transfers smooth 14 till 16 percent of the income shocks in the US, there was federal government dis-smoothing in the 1970s and an insignificant effect in the 1980s in the EMU.

4.4 Conclusion

We analysed the various channels of risk sharing among EMU countries, using the methodology of Asdrubali et al (1996). We estimated what fraction of GDP shocks remains unsmoothed, and hence translates directly into shocks in consumption, and what fractions are smoothed through cross-border ownership (capital market integration), fiscal transfers among countries, and credit markets.

[9] Because of a lack of data on consumption per state we have not updated the analysis on the US.

Judging by cross-border debt and equity ownership statistics, capital markets in the EMU have become much more integrated since the introduction of the euro. However, the role of this cross-border ownership in insuring country-specific output shocks in the EMU is still weak compared to the US, where it is one of the most important channels of insurance. In fact, and consistent with other recent analyses, this role has again decreased during the recent crises.

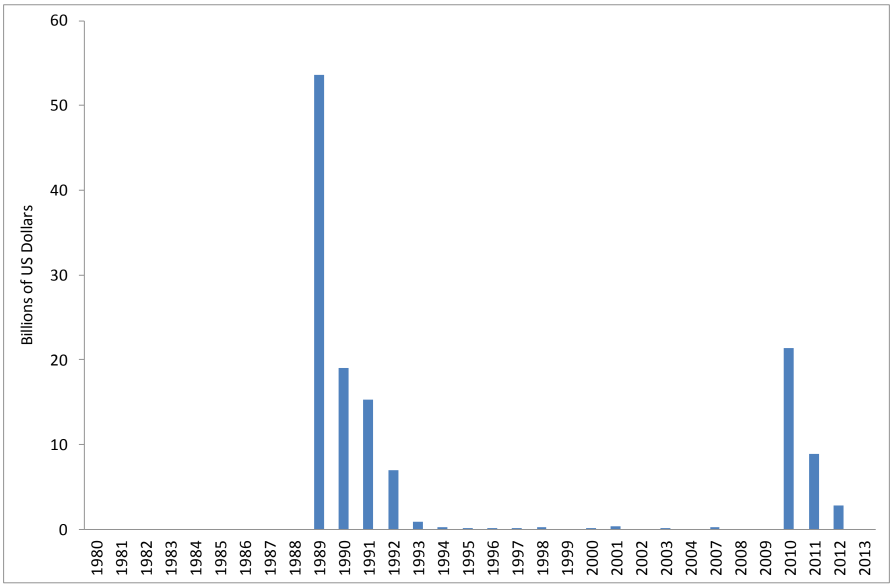
Among the different channels, only credit markets play a large role in smoothing output shocks, although the size of risk sharing through this channel has declined over time. Consequently, the fraction of shocks that goes unsmoothed in the EMU remains large compared to the US, and has increased over time.

5. Risk sharing through a common safety net for banks

Since the financial crisis, EMU institutional arrangements have undergone drastic changes. Plans have been developed to strengthen the safety net for banks, through a combination of private creditors' bail-in, national safety nets[10] and as a backstop the possibility for indirect or direct recapitalisation by the ESM. The latter is a potential source of transfers between governments.

In the US, an in some ways similar form of burden sharing exists in the form of the Federal Deposit Insurance Company (FDIC), which covers all deposit accounts up to an amount of $250,000 per depositor, per insured bank. Figure 5.1 below shows the losses incurred by the FDIC and its predecessors since 1980. The total amount of estimated losses incurred by the FDIC in the period 2007-2013 was $33.2 billion, while the total size of bank assets involved in FDIC restructuring amounted to $1,869 billion.

Figure 5.4: FDIC losses since 1980



Source: FDIC, author calculations.

Although it is instructive to compare the FDIC with the safety net created in the EMU, a number of caveats apply. The FDIC has immediate access to a $100 billion line of credit at the Treasury that, under federal law, can be expanded to $500 billion. In addition, the banking structure in the US is different from that in Europe. European banks are more locally oriented and hold more securities issued by their own governments than US banks (Pisani-Ferry and Wolff, 2012).

[10] The national resolution fund is part of the Bank Resolution and Recovery Directive (BRRD).

To assess the potential extent of burden sharing that results from the proposed safety net in case of a banking crisis, we use a simulation method that has the following inputs: a distribution of shocks that hits banks in case of a banking crisis, assumptions concerning the impact of a shock on a particular bank given its characteristics and assumptions concerning the institutional details of the setup of the safety net. We are not aware of any empirical literature that undertakes a similar analysis. One somewhat related study by Bénassy-Quéréy and Roussellet (2013) aims to include the costs of implicit liabilities due to the banking sector in an analysis of the sustainability of government finances by combining an estimate of the frequency of crises with an estimate of government exposure to bank liabilities.

Our analysis is limited in several important ways. First, one could go much further in modeling each of the steps in our simulation. Literature on stress testing exists, that generates shocks by estimating, for example, VaR regressions with macro-economic variables over multiple countries, see e.g. IMF (2011). Also, one could go into much more detail in analyzing the impact of a shock given bank-specific characteristics and relate macroeconomic shocks to their impact on banks. This would require a much more detailed analysis using e.g. different risk factors, detailed estimates of the probability of default (PD) and loss given default (LGD) of the loans on bank balance sheets. One could also try to model the propagation of shocks from one bank to another, something we abstract from here.

The second important caveat relates to the uncertainty that surrounds the exact design of inter-country risk sharing through this mechanism. Creditor bail-in looks good on paper, but may not be credible if it triggers a run on a systemic bank or leads to contagion, even though some institutional features may enhance credibility.[11] Also, funds from the ESM can only be obtained if a country enters a program, and if countries are unable to shoulder the costs of recapitalising banks themselves. The probability of countries being unable to shoulder the cost of recapitalisation is very difficult to assess.

Third, bail-in of shareholders and creditors also results in risk sharing between countries to the extent that such financial titles are held by foreign financiers. As a result of bail-in, foreign private financiers of banks will share in the cost of banking failures. We do not analyze the amount of risk sharing resulting from this mechanism, as there is little information on the exact distribution of bank debt, while this distribution is also highly endogenous.

Because of these limitations, we only take a very partial first step in quantifying the extent of risk sharing resulting from having a common safety net for banks. We implement a simple analysis, which we think can provide some indication as to the size of the numbers involved.

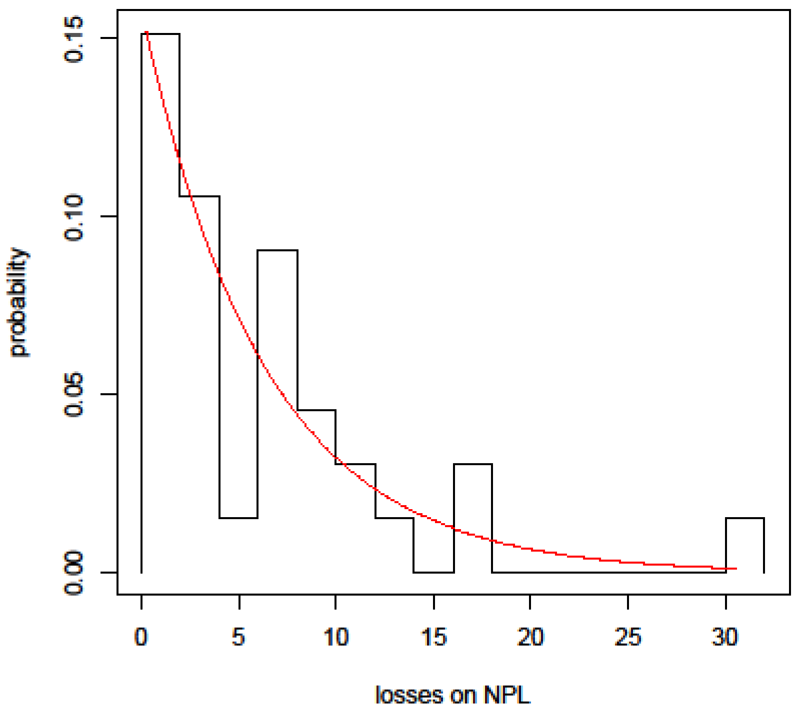
[11] Funds from the resolution fund are only available after 5% bail-in, while the BRRD prescribes that government support is only possible after bail-in of senior debt.

5.1 Method

For the simulation of shocks received by banks, we use a simple parametric distribution for the shocks hitting the assets side of banks' balance sheets. We consider two extreme situations. First, all banks are hit by an idiosyncratic shock, i.e., the shocks different banks receive are uncorrelated. Second, all banks are hit by perfectly correlated shocks.

In both cases the shocks are drawn from the same exponential distribution, which we calibrate to match that of the distribution of non-performing loan ratios in banking crises in OECD countries, as found in Laeven and Valencia (2012). The mean of the distribution is 12.8 percent with a standard deviation of 12.6 percent. We fit an exponential distribution to the empirical distribution of Laeven and Valencia (2012), this gives a decay rate of 0.079. To translate a shock to a banks' balance sheet into losses, the non-performing loan ratio should be adjusted for loss given default. We use the estimate of Schuermann (2004) of the mean loss given default on senior secured debt in the US over 1970-2003, which was on the order of 50 percent. Thus, in our simulations, banks will receive on average a shock with a mean of 6.4 percent and a standard deviation of 6.3 percent. In our sample of banks, which includes roughly $26,450 billion of assets in total, this implies that we will study an expected shock to the banking system amounting to roughly $1,694 billion in losses.

Figure 5.5: Histogram of the non-performing loan ratio during banking crises in OECD countries in the period 1970-2011 with exponential fit



Source: Laeven and Valencia (2012), author calculations.

To assess the distribution of these losses over shareholders, debt holders, national resolution funds, national governments and the ESM, we adhere to the current Bank Recovery and Resolution Directive (BRRD) of the European Commission, which has the following characteristics.

Writing down the claims of existing shareholders and creditors of the beneficiary institution will be the first solution in case of a shock. This includes an appropriate level of write-down or conversion of debt. If the banks' risk-weighted capital falls below the required minimum after the shock, equity and debt holders will be required to contribute up to 8 percent of liabilities to restore equity to its minimum level. Next in line is the resolution fund[12], with a contribution that is capped at 5 percent of a beneficiary institution's total liabilities. After that, bail-in of debtors up to and including senior debt holders has to take place.

[12] These national resolution funds will merge into the European resolution fund, part of the Single Resolution Mechanism (SRM), over a period of ten years.

Member states also agreed on an operational framework for using the ESM as a fiscal backstop for banking resolution that can only be tapped into after these aforementioned forms of recapitalisation are insufficient.[13] Direct recapitalisation by the ESM will only be possible if the sovereign concerned is in an ESM program. Also, the sovereign must provide co-financing according to the burden sharing scheme which has been agreed between the sovereign and the ESM, where the Member State contributes either via a capital injection to reach the legally required minimum CET1-ratio or via a part of the capital injection of the ESM when the minimum CET1-ratio has already been reached.[14]

Given a negative shock to bank assets and the institutional characteristics described above, we will allocate losses in the following stylised way, where we assume that any capital shortfall will have to be replenished to the old level, and that this cannot be done through the capital market.

We consider two scenarios. In the first scenario ('full bail-in'), in our simulation we first write down the equity holders' claims. If there is still a shortfall in capital, we then write down subordinated debt.[15] In case more capital is needed after that, we allocate 5 percent to the national resolution fund. If there is still a capital shortfall left, we write down the following liabilities: senior debt with a maturity of over one year, trading liabilities, and the category other liabilities, which often contains unsecured items that can potentially be bailed-in. The amount that remains is what is potentially liable for financing by other EU member states and is the number that we are interested in.

In our second scenario ('partial bail-in'), we first hit the equity holders and then we hit subordinated debt. After that, we allocate 5 percent to the national resolution fund. If there is still a capital shortfall left, we write down 50 percent of the following liabilities: senior debt with a maturity of over one year, trading liabilities and the category other liabilities, which often contains unsecured items that can potentially be bailed-in. Again, the output of the simulation is the amount that still remains to be covered after these steps.

[13] ESM recap money will not be available before the BRRD and the revised Deposit Guarantee Scheme Directive have been finalised. It will only be provided to systemically important banks that cannot raise private capital, but do have a viable plan for returning to health.

[14] This burden-sharing scheme determines the contributions of the requesting ESM member and the ESM, respectively. The scheme has two parts. First, if the bank has insufficient equity to reach a Common Equity Tier 1 (CET1) ratio of 4.5 percent in a stress scenario, the requesting ESM member will be required to make a capital-injection to reach a CET1 ratio of 4.5 percent before the ESM enters. Second, if this ratio is reached, the national government of the bank involved will be required to make a capital contribution alongside the ESM equal to 20 percent of the ESM contribution in the first two years after the entry into force of the instrument and to 10 percent in the years after that initial period.

[15] The national resolution fund can in principle only step in after 8 percent of liabilities has been bailed in. This does not fully correspond to what we do here. However, we (1) do not see how it is possible to bail in only part of senior debt and (2) this only makes a difference in a small number of cases.

As we also consider either fully correlated or fully uncorrelated shocks, we have in total four scenarios. In all scenarios a sum will remain that has to be borne by the national government, or will be shared with the other member states. The extent to which this burden will be shared with the other member states depends on the ability of the national government to bear the additional burden. Therefore, we will not make statements as to how this remaining capital shortfall is distributed among the EMU countries.

5.2 Data

We use balance sheet data for the year 2011 and make the following selection of 16 countries - Austria, Belgium, Cyprus, German, Estonia, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, and Slovenia.[16] In addition, we select per country banks that are included in the Asset Quality Review (AQR) as well as banks that have a rating from Moody's. This results in 133 banks in total. From the balance sheets of banks in our sample we use equity, the CET1-ratio, and total liabilities. Table 5.1 on the next page shows per country: the number of banks in our sample, the average amount of equity in billions of USD, the leverage ratio, and the ratio to total assets of subordinated debt; trading liabilities; other liabilities; other deferred liabilities; senior debt with maturity greater than one year, and senior uncovered debt. We calculate risk-weighted assets by combining information on total equity, tier 1 regulatory capital ratio, and total assets. For some banks, tier 1 regulatory capital ratio is missing. We assign these banks the average tier 1 regulatory capital ratio in their country sample.

[16] Banks balance sheets will have changed since 2011. However, we expect these changes to be limited relative to total bank assets, while the shocks we are considering are large relative to banks' equity levels.

Table 5.1: Balance sheet characteristics of banks in the sample

CID	N	Av Bank Equity (bn $)	Leverage Ratio	Sub Debt Ratio	Trading Liabilities Ratio	Other Liabilities	Other Deferred Liabities	Senior Debt Maturity greater than 1 yr	Senior Uncovered Deb to Assets
AT	9	4,84	0,05	0,02	0,02	0,02	0,00	0,21	0,24
BE	6	3,13	0,03	0,01	0,02	0,02	-	0,09	0,12
CY	3	0,41	0,04	0,02	0,01	0,01	0,00	0,01	0,02
DE	25	9,53	0,04	0,02	0,02	0,02	0,00	0,23	0,27
EE	1	0,63	0,15	0,01	0,01	0,01	-	-	0,03
ES	19	11,11	0,06	0,02	0,01	0,01	-	0,12	0,15
FI	4	4,15	0,05	0,02	0,04	0,04	-	0,16	0,24
FR	12	19,22	0,04	0,01	0,11	0,11	0,00	0,23	0,46
GR	5	0,58-	0,00-	0,03	0,06	0,09	0,00	0,17	0,33
IE	6	7,34	0,07	0,01	0,01	0,01	0,00	0,12	0,14
IT	14	10,70	0,07	0,03	0,02	0,02	-	0,28	0,32
LU	6	1,38	0,12	0,02	0,01	0,01	0,00	0,07	0,09
MT	2	0,42	0,07	0,02	0,01	0,01	0,01	0,01	0,04
NL	8	11,53	0,03	0,01	0,02	0,02	-	0,31	0,34
PT	6	3,04	0,05	0,01	0,02	0,02	0,00	0,11	0,15
SI	4	0,50	0,07	0,02	0,01	0,01	-	0,19	0,20
SK	3	1,04	0,10	0,02	0,01	0,01	0,00	0,09	0,10

Source: author calculations.

5.3 Results

Here we present results per country of our simulation analysis, where we average over 1,000 simulated banking crises.[17] We consider two cases: idiosyncratic banking shocks (i.e., fully uncorrelated shocks) and pure EMU shocks (i.e., fully correlated shocks). First, we show how the expected costs of a banking crisis are distributed across countries and across equity holders, debtors, the national resolution fund and the national government and possibly the ESM. We only show the expected cost for a pure banking shock, because the type of the shock (pure banking or pure EMU) does not affect the average expected shock, while the effect on who bears what part of the total shock also turns out to be limited.

In aggregate, when a banking crisis occurs, with these parameters and our exponential probability distribution of banking shocks, the remaining shock in the scenario with full bail-in and idiosyncratic banking shocks is $31.7 billion. The total shock to the banking system amounts to roughly $1,678 billion. Table 5.2 below shows the remaining required contributions under the four scenarios, after various categories have been bailed-in.

[17] If a crisis arises roughly every twenty years, this corresponds to averaging over a very long time-period.

Table 5.2: Remaining shock (billion dollars)

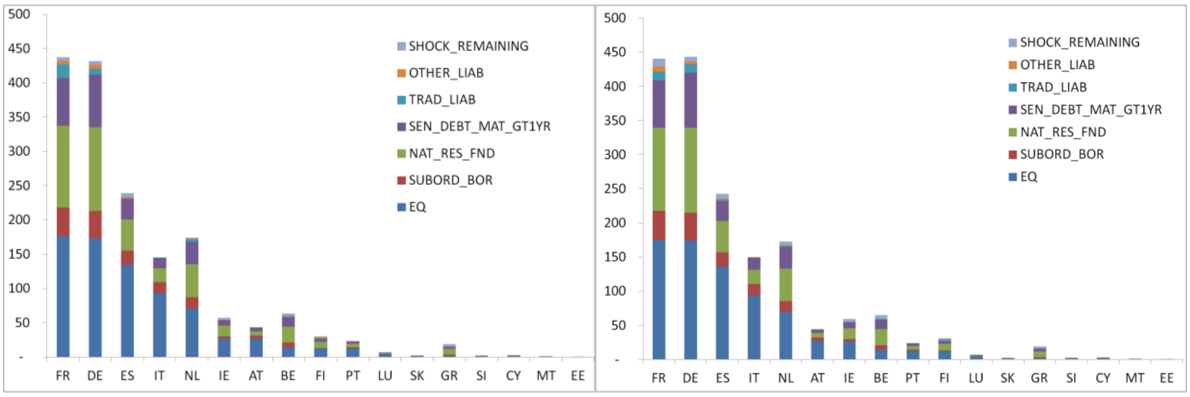
	Full bail-in	Partial bail-in
Idiosyncratic banking shock	31.7	137.3
Pure EMU shock	44.7	153.2

Source: author calculations.

For comparison, the losses borne by the FDIC in the period 2007-2013 amounted to $33.2 billion. Note, however, that the EU banking system is roughly 4.5 times the size of the US banking system in 2011 (see Table B.17 in Bijlsma and Zwart, 2012), scaling FDIC losses by this amount results in $149.8 billion. This is of the same order of magnitude as the remaining losses under the partial bail-in with idiosyncratic bank-shocks or pure EMU shocks.

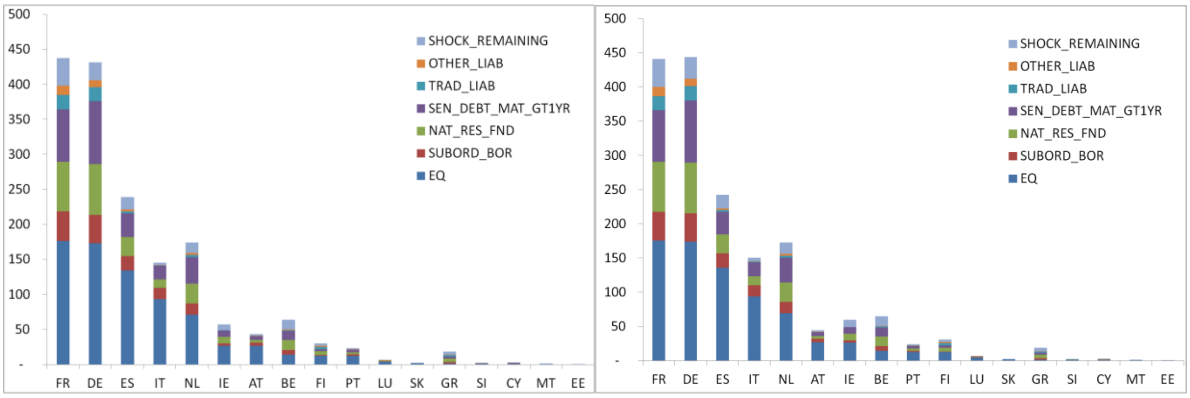
Figures 5.3 and 5.4 below show the distribution of the expected shock over the various categories. It is clear from this figure that equity holders will bear the largest burden under the proposed rules, while national resolution funds also contribute substantially.

Figure 5.6: Fully uncorrelated (L) and fully correlated shock (R) - full bail-in



Source: author calculations.

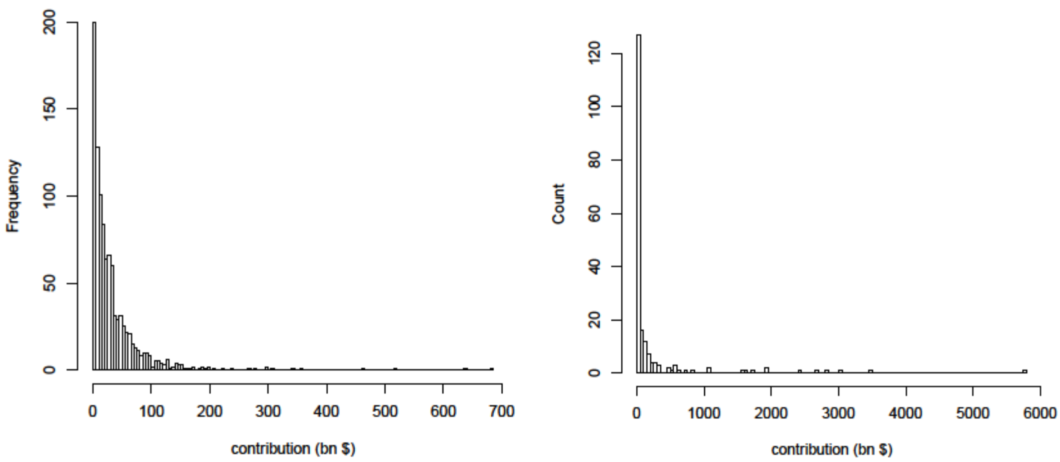
Figure 5.7: Fully uncorrelated (L) and fully correlated shock (R) - partial bail-in



Source: author calculations.

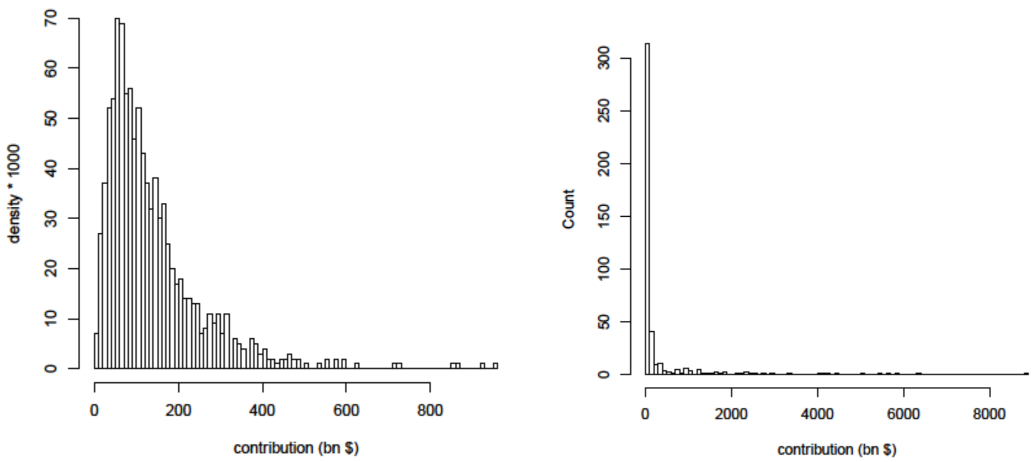
Simulations show that the correlation coefficients of the various components of the shock hardly affect the expected contribution through the resolution. This result arises because shocks are uncorrelated over time and diversification over time (i.e., between different simulations) has roughly the same effect as diversification over banks. What does change substantially upon changing correlations, however, is the shape and variance of the expected contribution. The two graphs in Figure 5.5 below show the probability distribution for the two cases under consideration. Note the different scaling of the axes. In the case of a pure banking shock, we have fewer extremes but we get a positive contribution by the resolution fund more frequently. In the case of a pure EMU shock, positive contributions occur less frequently, but extremes are larger.

Figure 5.8: Fully uncorrelated (L) and fully correlated shock (R) - full bail-in



Source: author calculations.

Figure 5.9: Fully uncorrelated (L) and fully correlated shock (R) - partial bail-in



Source: author calculations.

5.4 Conclusions

We presented a simple simulation analysis of risk sharing through the banking union. An important caveat is that results depend on assumptions made with respect to the size and cross-bank cross-country correlation of the shocks received by individual banks. We also do not include a potentially important source of risk sharing that results because bail-in of foreign shareholders and creditors. With this in mind, we draw the following conclusions.

First, requiring private entities to carry more of the burden will reduce the risk borne by the taxpayer. In the current set-up of the banking union the private sector absorbs by far the largest part of shocks. This also implies that the risk borne by the taxpayer depends strongly on how credible bail-in is.

Second, if bail-in is credible, the expected level of the remaining shock (the maximum potential amount of risk sharing) is relatively small, $31.7 billion to $44.7 billion for the EMU as a whole in an average crisis with full bail-in, depending on how correlated the shock is. This may sound like a lot, but amounts to roughly 0.2 percent of EU GDP. Also, governments will have to bear these costs themselves if they are able to, which will limit risk sharing. If liabilities that can potentially be bailed-in are only used up to 50 percent, for example because full bail-in is not always credible, the expected level of the remaining shock increases, and roughly equals the level of risk sharing in the US through FDIC.

Finally and importantly, although on average the amount of sharing across countries is small, our simulations show there may be crises in which contributions are quite sizeable. The probability of this happening depends strongly on how shocks are correlated. For example, in a pure EMU shock, the remaining shock may involve over $5,000 billion in roughly five out of one thousand crises. When shocks to banks are idiosyncratic, such extreme events never happen due to risk sharing.

6. Discussion

When countries join a currency union, they give up independent monetary policy. This implies that those countries cannot use such monetary policy anymore to recover from country specific downturns. Instead, they have to find other channels to insure against such economic shocks. One channel of insurance involves risk sharing with partner countries in the currency union.

We survey the evolution of risk sharing among countries within the EMU, and compare with earlier literature and with risk sharing among states in the US. We find that, although country specific shocks did decrease in the intermediate aftermath of the creation of the euro, since the financial crisis new divergence has emerged between business cycles in various regions in the EMU. Asymmetries of GDP shocks between US states and EU countries are of a similar magnitude, but asymmetries in inflation rates are wider among the EU countries.

Countries can mitigate the impact of such economic downturns on consumption if their labour force can easily adjust to shocks by migrating to other, more thriving countries. Another channel of insurance is provided by openness of capital markets, which makes economic shocks to be borne in part by foreign investors. And finally, shocks can be insured by other countries through explicit transfers. Fiscal cooperation in stabilising the banking system can be one example of such fiscal channels.

Migration among EU countries has traditionally been a less important channel than in the US. We find that the situation has improved since earlier studies, but levels of migration in response to labour market shocks are still less developed than in the US.

Financial integration among euro-area countries has increased enormously since 2000. In part, this has occurred through growth of banks' foreign assets and liabilities, in particular through the interbank market. If we look at the effect of capital market integration on the sharing of risk, this appeared to improve over the first years after the euro, although it remained a much less important channel of insurance than in the US. Since the financial crisis, capital markets have not been effective at sharing risks among euro-area countries.

The current movement towards the Single Supervisory Mechanism (SSM) in banking may not only transfer risk from tax-payers to private bank shareholders and debt holders, leading to cross-border insurance if these parties are non-domestic. It can also give rise to stronger fiscal insurance among countries. A preliminary analysis shows that in expectation the money flows among countries for bank restructuring will be modest. Depending on the correlations among bank crises, however, larger contributions may occur with low probability.

References

Afonso, A., and D. Furceri (2008) 'EMU enlargement, stabilisation costs and insurance mechanisms', Journal of International Money and Finance, 27(2), 169-187

Ahearne, A., H. Brucker, Z. Darvas, J. von Weiszacker (2009) 'Cyclical dimensions of labour mobility after EU enlargement', Working Paper 2009/03, Bruegel

Alesina A, and R.J. Barro (2002) 'Currency Unions', Quarterly Journal of Economics, 117(2), 409-436

Alesina A., R.J. Barro and S. Tenreyro (2002) 'Optimal currency areas', in NBER Macroeconomics Annual 17

Asdrubali, P., B.E. Sorensen, and O. Yosha (1996) 'Channels of interstate risk sharing: United States 1963–1990', The Quarterly Journal of Economics, 111(4), 1081-1110

Balli, F., and B.E. Sorensen (2007) 'Risk sharing among OECD and EU countries: The role of capital gains, capital income, transfers, and saving', MPRA Working Paper 10223

Barro R. and S. Tenreyro (2007) 'Economic effects of currency unions', Economic Inquiry 45

Bayoumi T. and B. Eichengreen (1993) 'Shocking aspects of European economic unification' in Adjustment and Growth in the European Monetary Union (ed) F Torres, F Giavazzi, pp193-229, Cambridge: Cambridge University Press

Bénassy-Quéréy, Agnès, and Guillaume Roussellet (2013) 'Fiscal Sustainability in the Presence of Systemic Banks: the Case of EU Countries', International Tax and Public Finance, pp 1-32

Bijlsma, M.J. and Zwart, G.T.J. (2013) 'The changing landscape of financial markets in Europe, the United States and Japan', Working Paper 2013/02, Bruegel

Blanchard, O. and L. Katz (1992) 'Regional Evolutions', Brookings Papers on Economic Activity 23

CPB (2009) 'Great Moderation, bubbles en internationale onevenwichtigheden', chapter 5.1 in Centraal Economisch Plan 2009

Decressin, J. and A. Fatas (1995) 'Regional labour market dynamics in Europe', European Economic Review 39

De Haan, J., R. Inklaar and R. Jong-A-Pin (2008) 'Will business cycles in the EMU converge? A critical survey of empirical research', Journal of Economic Surveys 22(2)

Di Giovanni J. and A.A. Levchenko (2010) 'Putting the Parts Together: Trade, Vertical Linkages, and Business Cycle Co-movement', American Economic Journal: Macroeconomics 2

Dornbusch, R. (2001) 'Fewer Monies, Better Monies', NBER Working Paper 8324

Estrada Garcia, A., J. Gali and D. Lopez Salido (2013) 'Patterns of convergence and divergence in the euro area', CEPR DP 9685

Furceri D. and A. Zdzienicka (2013) 'The Euro Area Crisis: Need for a Supranational Fiscal Risk Sharing Mechanism?', IMF Working Paper WP/13/198

Gakova Z. and L. Dijkstra (2008) 'Labour mobility between the regions of the EU-27 and a comparison with the USA', European Union Regional Policy Note 02/2008

Gaechter, M., Riedl, A. and D. Ritzberger-Gruenwald (2012) 'Business Cycle Synchronisation in the Euro Area and the Impact of the Financial Crisis', Monetary Policy & the Economy, Oesterreichische Nationalbank (Austrian Central Bank), issue 2, pp 33-60

Imbs, J. (2004) 'Trade, finance, specialisation and synchronisation', The Review of Economics and Statistics, 86(3)

IMF (2011) 'Next Generation Balance Sheet Stress Testing', IMF Working Paper WP/11/83

IMF (2013) 'Toward a Fiscal Union for the Euro Area', IMF Staff Discussion Note/13/09

IMF (2013a) 'Toward a Fiscal Union for the Euro Area: Technical background note', background paper to IMF Staff Discussion Note/13/09

Kalemli-Ozcan, S., E. Luttini and B. Sorensen (2014) 'Debt Crises and Risk-Sharing: The Role of Markets versus Sovereigns', Scand. J. of Economics 116(1)

Krugman P. (1993) 'Lessons of Massachusetts for EMU', in Adjustment and Growth in the European Monetary Union (ed) F Torres, F Giavazzi, pp.241-60, Cambridge: Cambridge University Press

Krugman, P. (2012) 'Revenge of the Optimum Currency Area', in NBER Macroeconomics Annual 2012, volume 27

Laeven, L and F Valencia (2012) 'Systemic Banking Crises Database: An Update', IMF Working Paper 12/163

Milesi-Ferretti, G-M and C. Tille (2011) 'The great retrenchment: international capital flows during the global financial crisis', Economic Policy, April

Mundell, R. (1961) 'A theory of Optimum Currency Areas', American Economic Review, 51 (4)

Pisani-Ferry, J. and G.B. Wolff (2012) 'The fiscal implications of a Banking Union', Policy Brief 2012/02, Bruegel

Santos Silva, J. and S. Tenreyro (2010) 'Currency Unions in Prospect and Retrospect', Annual Review of Economics 2010 (2), pp 51–74

Sapir, A. and G.B. Wolff (2013) 'The neglected side of banking union: reshaping Europe's financial system', note presented at the informal ECOFIN, Vilnius, 14 September, Bruegel

Schmieder, C., C. Puhr, and M. Hasan (2011) 'Next Generation Balance Sheet Stress Testing', IMF Working Paper WP/11/83

Wolff, G. B. (2012) 'A budget for Europe's Monetary Union', Policy Contribution 2012/22, Bruegel

Appendix

Table 0.1: Co-movement of individual euro-area countries with average EMU

	Co-movement Y			Co-movement of P			Co-movement of C		
Country	pre-euro	euro	Δ	pre-euro	euro	Δ	pre-euro	euro	Δ
Austria	0.0116	0.0044	-0.0072	0.0070	0.0070	0.0000	0.0155	0.0084	-0.0071
Belgium	0.0078	0.0044	-0.0035	0.0110	0.0045	-0.0065	0.0099	0.0068	-0.0031
Finland	0.0210	0.0172	-0.0038	0.0092	0.0105	0.0012	0.0194	0.0143	-0.0052
France	0.0069	0.0062	-0.0008	0.0067	0.0052	-0.0015	0.0085	0.0031	-0.0054
Germany	0.0087	0.0103	0.0016	0.0070	0.0074	0.0004	0.0095	0.0125	0.0031
Greece	0.0308	0.0323	0.0016	0.0238	0.0111	-0.0127	0.0206	0.0252	0.0045
Ireland	0.0265	0.0194	-0.0071	0.0150	0.0277	0.0126	0.0317	0.0295	-0.0022
Italy	0.0117	0.0048	-0.0069	0.0088	0.0126	0.0038	0.0127	0.0050	-0.0077
Luxembourg	0.0286	0.0170	-0.0116	0.0110	0.0258	0.0148	0.0144	0.0134	-0.0010
Netherlands	0.0123	0.0047	-0.0077	0.0074	0.0107	0.0032	0.0123	0.0117	-0.0006
Portugal	0.0262	0.0122	-0.0140	0.0190	0.0093	-0.0097	0.0300	0.0126	-0.0174
Spain	0.0134	0.0102	-0.0033	0.0102	0.0060	-0.0043	0.0123	0.0140	0.0017

Source: World bank and Bureau of Economic Analysis, author calculations.
* Pre-euro period is 1960-2001, euro period is 2002-2012.

Table 0.2: Co-movement of individual states US with average US

	Co-movement Y			Co-movement of P			Co-movement of C		
Country	pre-euro	euro	Δ	pre-euro	euro	Δ	pre-euro	euro	Δ
Alabama	0.0130	0.0064	-0.0065	0.0033	0.0022	-0.0010	0.0102	0.0085	-0.0017
Alaska	0.0477	0.0436	-0.0041	0.0334	0.0611	0.0277	0.0400	0.0738	0.0337
Arizona	0.0200	0.0225	0.0025	0.0053	0.0043	-0.0010	0.0111	0.0109	-0.0001
Arkansas	0.0177	0.0052	-0.0125	0.0042	0.0036	-0.0007	0.0118	0.0080	-0.0038
California	0.0153	0.0082	-0.0070	0.0026	0.0014	-0.0012	0.0114	0.0036	-0.0078
Colorado	0.0102	0.0082	-0.0020	0.0018	0.0064	0.0046	0.0091	0.0063	-0.0029
Connecticut	0.0165	0.0168	0.0002	0.0019	0.0054	0.0035	0.0107	0.0114	0.0007
Delaware	0.0262	0.0268	0.0006	0.0100	0.0111	0.0012	0.0273	0.0171	-0.0102
District of Columbia	0.0276	0.0152	-0.0124	0.0067	0.0063	-0.0004	0.0256	0.0236	-0.0021
Florida	0.0073	0.0108	0.0035	0.0022	0.0046	0.0025	0.0101	0.0207	0.0106
Georgia	0.0084	0.0093	0.0009	0.0032	0.0068	0.0036	0.0067	0.0128	0.0060
Hawaii	0.0195	0.0061	-0.0134	0.0050	0.0041	-0.0009	0.0168	0.0115	-0.0052
Idaho	0.0252	0.0198	-0.0055	0.0069	0.0072	0.0003	0.0119	0.0138	0.0019
Illinois	0.0073	0.0056	-0.0017	0.0024	0.0052	0.0028	0.0092	0.0072	-0.0020
Indiana	0.0146	0.0196	0.0050	0.0039	0.0076	0.0038	0.0074	0.0098	0.0025
Iowa	0.0177	0.0144	-0.0033	0.0056	0.0085	0.0029	0.0177	0.0197	0.0020
Kansas	0.0087	0.0179	0.0092	0.0039	0.0046	0.0007	0.0054	0.0212	0.0157
Kentucky	0.0191	0.0119	-0.0072	0.0047	0.0076	0.0029	0.0077	0.0066	-0.0010
Louisiana	0.0365	0.0255	-0.0110	0.0243	0.0403	0.0160	0.0329	0.0410	0.0082
Maine	0.0053	0.0134	0.0082	0.0060	0.0065	0.0005	0.0087	0.0093	0.0006
Maryland	0.0106	0.0097	-0.0010	0.0020	0.0044	0.0023	0.0072	0.0063	-0.0009
Massachusetts	0.0139	0.0073	-0.0066	0.0023	0.0058	0.0035	0.0150	0.0047	-0.0103

Michigan	0.0210	0.0270	0.0060	0.0049	0.0110	0.0061	0.0121	0.0157	0.0035
Minnesota	0.0111	0.0125	0.0015	0.0024	0.0041	0.0017	0.0110	0.0097	-0.0013
Mississippi	0.0115	0.0145	0.0030	0.0040	0.0032	-0.0009	0.0128	0.0154	0.0027
Missouri	0.0156	0.0104	-0.0052	0.0038	0.0069	0.0031	0.0097	0.0096	-0.0001
Montana	0.0208	0.0073	-0.0135	0.0044	0.0085	0.0041	0.0194	0.0111	-0.0083
Nebraska	0.0205	0.0178	-0.0027	0.0056	0.0095	0.0039	0.0129	0.0180	0.0051
Nevada	0.0201	0.0262	0.0061	0.0070	0.0037	-0.0033	0.0124	0.0235	0.0111
New Hampshire	0.0275	0.0058	-0.0217	0.0053	0.0074	0.0020	0.0269	0.0101	-0.0169
New Jersey	0.0100	0.0081	-0.0019	0.0027	0.0039	0.0012	0.0087	0.0047	-0.0039
New Mexico	0.0377	0.0248	-0.0129	0.0158	0.0175	0.0018	0.0261	0.0221	-0.0040
New York	0.0127	0.0134	0.0007	0.0039	0.0027	-0.0012	0.0122	0.0116	-0.0006
North Carolina	0.0121	0.0079	-0.0042	0.0064	0.0074	0.0010	0.0100	0.0100	0.0000
North Dakota	0.0230	0.0373	0.0143	0.0077	0.0121	0.0043	0.0260	0.0541	0.0281
Ohio	0.0132	0.0118	-0.0014	0.0028	0.0070	0.0041	0.0091	0.0045	-0.0047
Oklahoma	0.0135	0.0203	0.0068	0.0074	0.0239	0.0165	0.0109	0.0199	0.0090
Oregon	0.0281	0.0118	-0.0163	0.0055	0.0086	0.0030	0.0099	0.0086	-0.0012
Pennsylvania	0.0075	0.0055	-0.0020	0.0033	0.0049	0.0016	0.0069	0.0033	-0.0037
Rhode Island	0.0168	0.0097	-0.0071	0.0028	0.0040	0.0012	0.0157	0.0109	-0.0048
South Carolina	0.0078	0.0072	-0.0007	0.0054	0.0089	0.0035	0.0088	0.0045	-0.0043
South Dakota	0.0196	0.0303	0.0107	0.0076	0.0138	0.0062	0.0224	0.0342	0.0118
Tennessee	0.0166	0.0105	-0.0062	0.0040	0.0089	0.0049	0.0095	0.0089	-0.0007
Texas	0.0077	0.0178	0.0101	0.0103	0.0224	0.0121	0.0108	0.0157	0.0049
Utah	0.0187	0.0109	-0.0078	0.0040	0.0046	0.0006	0.0087	0.0102	0.0015
Vermont	0.0140	0.0158	0.0019	0.0021	0.0078	0.0057	0.0123	0.0112	-0.0011
Virginia	0.0106	0.0108	0.0002	0.0051	0.0047	-0.0004	0.0097	0.0049	-0.0048
Washington	0.0197	0.0149	-0.0047	0.0029	0.0039	0.0010	0.0083	0.0112	0.0029
West Virginia	0.0184	0.0181	-0.0002	0.0047	0.0041	-0.0006	0.0097	0.0158	0.0061
Wisconsin	0.0092	0.0059	-0.0033	0.0045	0.0082	0.0037	0.0076	0.0023	-0.0053
Wyoming	0.0291	0.0393	0.0103	0.0240	0.0637	0.0397	0.0237	0.0299	0.0062

Source: World bank and Bureau of Economic Analysis, author calculations.

* Pre-euro period is 1987-2001, euro period is 2002-2012.

Table 0.3: Common labour market disturbances EMU

Country	Employment			Unemployment rate			Participation rate		
	β	St. error	R^2	δ	St. error	R^2	ζ	St. error	R^2
Belgium	0.279*	0.123	0.159	0.710	0.209	0.291	1.085	0.063	0.915
Finland	0.121*	0.269	0.008	1.331	0.503	0.200	0.005*	0.075	0.000
France	0.238*	0.091	0.203	1.013	0.125	0.701	0.349*	0.036	0.775
Germany	2.333*	0.271	0.733	-0.126*	0.243	0.010	1.082	0.048	0.947
Greece	0.112*	0.282	0.006	0.693	0.517	0.061	1.023	0.079	0.857
Ireland	0.593	0.344	0.099	2.461*	0.599	0.376	1.438*	0.102	0.876
Italy	0.376*	0.104	0.326	0.968	0.204	0.446	0.703*	0.051	0.871
Luxembourg	0.019*	0.191	0.000	-0.116*	0.184	0.014	0.980	0.058	0.910
Netherlands	0.339*	0.246	0.066	1.049	0.473	0.149	2.066*	0.152	0.869
Portugal	0.804	0.180	0.425	0.522	0.398	0.058	0.569*	0.061	0.756
Spain	0.976	0.305	0.276	3.606*	0.330	0.810	1.775*	0.033	0.991
Average	0.563	0.219	0.209	1.101	0.344	0.283	1.007	0.069	0.797
Weighted average	0.996	0.200		1.325	0.500		0.979	0.053	

* Significantly different from 1 at 5%.

Table 0.4: Common labour market disturbances US

State	Employment			Unemployment rate			Participation rate		
	β	St. error	R^2	δ	St. error	R^2	ζ	St. error	R^2
Alabama	1.358*	0.130	0.803	1.276*	0.127	0.784	1.763*	0.141	0.849
Alaska	0.474*	0.174	0.215	0.483*	0.130	0.332	0.836	0.186	0.420
Arizona	1.317	0.195	0.629	1.030	0.076	0.869	0.955	0.146	0.603
Arkansas	0.849	0.150	0.544	0.739*	0.106	0.634	1.142	0.165	0.630
California	1.285	0.142	0.751	1.208	0.109	0.813	0.718	0.148	0.457
Colorado	0.900	0.234	0.354	0.904	0.102	0.737	0.697	0.198	0.307
Connecticut	0.516*	0.109	0.453	0.909	0.131	0.631	0.258*	0.232	0.042
Delaware	1.277*	0.110	0.833	0.887	0.069	0.854	1.909*	0.275	0.632
District of Columbia	0.756	0.376	0.130	0.785	0.111	0.641	-0.406*	0.318	0.055
Florida	1.601*	0.105	0.896	1.189*	0.087	0.871	1.065	0.157	0.620
Georgia	1.459*	0.077	0.930	1.024	0.088	0.827	1.352*	0.124	0.809
Hawaii	0.674	0.167	0.375	0.494*	0.131	0.336	1.342	0.230	0.550
Idaho	0.967	0.197	0.473	0.846	0.094	0.745	1.568*	0.144	0.810
Illinois	1.191	0.113	0.804	1.183*	0.060	0.933	1.015	0.117	0.728
Indiana	1.374*	0.124	0.819	1.301*	0.088	0.887	1.836*	0.122	0.889
Iowa	0.536*	0.174	0.260	0.749*	0.105	0.646	1.572*	0.265	0.558
Kansas	0.427*	0.085	0.482	0.495*	0.053	0.756	0.850	0.150	0.533
Kentucky	0.697*	0.078	0.745	1.075	0.093	0.826	0.410*	0.085	0.457
Louisiana	0.474*	0.197	0.177	0.760	0.242	0.260	0.458*	0.148	0.254
Maine	0.979	0.127	0.686	0.799*	0.079	0.786	1.209	0.155	0.685
Maryland	0.823	0.087	0.766	0.734*	0.059	0.846	0.928	0.104	0.740
Massachusetts	0.939	0.115	0.711	0.799	0.141	0.533	0.731*	0.108	0.622
Michigan	1.743*	0.112	0.900	1.580*	0.133	0.834	1.944*	0.178	0.811

Minnesota	0.644*	0.102	0.598	0.784*	0.060	0.861	1.258	0.136	0.754
Mississippi	0.803	0.138	0.557	1.045	0.147	0.643	1.111	0.167	0.611
Missouri	0.977	0.102	0.775	0.975	0.061	0.902	1.904*	0.136	0.876
Montana	0.825	0.127	0.611	0.559*	0.118	0.444	1.029	0.164	0.583
Nebraska	0.464*	0.112	0.391	0.410*	0.078	0.499	1.256	0.326	0.347
Nevada	1.264	0.208	0.578	1.523*	0.126	0.840	0.173*	0.364	0.008
New Hampshire	1.208	0.140	0.734	0.603*	0.127	0.446	0.827	0.127	0.603
New Jersey	0.973	0.106	0.756	0.974	0.108	0.746	0.524*	0.105	0.469
New Mexico	0.982	0.106	0.762	0.605*	0.133	0.424	1.175	0.160	0.658
New York	0.896	0.096	0.763	0.771*	0.081	0.762	0.703	0.160	0.407
North Carolina	1.231*	0.081	0.896	1.176	0.120	0.774	1.099	0.219	0.473
North Dakota	0.348*	0.182	0.119	0.316*	0.093	0.292	0.646	0.390	0.089
Ohio	0.974	0.049	0.935	1.148	0.090	0.854	0.993	0.135	0.659
Oklahoma	0.407*	0.114	0.319	0.670*	0.116	0.545	0.330*	0.118	0.220
Oregon	0.994	0.119	0.722	1.046	0.093	0.819	1.241	0.144	0.727
Pennsylvania	0.815	0.094	0.734	0.994	0.080	0.847	0.884	0.266	0.282
Rhode Island	1.120	0.190	0.564	1.191	0.172	0.631	0.139*	0.170	0.023
South Carolina	1.076	0.164	0.614	1.142	0.111	0.792	1.288	0.319	0.368
South Dakota	0.525*	0.118	0.423	0.416*	0.044	0.761	1.104	0.283	0.352
Tennessee	1.169	0.134	0.739	1.163*	0.079	0.886	1.149	0.158	0.653
Texas	0.391*	0.092	0.401	0.605*	0.095	0.591	0.699	0.201	0.302
Utah	1.096	0.203	0.520	0.869	0.092	0.760	1.594*	0.125	0.853
Vermont	0.821	0.112	0.666	0.643*	0.069	0.758	0.696*	0.105	0.610
Virginia	0.751	0.130	0.553	0.773*	0.042	0.923	0.369*	0.163	0.154
Washington	1.026	0.186	0.530	0.996	0.073	0.871	1.317*	0.134	0.776
West Virginia	0.768*	0.086	0.749	1.211	0.303	0.364	1.205	0.331	0.321
Wisconsin	0.867	0.117	0.669	0.990	0.087	0.822	1.808*	0.173	0.797
Wyoming	0.240*	0.212	0.045	0.609*	0.141	0.400	0.340*	0.169	0.127
Average	0.907	0.137	0.597	0.891	0.105	0.699	1.000	0.183	0.513
Weighted average	1.010	0.119		0.991	0.097		0.985	0.166	

* Significantly different from 1 at 5%.

Table 0.5: Regional relative employment growth

⊿n(it)	⊿n(it-1)	⊿n(it-2)
EMU (11 countries)	0.415	0.075
	(0.060)	(0.062)
US (51 states)	0.445	-0.064
	(0.027)	(0.027)

Standard errors are in parentheses.

Table 0.6: Regional relative unemployment

u(it)	u(it-1)	u(it-2)
EMU (11 countries)	1.463	-0.574
	(0.054)	(0.055)
US (51 states)	1.1	-0.287
	(0.026)	(0.025)

Standard errors are in parentheses.

Table 0.7: Regional relative participation

p(it)	p(it-1)	p(it-2)
EMU (11 countries)	0.889	-0.147
	(0.058)	(0.056)
US (51 states)	1.022	-0.205
	(0.026)	(0.026)

Standard errors are in parentheses.

Table 0.8: Univariate model of relative employment growth, unemployment rates and participation rates EMU

Coefficient	Δ Employment		Employment rate		Participation rate	
	Coefficient	St. error	Coefficient	St. error	Coefficient	St. error
Δn(it)			-0.158	0.026	0.345	0.025
Δn(it-1)	0.495	0.085	0.089	0.036	-0.118	0.035
Δn(it-2)	0.114	0.060				
u(it)						
u(it-1)	-0.424	0.135	1.384	0.060	0.073	0.058
u(it-2)	0.298	0.135	-0.497	0.059	-0.113	0.057
p(it)						
p(it-1)	-0.741	0.147	-0.077	0.065	1.014	0.063
p(it-2)	0.333	0.145	0.081	0.060	-0.189	0.058

Table 0.9: Univariate model of relative employment growth, unemployment rates and participation rates US

Coefficient	Δ Employment		Employment rate		Participation rate	
	Coefficient	St. error	Coefficient	St. error	Coefficient	St. error
Δn(it)			-0.171	0.012	0.417	0.019
Δn(it-1)	0.454	0.036	0.081	0.016	-0.110	0.025
Δn(it-2)	-0.027	0.028				
u(it)						
u(it-1)	-0.241	0.064	1.079	0.028	-0.150	0.045
u(it-2)	0.002	0.061	-0.283	0.027	0.017	0.043
p(it)						
p(it-1)	-0.206	0.042	-0.102	0.019	1.040	0.029
p(it-2)	0.090	0.040	0.074	0.018	-0.190	0.028

Table 0.10: GLS estimates of income and consumption smoothing EMU

	1972-2012	1992-2012	2002-2007	2008-2012
Capital Markets (β^c)	0.028	0.034	0.04	-0.294**
	(0.67)	(0.48)	(0.22)	(1.67)
Fiscal Transfers (β^f)	0.004	0.025	0.125	0.158
	(0.13)	(0.44)	(0.94)	-0.82
Saving (β^s)	0.481***	0.364***	0.332***	0.387***
	(11.18)	(6.19)	(2.80)	(4.34)
Not Smoothed (β^u)	0.487***	0.617***	0.532***	0.763***
	(12.13)	(11.91)	(4.81)	(7.79)

Standard errors are in parentheses.
*, **,*** - statistically significant at the 10, 5 and 1 percent level respectively.

Table 0.11: GLS estimates of income and consumption smoothing VS, Asdrubali *et al* (1996)

	1964-1970	1971-1980	1981-1990
β^c	0.27***	0.34***	0.48***
	(0.04)	(0.04)	(0.04)
β^f	0.05***	0.16***	0.14***
	(0.02)	(0.01)	(0.01)
β^s	0.37***	0.45***	0.19**
	(0.07)	(0.08)	(0.09)
β^u	0.3***	0.06	0.19***
	(0.06)	(0.08)	(0.08)

Standard errors are in parentheses.
*, **,*** - statistically significant at the 10, 5 and 1 percent level respectively.

Table 0.12: ESM contribution key

Country	ESM Contribution Key
Germany	0.271464
Finland	0.017974
France	0.203859
Ireland	0.015922
Italy	0.179137
Slovakia	0.00824
Spain	0.119037
Slovenia	0.004276
Netherlands	0.05717
Luxembourg	0.002504
Belgium	0.034771
Cyprus	0.001962
Greece	0.028167
Estonia	0.00186
Austria	0.027834
Malta	0.000731
Portugal	0.025092