Risk Sharing and the EMU in Crisis

What happened to risk sharing during the sovereign debt crisis and why?

The aim of this thesis is to plot the conditionality of income risk sharing through international financial exchange within the EMU. In theory, international financial integration should lead to higher levels of risk sharing, by hedging local income against local output fluctuations.
In order to research the occurrence of risk sharing, a model is used that measures the co-movements between idiosyncratic income growth and idiosyncratic productivity growth. This thesis finds that countries that are prone to financial crises, within the EMU referred to as periphery countries, structurally share lower levels of output risk than more stable economies: the core. However, the discrepancy is not particularly amplified during such a crisis, as the global financial crisis or the sovereign debt crisis.
Likewise, high foreign debt liabilities harm risk sharing in all EMU member states, predominantly when foreign debt assets are low. Logically, one would expect this second notion to explain the rationale behind the first finding. However, even in a model that incorporates the negative effects of relatively high foreign debt positions, the structural differences between core and periphery subsist. The reasons behind the negative relation between a vulnerability to crises and income risk sharing are therefore still puzzling.

Keywords: Risk Sharing; Sovereign debt crisis; Foreign debt

Name: Charlotte Birkenhäger
Supervisor: Dr. S. van den Hauwe
MSc Economics & Business Economics, Specialization Financial Economics
Studentnumber: 425312
Date: 1/29/2017

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1. Introduction

Risk hedging is of central importance in financial economics. Economic theories depart from the perspective of perfect markets, and therefore individuals can align income growth rates. Essentially, if individuals diversify their portfolio internationally and across all asset classes, their income is less susceptible to local output shocks. Fluctuations in local productivity are compensated for by international revenue streams that are generally more smooth than domestic (Sorensen, 2007). In this paper, risk is assessed from a macro-economic point of view and considered as idiosyncratic output risk on a national level. Local income is (to some extent) hedged against volatility in local output through the international exchange in financial assets. This research investigates this so-called *income risk sharing.* In this economic theory inflow from foreign assets and the outflow on foreign liabilities essentially separate the growth rate of domestic income from domestic productivity growth (Demyanyk, 2008). Principally, holding of foreign assets smooths income when the return on foreign assets is correlated with global output growth more than with local output growth, while issuing foreign liabilities smooths income when the return on foreign liabilities is correlated more with local output growth than with global output growth (Sorensen, 2007). Both assumptions seem to be quite tangible, however, they are dealt with extensively in this research.

Theoretically, the creation of the European Monetary Union, the EMU, in 1999 should have led to a higher level of financial integration among its member states. The euro has lifted trade barriers and the common currency should have increased liquidity and decreased transaction costs (Sorensen, 2007). Earlier research by Demyanyk et al. (2008) and D'Imperio (2015) studied whether or not the creation of the EMU has led to a substantial increase in risk sharing among member states. The results have been

convincing, particularly during the first ten years of the EMU's existence Demyanyk (2008) concludes that the gradual intensification of financial integration among member states causes smoother income growth levels. However, other research indicates that higher levels of financial integration do not necessarily relate to higher levels of risk sharing. D'Imperio (2015) finds what Kose (2009) already suggested, whether or not risk sharing increases with financial integration depends on the composition of the financial positions that are shared among countries.

Recent economic history has made risk sharing all the more relevant from a welfare point of view. Within the EMU two major crises occurred, the global financial crisis or "Great Recession" had its impact, which peaked in 2008, and the European sovereign debt crisis, which surged in 2011 but still continues to affect some economies. During these crises, many economies experienced major negative output shocks and there was a lot of pressure on financial markets. Risk sharing mechanisms could have had a significant smoothing effect on income during these periods. However, recent research leads us to question whether financial integration actually does initiate higher levels of risk sharing, in particular during crisis years (D'Imperio, 2015).

Risk sharing is an important tool that could hedge income against fluctuations in output. GDP growth tends to experience occasional negative shocks, and through risk sharing income smoothing effects could benefit general welfare. This is all the more relevant in the economic development of EMU countries over the last eighteen years. Investigating the data, for example, all countries in this research displayed negative growth in the last two quarters of 2008, and the first quarter of 2009. However, through risk sharing this economic shrinkage could be mitigated to the EMU average for countries that experienced the most severe shocks. For example, Spain showed a GDP contraction of

almost 4% in 2012, while on average the European GDP displayed a GDP movement of -1%. The Spanish National Income could in this case have benefitted from income that was generated by foreign assets in exchange for the outflow of return on domestic assets. Meanwhile, Portuguese and Italian output shrunk with 8% in two years (2011-2012), while the European aggregate average over this period was -1%. For Greece, GDP movements were far more volatile than for other EMU countries, quarterly fluctuations stood as high as 10% and as low as -12% per period (World Bank Financial Database). It becomes clear from these data that hedging income against these shocks is very desirable in light of national welfare.

At the same time, the data show that for many periphery countries financial positions with other EMU members have risen, especially debt liabilities. In Italy, the ratio of foreign debt liabilities to GDP more than doubled since the EMU came into existence, and foreign debt liabilities are now twice as high as foreign debt assets. In Greece, the country that suffered most under the sovereign debt crisis, debt liabilities to other countries in the EMU grew from 19% of GDP in 1999 to 112% of GDP in 2009, at the same time, the debt assets position grew modestly and amounted to 46% of GDP at its peak in 2009. Portuguese financials experienced a comparable development by increasing its foreign debt liabilities to other EMU states from 15% of GDP in 1999 to 97% ten years later. Other countries, so-called core countries, did not experience this misbalanced growth in foreign debt while private and public borrowing among EMU states intensified. Debt assets and liabilities have been almost equal in France and Germany, even though over the last eighteen years both ratios to GDP have risen. The same holds for smaller economies such as Belgium and Finland (World Bank Financial Database).

The objective of this research is to investigate whether or not countries that were more severely affected during the sovereign debt crisis, so-called periphery countries display a structurally lower level of risk sharing than other countries. Moreover this paper dives deeper into the cause behind this difference. One explanation could be that, as Kose suggested in his research (2009), different financial positions have different effects on risk sharing. Not all forms of financial integration may promote risk sharing, some may deteriorate the mechanism. Another idea offered by D'Imperio (2015), is that countries that are more disposed to negative output shocks generally show lower degrees of risk sharing, in particular during those stressed periods.

Essentially, the research question in this paper is threefold. First, are countries less capable of sharing idiosyncratic output shocks with other economies in the EMU in times of crisis? If this is the case, we suspect that the periphery benefitted less from risk sharing than other countries during the same period. Additionally, this implies that the gap in risk sharing between core and periphery would become wider during periods of crisis. Secondly, there are reasons to believe that different forms foreign financing, namely debt, equity and foreign direct investment (FDI), affect risk sharing in different ways, this could also hold for differences between inward and outward positions. This paper could concretize the thoughts raised by Kose (2009), particularly that countries with high debt liabilities are less able to benefit from risk sharing, as a result of this financial position. The third hypothesis presumes that a potential negative effect of debt liabilities on risk sharing could be enhanced during crises. That would mean that, in general, countries with a high debt deficit are more prone to negative shocks and may be less apt to share these shocks internationally because of their financial position, essentially linking the two considerations raised by Kose (2009) and D'Imperio (2015).

Theoretically, when shocks occur debt positions become more visible, and it becomes harder to smooth income so the shock becomes more persistent, in which case risk sharing should be negatively correlated with foreign debt ánd this effect should become stronger during crisis times. Hypothetically, this mechanism could explain the potential difference in risk sharing between core and periphery.

2. Literature Review

2.1 Risk Sharing Theory

Financial integration should delink fluctuations in national income from fluctuations in national output and generate welfare gains from less volatile aggregate income according to risk-sharing theory. The EMU, an integrated monetary union, has experienced an increase in risk sharing during its earlier years. (Demyanyk et al., 2008) This paper focuses on what happened to risk sharing during the crisis years and why.

Theoretically there are multiple ways in which financial integration can generate welfare gains. International financial integration facilitates capital flow to capital-scarce regions, which can boost output. This phenomenon has been widely researched in the past. However, some researchers have found that financial integration does not necessarily promote welfare growth (Edison et al., 2002). Boyd and Smith (1992) have shown that for capital-scarce countries with weak institutions, financial openness causes capital outflow to capital-abundant countries with a stronger legal and financial system.

Another manner, in which international financial integration possibly promotes welfare, is through risk sharing. Sharing income risk is desirable because it should ultimately create possibilities to specialize in production (locally or nationally) and therefore result

in welfare gains through an increase in (future) productivity. Production specialisation and therefore higher productivity is not the only welfare gain that is related to risk sharing. Ultimately sharing income risk should lead to higher and smoother income. Because cross-border ownership of assets should offer opportunities to diversify ones portfolio and share the idiosyncratic regional output risk, resulting in income smoothing. More specifically, income (GNI) in a country or region is equal to productivity (GDP) minus payments (or return) to foreign investors plus payments to domestic investors holding foreign assets. It becomes clear from this function that when the return on domestically held foreign assets is highly correlated with average foreign output growth and the return on domestic liabilities is highly correlated with domestic productivity growth, income is less correlated with productivity. When output growth is relatively high, return and thus payments on foreign held liabilities will be high, and when output growth is low (relative to international growth levels) income from foreign assets held domestically will be relatively high (Demyanyk, 2008). Theories that are based on the assumption of complete markets forecast country-specific income growth to display a higher correlation with global output growth, which essentially is the same as global income, than with local output growth (Kose, 2009). Theoretically, when a region fully shares its risks, income in one country does not move together with output shocks in that particular country but moves together with income fluctuations in the whole region, which are generally smoother, fully eliminating the idiosyncratic local risk. (Baele et al., 2004)

Currently, risk sharing is not perfect and therefore does not fully eliminate idiosyncratic output risk in practice (Demyanyk et al., 2008). Researchers have found that on a global scale the risk sharing coefficient has only slightly improved over the last thirty years, a

period in which international financial liberalization developed substantially. The risk sharing coefficient is related to the correlation between the deviation of domestic income growth rate from international income growth and the deviation of domestic output growth rates from international output growth: the smaller this coefficient, the higher the level of risk sharing. (Kose, 2009).

There has been a considerable amount of research on the extent to which financial openness leads to risk sharing. Kose et al. (2009) examine how risk sharing in industrial countries differs from risk sharing in developing countries and emerging market economies. They conclude that non-industrial countries have not improved risk sharing of output shocks in the last decades, although financial integration has intensified during this period. Kose suggests that the composition of international capital flows may influence the ability of countries to share output risk. In most circumstances, international exchange of equity and FDI improves risk sharing in both emerging market economies and industrial countries. However, according to their hypothesis, international flows of debt have a potential pro-cyclical effect. As international debt dominates international exchange of financial assets for emerging markets and developing countries, it could explain why non-industrial countries experience less international risk sharing.

Many researchers have found a correlation between large ratios of (short-term) foreign debt and vulnerability to financial crises long before the European sovereign debt crisis. Rodrik and Velasco (2000) describe this causal relation in the following way: "the combination of large short-term liabilities and relatively scarce internationally liquid assets resulted in extreme vulnerability to a confidence crisis and a reversal of capital flows". In this case, when capital flows are reversed as a result of the occurrence of a

crisis, the opportunities to share output risk internationally become limited during stressed times. Essentially, these researchers plead that policymakers should maintain that (short-term) foreign debt liabilities and assets remain somewhat balanced in order to be insured against shocks in the capital market.

Bai and Zhang (2012) focus their research on international frictions within the debt market. They emphasize that countries have the option to default on their debt although as a consequence these countries might have limited access to the debt market in the future and are likely to suffer from a decline in output. Default risk on bonds limits borrowing in times of falling output. Essentially this is because international debt contracts are incomplete, and debt repayments are only enforceable to a limited extent. Countries in bad times experience high interest rates and when the fall in output is persistent, they are more likely to default in the future. In short, when productivity is falling, default risk on bonds increases, borrowing opportunities become scarce and interest payments on foreign debt liabilities increase. This could imply that payments on foreign debt liabilities actually rises when output falls, and vice versa. When debt liabilities are high to begin with, output shocks potentially resonate in persistent income shocks. This is why international debt contracts may not work counter-cyclical but rather have a neutral or pro-cyclical effect. Worldwide, debt contracts account for 70% of gross foreign asset positions, and 60% of net foreign asset positions (Kose, 2009). This may explain why on a global level, financial integration has not fostered risk sharing significantly in the last few decades.

The findings of Bai and Zhang, Rodrik and Velasco and Kose et al. may explain why Edison et al. (2002) find that in general there is no statistical evidence that international financial integration enhances economic growth. The pro-cyclical characteristics of

international debt liabilities and its significant proportion in international financial positions in developing countries may undo the smoothing effect of international equity and FDI positions on income volatility and consequently on specialisation. Research by Bracke and Schmitz (2008) substantiates this hypothesis. They find that for industrial countries, foreign equity divided by GDP has a significant positive effect on risk sharing. They mention however that the effect of international equity exchange is limited as most firms aim to keep their dividends fairly constant over time. Furthermore, the positive effect of foreign equity positions on risk sharing is limited to industrial countries, emerging market economies do not seem to benefit significantly (Bracke and Schmitz, 2008). The findings of Sorensen et al. (2007) are quite similar. They find a beneficial effect of equity, FDI and debt on risk sharing. However, the effect of FDI assets on risk sharing is the strongest, while the positive effect of foreign debt holdings is the weakest out of the asset classes. Foreign liabilities do not have a significant effect on risk sharing according to Sorensen et al. consequently this research cannot support the premise that debt (liabilities) has a pro cyclical effect. However, it does not prove any countercyclical effect either.

2.2 Risk sharing in the EMU

The EMU is an extensively financially integrated region. Therefore, there already has been some research on risk sharing within the EMU. In 2004 analyses focused mainly on the extent to which the EMU could mimic the amount of risk sharing in the United States. We have to keep in mind that within the US another mechanism is in place that enables risk sharing; a tax system. Contributions for states with negative output shocks effectively diminish when productivity falls while federal subsidies stay constant or even increase. This fiscal mechanism is negligible within the EMU and therefore not

taken into account (Mélitz, 2004). Moreover, because the US have functioned as a single market for a long time, regions are more specialised than countries of comparable size within the EMU. Since there is less industry specialisation in the EMU than in the US there is less opportunity for smoothing shocks through financial integration, as there will be more industry-specific output shocks that affect all EMU countries. (Mélitz, 2004)

Demyanyk et al. (2008) find that the creation of the EMU and the consequent further financial integration has significantly increased the smoothing of income. However, they find that asset positions outside the EMU have a larger effect on risk sharing than the exchange of assets within the EMU. This finding is quite obvious as domestic output is more correlated with other EMU states than with countries outside the monetary union.

But Demyanyk's research does not find the earlier suggested negative effect of (large) foreign debt positions on risk sharing. Moreover, they find a significant increase in risk sharing between the periods 1995-1999 and 2000-2006. The increase in the risk-sharing coefficient is more substantial within the EMU than in the EU. This outcome suggests that the monetary union has had a direct positive effect on risk sharing.

Recently, papers by Kalemni-Oczan et al. (2003) and D'Imperio (2015) divide the EMU in core and periphery countries when analysing the amount of risk sharing, based on their perceptibility to the recent debt crisis. D'Imperio's findings indicate that non-PIIGS countries[1] were better able to smooth consumption through savings than PIIGS countries in the period before 2008 (2000-2007). The results reveal that the credit market in general (savings and debt) has diminished risk sharing for PIIGS countries throughout both periods 2008-2009 and 2010. A remarkable finding is that the

[1] PIGS countries: Portugal, Italy, Ireland, Greece and Spain
Non- PIGS countries: Belgium Denmark, France, Germany, the Netherlands and the UK

exchange of FDI and equity has had this negative effect as well for PIIGS countries in 2010. The latter result does not correspond with risk-sharing theory and earlier findings. But it is an indication that the integrated financial market does not offer insurance to periphery countries against relatively large or persistent shocks as the Great Recession. (D'Imperio, 2015)

Comparing D'Imperio's research to that of Kose et al. and Demyanyk et al. it specifically provides an indication that in times of persistent negative shocks, financial integration may not improve income smoothing. The recent Euro crisis could be an example of such a stressed period in which risk sharing mechanisms that provided insurance in periods of stable economic growth is severely diminished.

Besides research on financial integration and the development of risk sharing in the EMU, Kalemli-Ozcan et al. (2014) found notable results regarding the relation between the savings market, the debt market and the recent Euro crisis. PIIGS countries experienced negative consumption risk sharing in 2010 which at first sight seems quite inexplicable. The researchers explain that in 2010 GDP declined while at the same time government increased saving. Because in this case, governments did not save enough before the crisis and actually needed to stabilize budgets during the crisis resulting in enhanced idiosyncratic consumption shocks. However, this paper does not focus on consumption risk sharing but rather on income risk sharing. Furthermore, Kalemli-Ozcan et al. find that, among the PIIGS, net factor income (capital flows that contribute to income risk sharing) provided dis-smoothing effects in 2010 as well. Even though this effect is not significant, the writers still want to provide an explanation for negative income risk sharing. They suggest that a potential negative value of income risk sharing is caused by higher interest payments on government debt held abroad which

essentially results in a net outflow of capital in times of falling output. As opposed to stocks, where international investors share the risk of falling stock values, (sovereign) debt follows another pattern. When (sovereign) debt liabilities are high, interest payments to foreign investors increase which leads to higher debt etcetera. Essentially high deb liabilities can lead to such a vicious circle, and therefore to negative levels of risk sharing (Kalemli-Ozcan, 2014).

2.3 Financial Integration and Output shocks in the Euro area

Data on debt liabilities show a steep increase in private credit in periphery countries since the creation of the EMU. Between 1998 and 2007 loans to the private sector as a percentage of GDP increased from 31.8% to 84.4% in Greece. In the same period, Irish debt increased from 81.2% to 184.3%, Portugal experienced an increase from 92.1% to 159.8%, and in Spain and Italy the ratio of private credit to GDP almost doubled. At the same time, this ratio decreased in Germany and remained almost constant in France as happened for most core countries (World Bank Financial Database). The most important reason for these credit booms in the European periphery was the sudden access to international funds in the domestic currency, eliminating foreign currency risk. Furthermore, because credit became available in an integrated EMU financial market, interest rates were relatively low and funds were easily available (Lane, 2012).

Besides this private credit boom, a lot of EMU countries also experienced an increase in current account deficits. Before the Euro was introduced most European countries displayed slight deficits on their current account. Throughout the nineties, Italy, Ireland and France even showed a current account surplus. In the period between 2003 and 2007, the Euro area account was balanced on average, but the accounts of the individual countries dispersed. While some countries had a positive balance on their current

account, the average deficit of Greece and Portugal amounted to almost 10% of GDP. In theory, budget deficits are an indication of fund flows from capital-abundant countries to capital-scarce low-income countries. According to Lane (2012) these deficits are strongly related to the concept of risk sharing. Budget deficits can ameliorate consumption smoothing when current productivity is believed to be lower than future productivity. Conversely, in order to achieve this, current capital flows should be invested in assets that increase future productivity. But a large budget deficit imposes a risk if the external funding suddenly stops. Particularly, in 2009, when the risk of default became more apparent in Greece, short-term funding became costlier, imposing a lot of pressure on the national economy. A strong reduction of international funding ultimately caused high unemployment and a decline in both output and asset prices.

While the global financial crisis of 2008 affected all EMU countries, the severity and persistence of this shock differed between core and periphery countries. At the end of 2009, Greece announced that they adjusted their current account deficit from 6% to 12.7% (Lane, 2012). This incident eventually led investors to re-evaluate the fiscal and financial solvability of individual countries within the EMU. Investors penalised large external deficits and doubted the sustainability of the boom in private credit (Constancio, 2012). As Bai and Zhang (2012) also touch upon, the price of sovereign risk is high in times of recessions and low when the economy is booming, effectively working as a pro-cyclical mechanism. In this case, yields dispersed and the market priced sovereign risk unexpectedly high. Periphery countries that suffered from this increase in sovereign bond yields ended up with less fiscal liberty and lower output.

Past research conveys the hypothesis that financial integration would not help countries to smooth income by sharing output risk when negative shocks are persistent and when

countries depend heavily on foreign debt. Previously described events leading to and signifying the European sovereign debt crisis make it probable that this has consequences for the development of risk sharing within the EMU in the last eighteen years. Within the Euro-area, this hypothesis would entail that periphery countries (what D'Imperio refers to as PIIGS countries) that were severely affected by the sovereign debt crisis of 2010 would not demonstrate the same level of risk sharing as core countries, countries that were less affected by the sovereign debt crisis.

Furceri (2013) highlights the importance of risk sharing, particularly during crises. Risk sharing is not only important on a country-specific level, where it functions as a non-perfect hedge against idiosyncratic output risk. But it is also relevant from the perspective of the monetary union as a whole. When a specific country is hit by a shock, this shock will easily spread through an integrated monetary and financial system. When risk is not shared properly, the debt market could freeze up, leading to a magnification of the shock. The recent manifestation of the sovereign debt crisis shows that persistent shocks can threaten the stability of the monetary union as a whole (Furceri, 2013). This research therefore focuses on risk sharing solely within the monetary union and how this was influenced by the manifestation of crises and by the composition of financial integration among its member states.

3. Methodology

3.1 Basic risk sharing

In the introduction was described how national income is essentially delinked from national productivity by the following function:

$$GNI = GDP + r_F Foreign\ Assets\ - r_D Foreign\ Liabilities$$

This means that National Income is equal to Domestic Productivity plus the return that is received over foreign assets minus the return that is paid over foreign liabilities. When a country has a high amount of foreign liabilities and the return paid over this position is strongly correlated with local productivity, National Income is less correlated with Domestic Productivity. At the same time, when a foreign asset position is high and the return gained on this position is rather unrelated to domestic fluctuations in productivity, this element also delinks income from productivity. International financial integration materialises capital inflow that is not linked to domestic productivity and outflow that is linked to local productivity. Specifically, this research focuses on this method of disengagement through foreign debt, equity and FDI positions, which is visualised in the following matter:

$$Income = Productivity + r_F B_F - r_{D_i} B_D + r_{F\ equity} E_F - r_{equity\ i} E_D + r_{F\ FDI} F_F - r_{FDI_i} F_D$$

This equation shows that when the return foreign liabilities (capital outflow) is correlated more with domestic productivity growth than with international productivity growth, these positions promote the disconnection of income from productivity. At the same time, when the return on foreign assets displays a higher correlation with international productivity growth than with domestic productivity growth, these promote risk sharing.

In this research, the focus lies on output risk that is shared within the EMU, through the exchange of financial assets among EMU member states, in the period since the creation of the EMU in 1999 until 2015. If EMU member states would share all productivity risk with other EMU member states, income growth in a specific country would be equal to EMU-level income growth. In other terms:

$$\Delta \log gni_{it} - \Delta \log GNI_t = 0$$

Because risk sharing considers aligning income growth rates, not income levels, this research only studies the natural logarithm of the difference in national income between period t and period *t-1.* Mathematically this implies the following: $\Delta \log gni_{it} = \ln \frac{gni_{it}}{gni_{it-1}}$. Specifically, gni_{it} denotes income in country i at time t while GNI_t denotes aggregate EMU[2] income in the same period. By the same means: $\Delta \log GNI_i = \ln \frac{GNI_t}{GNI_{t-1}}$, in order to acquire continuously compounding growth rates. Income risk sharing is not perfect and therefore measured by the following equation:

$$\Delta \log gni_{it} - \Delta \log GNI_t = \alpha + \beta_i(\Delta \log gdp_{it} - \Delta \log GDP_t) + \varepsilon_{it}$$

This method ultimately measures to what extent the deviation of domestic income growth from EMU income growth caused by a deviation in domestic productivity growth from EMU productivity growth for any country i. $\Delta \log GNI_t$ and $\Delta \log GDP_t$ account for common fluctuations in income and output. Research focuses on the coefficient β_i which measures the co-movement of national idiosyncratic income growth with idiosyncratic productivity growth. Aggregate figures are subtracted because it is not possible to mitigate risk that is related to EMU-level movements. Subtracting common fluctuations from national fluctuations results in variables that correctly reflect idiosyncratic movements. The correlation between $\Delta \log gni_{it} - \Delta \log GNI_t$ and $\Delta \log gdp_{it} - \Delta \log GDP_t$ consequently captures idiosyncratic output risk that is not shared internationally and causes national movements in income. In a situation where risk is shared completely β_i would thus be equal to 0. The degree of risk sharing is essentially: $1 - \beta_i$. The constant α incorporates any structural deviations of national growth rates from aggregate EMU growth rates, within a panel regression β_0 is therefore expected to

[2] Note that GNI_t is an aggregate of national income in countries included in the sample, this study excludes any countries that joined the EMU after Greece

be equal to 0. The error term ε_{it} is assumed to be stationary and accounts for any measurement errors in income and productivity.

In this research, we concentrate on the twelve countries that have been members of the EMU at least since 2001, Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. Quarterly data are used to be able to estimate the risk sharing coefficient. The first analysis will focus on the general concept that countries that were more affected during the Euro crisis, Spain, Portugal, Italy, Ireland and Greece, (categorized as such by multiple scholars) hypothetically would have benefitted less from risk sharing than countries that were less affected.

Conventional risk-sharing models are tested by the following equation:

1) $$\Delta \log gni_{it} - \Delta \log GNI_t = \alpha_i + \beta_1(\Delta \log gdp_{it} - \Delta \log GDP_t) + \varepsilon_{it}$$

Again, for example gdp_{it} signifies output for country i at time t, and GDP_t signifies aggregate output at time t. This will measure the extent to which income fluctuations can be viewed as independent from output fluctuations. For example, if local output rises with two percentage points more than global output, while local income rises with only 1 percentage point more than global income, essentially 50% of idiosyncratic output movements is shared internationally.

A basic panel regression is performed on the whole sample in order to measure general risk sharing. The time variable in this regression is obvious, as the dataset consist of quarterly observations. Equation (1) estimates risk sharing over the whole panel, therefore generates only one estimate for parameter β_1. But it is also likely that there are structural differences in the data across countries. Therefore, we need to test whether a fixed-effects or a random-effects panel regression more appropriately incorporates the heterogeneity across countries. The fixed effects model works under

the assumption that effects are constant for individual countries, at least temporarily, while the random effects model assumes that the intercept α_i vary among countries. Additionally, these country-specific α_i's, are expected to be normally distributed and non-related to the independent variable $(\Delta \log gdp_{it} - \Delta \log GDP_t)$. A Hausman test indicates that the use of a random effects model is more appropriate for this dataset. Essentially the model allows for $\Delta \log gni_{it}$ to be structurally higher or lower than the aggregate income for any country *i*, under the condition that this is unrelated to fluctuations in output (Verbeek, 2004).

In short, the degree of risk sharing is effectively measured by $1 - \beta_1$. In order to test whether core countries share more of their output risk among EMU states than the periphery we can apply a panel regression on two pools of countries. One pool will contain data on core countries in the period between 1999 and 2015, the other panel data on periphery countries in the same time-span. Comparing the two $\beta_1's$ will give an indication on whether or not core countries in general display a higher degree of risk sharing than periphery countries. However, this comparison in β_1's will not provide proof for the discrepancy. Whether potential discrepancies between risk sharing in core- and risk sharing in periphery countries are significant will be shown by the following regression.

2) $$\Delta \log gni_{it} - \Delta \log GNI_t = \alpha_i + \beta_1(\Delta \log gdp_{it} - \Delta \log GDP_t) + \mu * D_{periphery}(\Delta \log gdp_{it} - \Delta \log GDP_t) + \varepsilon_{it}$$

By including data on all countries in one regression but adding a dummy variable (interacting with relative output variations) that accounts for periphery countries this research could draw a significant conclusion on any differences that exist between general risk sharing levels in the periphery and the core. The dummy is an interaction

term because it essentially isolates the correlation between relative income fluctuations and relative output fluctuations that are exclusively associated with periphery countries and specifically not with core countries. If μ is significantly different from 0, there is a difference in risk sharing between core and periphery countries. In this case β denotes the general level of risk sharing in core countries and $\beta + \mu$ is associated with risk sharing in the periphery. So, when μ is significantly negative, the regression has proven that risk sharing is generally higher in periphery countries, but when μ is significantly positive, the level of risk sharing is significantly higher in core countries.

A relevant extension to this regression could be to include Gross Savings in the equation. In this case, the study does not focus on the phenomenon of income risk sharing but rather on *consumption* risk sharing. To some extent, people may be able to smooth consumption without financial integration by saving for a future period, or by tapping into savings. Therefore, a new dependent variable is constructed by subtracting the change Gross Savings per capita from Gross National Income per capita. When savings increase on a national level, that part of income is not used for consumption, presumably in times of high national income. In other periods, the amount of Gross Savings may decrease, and consumption may be higher than income. In general, the following equation provides an image to what extent households and governments smooth consumption by making changes in savings.

3.a) $$\Delta \log(gni_{it} - \Delta gs_{it}) - \Delta \log(GNI_t - \Delta GS_t) = \alpha_i + \beta_1(\Delta \log gdp_{it} - \Delta \log GDP_t) + \varepsilon_{it}$$

Comparing the new β_1 in equation (2) to the β_1 of the former test (1) will indicate whether households and governments in the EMU boost consumption smoothing across periods aside from international risk sharing by changing their level of savings. At the

same time, this could give an indication of differences in consumption smoothing between core and periphery countries by subsequently pooling the data. Consequently, this difference can be tested by regressing data on the complete pool of countries, but also including a dummy variable on periphery countries interacting with relative output fluctuations in order to test whether or not this difference is significant. Equation (3.b) will illustrate the significance of any variances in consumption risk sharing between PIIGS and non-PIIGS.

3.b) $$\Delta \log(gni_{it} - \Delta gs_{it}) - \Delta \log(GNI_t - \Delta GS_t) = \alpha_i + \beta_1(\Delta \log gdp_{it} - \Delta \log GDP_t) + \mu * D_{periphery}(\Delta \log gdp_{it} - \Delta \log GDP_t) + \varepsilon_{it}$$

3.2 Statistical diagnostics

This section will focus on whether this dataset can be appropriately used to test equation (1) and its variations. The first application will be on whether the regression contains some form of autocorrelation. In case of autocorrelation, (highly) negative and (highly) positive residuals cluster together in time. We are likely to find autocorrelation as both the independent variable and the dependent variable essentially contain a business cycle (Verbeek, 2004). The test will provide an indication on the accurateness of the OLS (Ordinary Least Squares) estimator in relation to the error component structure. When autocorrelation occurs the following holds: $Cov(\varepsilon_{it}, \varepsilon_{it-n}) \neq 0$. In other words, the error terms are correlated through time. A simple test on autocorrelation tests the following:

$$\varepsilon_{it} = \rho \varepsilon_{it-1} + \epsilon_{it}$$

In this case, the null-hypothesis of the test will be that $\rho = 0$. In this Durbin-Watson test we find that $p = 0.13$, so autocorrelation is not significant (Verbeek, 2004). Furthermore, this test is rewritten for panel data. In this case the regression is estimated

by applying iterated GLS (Generlized Least Squares) instead of OLS estimates, and subsequently the significance of ρ is tested on the residuals that are generated. Quite remarkably, the p-value of ρ again amounts to 0.13, so there is no significant autocorrelation found in any of the countries *i.*

Furthermore, the panel needs to meet the criterion of homoscedasticity. To test for this condition again we focus on the residuals ε_{it} of the regression on equation 1. The mathematical principle of homoscedasticity entails:

$$Var\{\varepsilon_i|(\Delta \log gdp_{it} - \Delta \log GDP_t)\} = Var\{\varepsilon_{it}\} = \sigma_i^2$$

In other words, the variance of the error term does not depend on the value of the independent variable (Heij et al., 2004). Executing a Breusch-Pagan test on the complete dataset delivers a Chi2-statistic of 0.02. A weak form of homoscedasticity holds for this dataset. However, this test generalises the dataset and does not consider the different countries in the panel. It may still be the case that for some country *i* the variance in the error term ε_{it} is significantly related to the independent variable $(\Delta \log gdp_{it} - \Delta \log GDP_t)$. Subsequently the data can be tested in order to find a heteroscedastic error structure that is not cross-sectionally correlated, thus specific for any country *i* in the dataset. First, equation 1 is estimated using an iterated GLS (Generalized Least Squares) estimator, specifying a heteroskedastic error structure without autocorrelation, in other words, heteroscedasticity-consistent or robust standard errors. Next, this estimate is compared to a GLS estimate without these characteristics. A likelihood-ratio test then compares the two estimates and finds a Chi2-statistic of 426.30, a highly significant determination of country-specific heteroscedasticity. It is therefore appropriate to incorporate robust standard errors in our model and apply a GLS analysis with robust standard errors instead of an OLS analysis.

The simple model of risk sharing reveals the problem of endogeneity quite obviously. Endogeneity arises because gni_{it} and gdp_{it} are very closely related, and causality works both ways. We could expect not only high productivity to affect income, but income could also influence (future) productivity which essentially is a problem of reverse causality and disturbs the error term, ε_{it} . Endogeneity is limited within the model because it takes first differences of the macro-variables and their lagged periods. Moreover, this approach subtracts the average change in value across countries (Canova and Ravn, 1996). So, the common factors between differenced income or output and the error term are to a large extent controlled for by subtracting these cross-sectional averages (Fuleky et al., 2015). As in all panel data sets, the variables vary through time and among individuals (in this case, countries). So, the different error terms ε_{it} may be correlated across countries or periods, for example as a result of measurement errors, with the independent as well as the dependent variable. Simply put, there are mechanisms that could simultaneously increase relative income and relative productivity, in which case the causality investigated, that of the independent on the dependent variable, does not capture the relevant relation. When endogeneity arises, it will be hard to capture the effect of x on y because y is influenced by $\beta * x$ but also through changes in ε_{it}. Mathematically the exogenous condition is met when:

$$E\{\varepsilon_{it}|(\Delta \log gdp_{it} - \Delta \log GDP_t)\} = 0$$

In other words, there are no mechanisms which cause the error term to increase when our independent variable increases. This also means that the covariance between the error term and the independent variable is equal to zero. One of the ways to test for endogeneity is to include an instrumental variable. Therefore, in addition to $(\Delta \log gdp_{it} - \Delta \log GDP_t)$, $\Delta \log gdp_{it}$ is included as an instrumental variable (Verbeek, 2004). $\Delta \log gdp_{it}$ itself does not relate to risk sharing because risk sharing corresponds

to smoothing of idiosyncratic output shocks relative to global output movements, but it is highly correlated to $(\Delta \log gdp_{it} - \Delta \log GDP_t)$. In order to perform a test on endogeneity the instrumental variable is included in an instrumental-variable regression using a two-stage least squares estimator. The results indicate that the statistics still cannot reject the null-hypothesis of no endogenous variables; the Durbin Chi2 as well as the Wu-Hausman statistic display a p-value of 0.056, slightly above the critical value.

Another, more straightforward way to test for endogeneity is to assemble the residuals on the panel regression on equation (1), and perform a test on this new variable. This matches a Davidson-MacKinnon test. The residual is subsequently regressed as an independent variable extending equation (1). A test on the p-value corresponding to the residual proves to be 0.06, hence not strong enough to reject the null-hypothesis of exogenous variables. A (weak) assumption of exogenous variables holds.

3.3 Risk Sharing in crisis and non-crisis periods

The next step in this research is to study the progress of risk sharing since the creation of the EMU. In this paper, a periodic estimate on risk sharing is conducted on a panel of all EMU countries, and a panel of core and periphery countries separately. Furthermore, in order to investigate if the gap between core and periphery amplified or shrunk, a dummy is again included. By this method, developments can be demonstrated that are specific for countries prone to crises, non-vulnerable countries and all countries. The regression is performed by assembling data per period. First, the periods are divided in simply non-crisis and crisis years: 1999-2007 and 2008-2015. The first period is characterised by relatively gradual economic growth, the second captures the years in which both the Great Recession and the sovereign debt crisis manifested. Then, more

specifically, the same regressions are performed over 1999-2006, 2007-2010 and 2011-2015, on National Income and National Product. The second division in periods was based on a rough classification. The first period can be characterised by quite constant economic growth, while the second period is characterised by the Great Recession, a period in which the global economy was affected quite severely. The third period could be labelled as the sovereign debt crisis and its aftermath, which harmed most economies within the EMU, but to different degrees. These panel regressions will display if there are distinct differences in the way risk sharing has developed since the creation of the EMU for different country categories. Moreover, these results could provide an indication on whether or not the hypothesis mentioned in the introduction is correct. Specifically, the hypothesis that presumes that the gap between core and periphery countries became more significant during the crises.

3.4 Financial Integration and Risk Sharing

The previously mentioned regressions measure the extent of risk sharing for EMU countries in a given period. However, they do not dissect the relationship between financial integration and risk sharing. In order to research whether the composition of capital flows affects the degree of risk sharing, a panel regression is performed on the data. Adding an interaction term for each form of financial exchange (debt, equity and FDI) extends the basic equation on risk sharing. The interaction term captures the degree of risk sharing that is linked to the level of the financial position. In these regressions the foreign financial position is taken as a percentage of GDP in order to put it in economic perspective.

4) $$\Delta \log i_{it} - \Delta \log I_t = \alpha_i + \beta_1(\Delta \log y_{it} - \Delta \log Y_t) + \gamma * Debt * (\Delta \log y_{it} - \Delta \log Y_t) + \delta * Equity * (\Delta \log y_{it} - \Delta \log Y_t) + \theta * FDI * (\Delta \log y_{it} - \Delta \log Y_t) + \varepsilon_{it}$$

In this case *i* represents gross national income, and *y* denotes domestic productivity. The capital letter again refers to EMU aggregates and the small-case letter to domestic figures. If all coefficients γ, δ and θ are negative, all forms of financial integration contribute to risk sharing. Any coefficient that is significantly positive is an indication that that particular form of fund exchange deteriorates risk sharing. The first step is to test for the distinct effects of gross positions on risk sharing by applying equation (4.a) on the data.

4.a) $$\Delta \log i_{it} - \Delta \log I_t = \alpha_i + \beta_1(\Delta \log y_{it} - \Delta \log Y_t) + \gamma * FP * (\Delta \log y_{it} - \Delta \log Y_t) + \vartheta * FP + \varepsilon_{it}$$

In this formula I, again, represents income, Y represents productivity, and FP represents the relevant financial position that is tested as an interaction term with idiosycratic output fluctuations. FP, the financial position that is tested, is also included as a separate term in order to control for structural effects of a certain position on comparative income. According to basic theory on financial openness; if a foreign position growths, risk sharing should also increase. This would mean that γ should be a negative coefficient for every single FP. The total risk sharing coefficient over the sample amounts to $1 - \beta - \gamma\left(\frac{\overline{FP}}{\overline{GDP}}\right)$. In this case, $1 - \beta$ shows the amount of risk sharing when the financial position amounts to 0, and $\gamma(\frac{\overline{FP}}{\overline{GDP}})$ displays the risk sharing as a result of the specific form of financial integration times the average position divided by the average GDP.

This panel test the data will also be measured along two axes: periphery and core countries and the non-crisis period and the crisis period (1999-2007 and 2008-2015). Adding a dummy variable to equation (3) will signify whether the effects of gross

positions will prove a potential difference in the effects of financials on risk sharing among core and periphery and whether it stays constant throughout periods.

The first extension will indicate whether the effect of gross positions on risk sharing differs among core- and periphery countries, by adding a dummy variable on periphery countries. This results in the construction of equation (4.b). Essentially, γ now captures risk sharing that is associated with a certain gross position, in core countries while $\gamma + \mu$ captures risk sharing that is associated with a financial position in a periphery country. When μ is significantly negative, risk sharing in periphery countries benefits more from that specific position than in core countries. When μ is positive, periphery countries benefit less from the position from the perspective of risk sharing.

4.b) $$\Delta \log i_{it} - \Delta \log I_t = \alpha_i + \beta_1(\Delta \log y_{it} - \Delta \log Y_t) + \gamma * FP * (\Delta \log y_{it} - \Delta \log Y_t) + \mu * FP * D_{periphery}(\Delta \log gdp_{it} - \Delta \log GDP_t) + \vartheta_i * FP + \varepsilon_{it}$$

The next step is to capture any discrepancies in the effects of gross positions between crisis and non-crisis years. Therefore, equation (4.b) is altered in order to capture period-specific elements in the effect of financial integration on risk sharing. The dummy on periphery countries is replaced by a dummy variable on crisis years, thus with a value of 1 when an observation is made in the period 2008-2015. This is mathematically shown in equation (4.c).

4.c) $$\Delta \log i_{it} - \Delta \log I_t = \alpha_i + \beta_1(\Delta \log y_{it} - \Delta \log Y_t) + \gamma * FP * (\Delta \log y_{it} - \Delta \log Y_t) + \varphi * FP * D_{2008-2015}(\Delta \log gdp_{it} - \Delta \log GDP_t) + \vartheta * FP + \varepsilon_{it}$$

Additionally, parameter $\gamma * -1$ can be interpreted as the amount of risk sharing resulting from that financial position in the period 1999-2007. When both parameters γ and φ are significant, the amount of risk sharing effectively resulting from that particular gross position in stressed times is equal to $1 - \beta - \gamma\left(\frac{\overline{FP}}{\overline{GDP}}\right) - \varphi\left(\frac{\overline{FP}}{\overline{GDP}}\right)$.

Furthermore, some researchers, such as Rodrik & Velasco (2000), mention that high debt liabilities may be particularly problematic when debt assets are low, therefore it may be interesting to elaborate on equation (4) by using net positions of asset classes instead of gross positions. The methodology remains unchanged but the interaction terms denote net positions, in order to find out whether imbalanced positions might have a significant effect on risk sharing. If this is the case the sign of the estimate indicates whether relatively high asset or high liabilities have a deteriorating or stimulating effect on risk sharing. Additionally, budget deficits could be an indication of inflows of capital from capital abundant countries to capital scarce countries because of expected future productivity growth. To control for this effect the regressions need to include all variables associated with net foreign balance: net debt, net equity and net FDI. The variables are constructed as equity assets – equity liabilities, FDI assets – FDI liabilities and debt assets – debt liabilities. Overall, including the net equity and net FDI could control for states when net debt deficits are high just because future domestic productivity is expected to grow above regional par and domestic capital is scarce. This analysis results in the following equation:

4.d) $$\Delta \log i_{it} - \Delta \log I_t = \alpha_i + \beta_1(\Delta \log y_{it} - \Delta \log Y_t) + \gamma * net\ Debt * (\Delta \log y_{it} - \Delta \log Y_t) + \delta * net\ Equity * (\Delta \log y_{it} - \Delta \log Y_t) + \rho * net\ FDI * (\Delta \log y_{it} - \Delta \log Y_t) + \varepsilon_{it}$$

Note that for any result on γ, δ and ρ the results are quite ambiguous. A significant positive sign on a coefficient could prove that a surplus in that asset class deteriorates risk sharing, or a deficit in that asset class improves risk sharing, or both effects exist. At the same time a negative sign could prove that a deficit leads to a fall in risk sharing, or a surplus to a rise in risk sharing, or both.

To test whether the results from the regression on equation (4.d), explain the differences in risk sharing coefficients between core and periphery countries, a dummy variable on the periphery is again included, resulting in equation (4.e).

4.e) $$\Delta \log i_{it} - \Delta \log I_t = \alpha_i + \beta_1(\Delta \log y_{it} - \Delta \log Y_t) + \gamma * net\ Debt * (\Delta \log y_{it} - \Delta \log Y_t) + \delta * net\ Equity * (\Delta \log y_{it} - \Delta \log Y_t) + \rho * net\ FDI * (\Delta \log y_{it} - \Delta \log Y_t) + \mu * Periphery * (\Delta \log y_{it} - \Delta \log Y_t) + \varepsilon_{it}$$

Comparing the results from equation (4.e) to those of equation (2), both over the whole sample period and over specific periods, will prove whether our hypothesis holds. If μ is significantly positive in equation (2), but insignificant in (4.e), it indicates that the discrepancies between core and periphery risk sharing can be explained by specifics in foreign asset balance. However, if the coefficient on the new dummy variable is significant, there is an essential factor which causes the differences in risk sharing coefficients between the two categories of countries that is not accounted for by net positions.

3.5 Risk Sharing: quarterly estimates

The second part of the statistical analysis focuses on how risk sharing evolved from period to period. The regression corresponding to equation (1) is applied, but over a ten-quarter rolling window of historic data on every specific country *i*. For every quarter a linear regression estimates β_{it} on a ten-period rolling window, which covers a period of two-and-a-half years. In this research, a ten period window is chosen to assure every estimate of β_{it} is based on sufficient observations and therefore holds its significance. However, if β_{it} is estimated over too many historical observations, estimations may become to general, and period specific variations may be captured to a limited extent. Moreover, a moving window is applied, as it is more appropriate to estimate the time

specific β_{it} for later periods solely on the ten most recent observations, not on all past observations. Hence putting equal weight on current observations for the first estimate as for later estimates. An appropriately large window is chosen to moderate outliers but also appropriately small to investigate if certain trends become visible over the years. β_{it} is estimated for every quarter and every country in the period 2001-2014 (data on 2015 and 2016 are not available for sufficient countries). The first estimation is on the second quarter of 2001, nine quarters after the first observation in the dataset.

Plotting the average values of β_{it} will provide insight in how risk sharing has developed within the EMU throughout the years. This approach is applied on the periphery pool of countries, core countries, as well as on all of the EMU. Foremost, this method will show whether the estimates that were made over periodic samples resemble this method, as these graphs will potentially provide a clearer image. Furthermore we may be able to conclude whether risk sharing has improved or deteriorated since the creation of the EMU and throughout the crisis years. Ideally, we could link changes in risk sharing to certain historic economic events. For example, these graphs could offer an indication that the level of risk sharing is related to the occurrence of an economic crisis.

Besides plotting the time-specific estimates, a regression can aim to distil a time trend. In this case, for every individual country an estimation on β_{it} is performed quarter-by-quarter over a ten-period historic window, this new set of β_{it}'s functions as the dependent variable. Next, a time trend was added to the equation, and dummy variables are included on the periods that were defined earlier in this chapter, either on the two-way or the three-way division of the sample period.

5.a) $$\beta_{it} = \beta_0 + \beta_1 t + \beta_2(Dummy\ Period_1) + \beta_3(Dummy\ Period_2) \ldots . \beta_{n+1}(Dummy\ Period_n) + \varepsilon_{it}$$

Equation (5.a) will be applied on data on core countries, periphery countries and all countries. The results can be interpreted as following: β_0 is the value of β_{it} at $t = 0$. A significant β_1 prove that risk sharing does gradually improve or deteriorate. When a coefficient on the period-specific dummy variable is significant, this indicates a structural break in the (potential) time trend, a positive sign indicates a structural fall in risk sharing for that period, while for a negative sign the opposite is true.

These moving estimates on risk sharing can also be used as another way of testing for the influences of fund composition on risk sharing. Subsequently, a panel test is performed over all these country-specific and time specific β's. In this next step the regression includes β_{it} as a dependent variable, and any type of foreign asset (FA), debt, equity or FDI holdings or liabilities, as an independent variable. This panel regression aims at finding any explanatory value that foreign asset positions could have on variations in β_{it} throughout time and across countries.

5.b) $$\beta_i = \beta_0 + \beta_1 t + \beta_2 (FA - \overline{FA}) + \varepsilon_{it}$$

The variable $(FA - \overline{FA})$ refers to the amount of a type of foreign assets as a percentage of GDP minus its average value across countries and time periods. The average value $\overline{FA}$ is subtracted because therefore β_2 only focuses on country- and time specific differences. If $= \overline{FA}$, we expect β_i to equal a EMU average at that specific point in time. The outcomes of the estimates on gross positions are expected to be comparable to-, although not exactly the same as outcomes of regressions on equation (4.a). This can be explained by the fact that the computation works through different mechanisms. In equation (4.a), the effect of gross positions is measured parallel to β, which can explain variations in this β, in a one-time panel regression. In this chapter, β_{it}'s are individually estimated, generalised over a ten-quarter period (with equal weights) and then a panel

regression on these outcomes is performed in order to capture the corellation between gross positions and these β_{it}'s.

However, if the suggestion by Kose et al. (2009) is correct and international debt flows are pro-cyclical, β_n should be positive for debt (liabilities), and negative for other asset classes. The interpretation of β_1 is some potential progressive time trend. If risk sharing gradually increases or decreases independently of processes in financial integration β_1 will be significant. β_0 represents risk sharing at $t = 0$ (when a time trend is relevant) and when the financial position tested is assumed to be at the average level of this sample. The average degree of risk sharing for a specific country (group) amounts to the following equation, which can be interpreted as the percentage to which output and income are delinked.

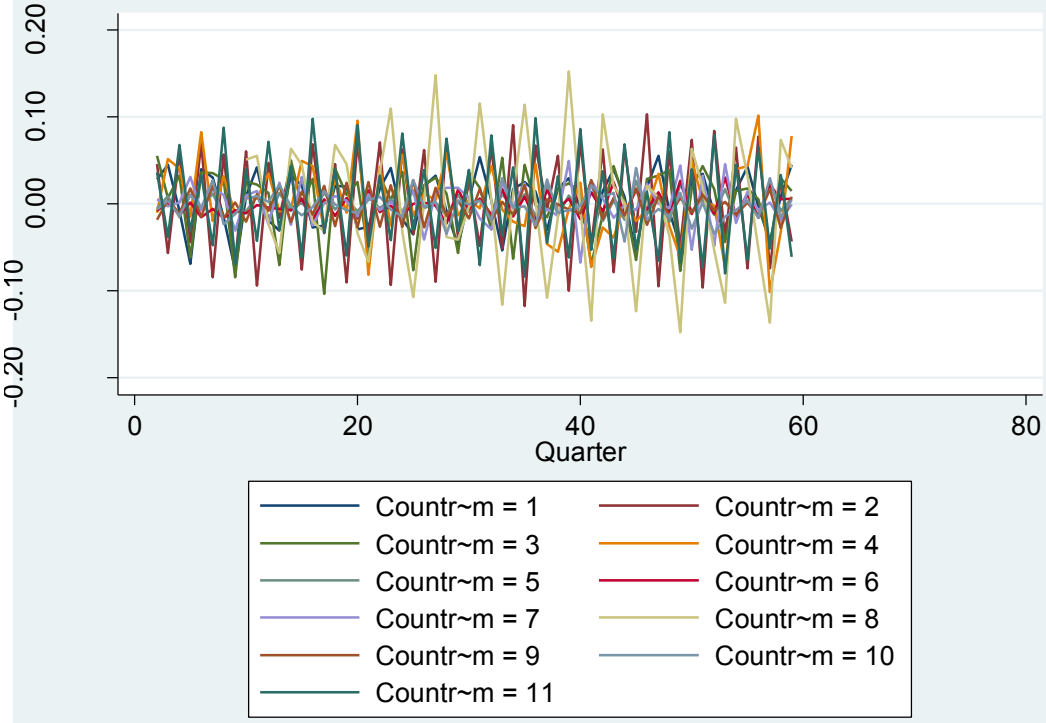
6) $$1 - \beta_0 - \beta_1(t - \bar{t}) - \beta_2(FA - \overline{FA})$$

4. Data

This research makes use of quarterly data on income (GNI) productivity (GDP) and Gross Savings for all EMU countries that have been members of the monetary union since 1999, and for Greece since 2001. This data is available over the period 1999 to 2016. This macroeconomic data was gained from the IMF website. Luxembourg is not taken into account because no consistent data on Gross National Income is made public. On financial positions, yearly data is available on the IMF website, published through the Coordinated Direct Investment Survey (CDIS). Furthermore, quarterly changes in Net Financial Positions are available on the website of the IMF. Other variables on Net Financial Positions are computed as the difference between Gross Assets and Gross Liabilities.

In the simple risk sharing regression (equation 1) the correlation between two variables, $(\Delta \log gni_{it} - \Delta \log GNI_t)$ and $(\Delta \log gdp_{it} - \Delta \log GDP_t)$ determines the level of risk sharing. It is important to determine whether or not these variables contain unit root before interpreting the significance of this relation. When time series data are non-stationary, the sample of least squares estimators is no longer assumed to be normally distributed because shocks (potentially) have permanent effects on the variable. In order for statistical evidence to be clearly interpretable we would wish our two variables to be mean (or trend) reverting (Hsiao, 2007). A Fisher test clearly indicates that in general, our panels do not contain unit root as we can reject the null hypothesis at p=0.0000. This is also shown by graph 1, a simple plot of the dependent variable, $(\Delta \log gni_{it} - \Delta \log GNI_t)$ which obviously reverts back to 0 for all countries in the sample. Evidently, we do not have to correct for unit root, and may assume that the approximation of estimators is normally distributed. Therefore, the data seem appropriate to use for the panel regressions in the following chapter.

Graph 1. $(\Delta \log gni_{it} - \Delta \log GNI_t)$ for every particular country in the dataset plotted over time



5. Results

5.1 Simple Risk Sharing

5.1.1 Income Risk Sharing

The first test in this paper will focus on the general concept of risk sharing, over the whole sample, and additionally, in order to compare the separate outcomes for core countries and periphery countries, on the two samples separately. The outcome of the first panel regression (on equation 1) shows that over the whole sample, $\beta = 0.95$ so income risk sharing $(1 - \beta)$ amounts to 0.05. This is a relatively low figure compared to other studies on risk sharing, but in this case simply income risk sharing for the average EMU country amongst other EMU member states (in this sample) is measured. So, on average, 0.05 or 5% of a country's idiosyncratic output risk is shared with other EMU countries, or in other words, 5% of national income is hedged against fluctuations in national output by being aligned EMU income. Total global risk sharing may amount to a

higher number for these countries, as financial integration with countries outside the EMU is also significant. Therefore, correlation to output fluctuations outside the EMU would contribute to general risk sharing as well.

The next step is to pool the core country[3] data and test this group for risk sharing. This regression shows that for these countries, risk sharing over the whole period has been significantly higher than the EMU average. The coefficient is three times as high, $1 - \beta$ amounts to 0.15, which is a far-reaching indication that the first hypothesis proposed in this research is correct. Specifically, this hypothesis suggests that the level of output shock to GDP smoothed by the international market is lower for countries that experience more severe negative output shocks, in this case periphery countries (D'Imperio, 2015).

The results on periphery country[4] risk sharing confirm the presumption that countries that were more heavily affected by the sovereign debt crisis did benefit less from the effects of risk sharing than core countries. In this case the β, which indicates the co-movement between changes in relative output and relative income, is higher than 1. This is unrealistic because it implies that the risk sharing coefficient will be a negative figure. It is however, a strong indication that risk sharing in core countries is significantly higher than in periphery countries, which matches our first hypothesis. However, this is still a test that is ran over the whole sample period (1999-2015) so it is hard to draw a specific conclusion about risk sharing during crisis years. Moreover, looking further into the data we find that specifically data on Greece during the period of 2009-2015 distorts the overall image of periphery risk sharing and causes the negative risk sharing coefficient. These data compound as high as an 18% change in GNI per quarter.

[3] Austria, Belgium, Finland, France, Germany and the Netherlands
[4] Greece, Italy, Ireland, Portugal and Spain

Observations on Spanish GNI and GDP seems to be problematic as well, At first sight data seem to be reasonable but when a preliminary estimate on country-specific risk sharing is performed β_{it} turns out to be negative. This result is both inexplicable and unrealistic, but could be caused by the fact that Spanish data were not reported as seasonally adjusted. Nevertheless, these two countries were excluded in order for us to find a more realistic estimate on risk sharing for periphery countries in general.

This second regression implies a risk sharing coefficient for periphery countries that is still negative. Altogether these results seem to be an indication that the first hypothesis in this research is correct; periphery countries do manifest lower levels of risk sharing than core countries. In order to further research the actual difference between the two categories, another test can be piloted and ran over the general sample but with a dummy variable for periphery countries[5]. The variable has a value of 1 when the country concerned is a periphery country and interacts with relative output fluctuations and will take the form of equation (2). This regression confirms that on average, β for core countries is 0.85 and coefficient $\mu = 0.33$, which is significant. Hence, the level of risk sharing in periphery countries is on average 33 percentage points lower than in core countries.

Historical data show that PIIGS countries have suffered from more severe and persistent negative asymmetric shocks. This regression seems to confirm that there is a negative correlation between persistent negative output shocks and the share of shock to GDP smoothed by the international financial market (D'Imperio, 2015).

5.1.2 Consumption risk sharing

[5] Including data on Greece and Spain

Furthermore, we can expand the model on risk sharing by focusing on consumption rather than income. Subtracting a change in gross savings from income approximates consumption. Equation (3) defines the regression associated with this model. The model incorporates both the potential smoothing effects of financial integration, integrated in idiosyncratic income movements, and the ability to safe money for future periods. Over the whole sample, the risk sharing coefficient for consumption risk sharing is significantly higher than for income risk sharing, $(1-\beta)$ is 0.54. Looking at the data itself we see that for relatively small economies, as Belgium and Ireland, changes in Gross Saving are very substantial, often times neutralizing or even flipping the sign on changes in Gross Income when computing changes in consumption. Essentially, consumption risk sharing is a dual mechanism; idiosyncratic movements in domestic output can be shared and through the exchange of financial assets and therefore income is smoothed, while income itself can be smoothed by households and the government, by changing their level of savings. The second mechanism cannot be directly contributed to the benefits of financial openness.

Furthermore, the regression displays that consumption risk sharing is much higher in periphery countries (0.82) than for core countries (0.50). This signals that consumption in periphery countries is less correlated with local productivity than consumption in core countries. The same conclusion was drawn by D'Imperio (2015), according to his research, especially in the period before 2008, periphery countries achieved a higher level of income smoothing through savings than core countries. To test whether or not this difference is significant, consumption risk sharing is again estimated, but over the whole sample while including a dummy variable for periphery countries, as in equation

(3.b). This test shows that the difference in consumption risk sharing (μ) between core and periphery is significant with a p-value of 0.01.

This regression demonstrates that $\mu = -0.31$, indicating that consumption risk sharing is a lot higher in periphery countries than in core countries. Although this is an appropriate conclusion, this result could also implicate that gross income minus change in gross savings is not a well-suited proxy for consumption, which by definition would be strange as Gross Domestic Saving is GDP minus final consumption expenditure. Kose (2009) and Sorensen et al. (2007) both mention that the motive to study income risk sharing rather than consumption risk sharing is twofold. They acknowledge their consideration that consumption is more susceptible to measurement errors than income, which can simply be accounted for by GNI. Additionally, it is more interesting to look at income risk sharing when researching the specific welfare effects of financial integration. Gross savings are likewise merely indirectly related to the potential welfare benefits that were instigated by creating the EMU and integrating the common financial market. Furthermore, when testing for different compositions in financial integration, using fluctuations in consumptions and essentially including savings makes it problematic to extract the effect of EMU financial integration on national income. For this reason, further tests are conducted considering income risk sharing and not consumption risk sharing. The succeeding effect of savings on consumption is therefore not taken into account in the following sections.

5.2 Periodic Estimations of Risk Sharing

Thusfar, the data showed a considerable difference in the risk sharing coefficient between so-called crisis countries and more stable economies. Likewise it is also interesting to consider how risk sharing developed over certain periods, over the whole

sample and by taking the different country categories into consideration. Subsequently , the significance and size of the discrepancy between risk sharing in core and periphery countries is investigated by regressing equation (2) over both periods seperately. The results are presented in table 1.

Table 1. Basic income risk sharing regressions, per period, on various compositions of categories. The values of μ that are reported result from a regression on equation (2) including all countries in the sample.

β per period (σ, Z)	EMU	Core Countries	Periphery Countries (PIIGS)	Periphery Countries[6] (PIIS)	Periphery Countries[7] (PII)	μ per period[8]
1999-2007	0.97***	0.88***	1.12***	0.96***	0.99***	0.24 **
	0.05, 20.7	0.05, 16.2	0.09, 12.9	0.13, 7.5	0.13, 7.79	0.10, 2.38
2008-2015	0.94***	0.79***	1.27***	1.11***	1.15***	0.49 ***
	0.05, 17.4	0.06, 13.8	0.10, 12.4	0.14, 8.09	0.14, 8.35	0.12, 4.18
1999-2006	0.96***	0.85***	1.18***	0.93***	0.97***	0.33 ***
	0.04, 21.5	0.05, 17.0	0.08, 13.9	0.13, 7.36	0.13, 7.61	0.10, 3.35
2007-2010	0.83***	0.77***	1.17***	1.04***	1.08***	0.40 **
	0.07, 12.4	0.07, 10.9	0.16, 7.12	0.15, 6.87	0.15, 7.07	0.18, 2.26
2011-2015	1.09***	0.92***	1.22***	0.92***	0.93***	0.30 **
	0.07, 16.7	0.08, 11.2	0.09, 12.56	0.16, 5.86	0.16, 5.96	0.13, 2.36

Figures $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1% levels

In order of simplicity this research starts out by dividing the sample period in non-crisis and crisis years. This does not deliver striking results. Over the whole EMU region, risk sharing remained rather constant. Originally, one would expect that through the gradual progress of financial integration, risk sharing would become more predominant over time. However, other theories indicate that risk sharing may be negatively affected by the recent crises that shook all European economies. The core countries seem to have

[6] Excluding Greece
[7] Excluding both Spain and Greece
[8] μ includes Spain and Greece

benefitted somewhat from further financial integration, while at the same time risk sharing in periphery countries seem to have become lower during the years of crisis. Understandably, the dummy on the gap in these risk sharing coefficents did increase from 0.24 in the non-stressed period, to 0.49 in stressed times.

It seems that both developments, the prevalent crisis as well as the more mature integration within the monetary union, neutralise eachother in relation to international income smoothing in the EMU as a whole. It makes sense to further divide the sample period over smaller fractions to dive deeper into the developments that took place in this timespan of seventeen years.

So the sample period was divided into three periods, a relatively stable period of economic growth (1999-2006), a period in which the Great Recession affected the global economy (2007-2010) and the period in which the the Euro crisis and its aftermath were most significant for the economic circumstances in the EMU (2011-2015). In general, risk sharing improved in the first ten years of the EMU existence, even though in the periode 2007-2010 most economies suffered under the Great Recession. This implies that the development of an internal financial market boosted risk sharing between 1999-2010, even though all countries in the sample experienced output loss as a result of the global financial crisis. It appears that while (negative) output shocks were greater in the second period than in the first, risk sharing mechanisms compensated for these shocks to a greater extent than during the more stable first period (1999-2006). The development in risk sharing among core countries seems to have driven the increase in risk sharing found for the EMU in general. Additionally, Greece and Spain were taken out of the dataset on periphery countries. Curiously, when all PIIGS countries are included in the periphery sample, risk sharing is at its worst during the

sovereign debt crisis, but when Greece is excluded the lowest level of risks sharing is found during the Great Recession (2007-2010). Therefore, it is somewhat harder to draw a sound conclusion about the developments of risk sharing in specific periphery countries during the first ten years of the EMU.

Furthermore table 1 shows that recently risk sharing has decreased. For most countries, risk sharing was higher, as β is lower, in the period 2007-2010 than in the period 2011-2015, except for periphery countries excluding Greece, and Greece and Spain. This raises the suspicion that the sovereign debt crisis has amplified the procyclical effect of output fluctuations on income movements, specifically in Greece. These results do not, however, provide proof on whether the differences found in risk sharing across periods are significant. Nevertheless, the most remarkable result in table 1 is that the decrease in risk sharing during the period 2007-2015 seems to be greater for core countries than for periphery countries.

Furthermore the discrepancy between core and periphery, shown by parameter μ is higher in 2007-2010 than during the last period, so the difference has declined. This seems to contradict the hypothesis that risk sharing worsens (more) in countries that are more affected in financial crises during those crises. From the first section we can conclude that periphery countries, countries that were more severely affected during the Euro crisis, generally share less of their idiosyncratic output risk with other EMU economies than core countries. However, this difference seems to have been present ever since the creation of the EMU and still seems to be unrelated to the timing of financial crises.

5.3 Risk Sharing and Composition of Financial Integration

5.3.1 Gross Financial Positions and Risk Sharing

Past research indicates that different forms of international financial exchange affect risk sharing in different ways and may not necessarily lead to an improvement in risk sharing. The composition of international financial positions may thus affect the risk sharing coefficient, potentially in a negative way. This section examines the effect of Debt, Equity and FDI, both for inward and outward positions (liabilities and assets). Basic risk sharing theory predicts that all different positions will contribute to risk sharing. However, this works in practice when r_i that is paid on foreign liabilities shows a higher correllation to domestic output than to European output. Likewise, r_i that is received over foreign assets should display a higher correllation to European output than to local output.

$$Income = Productivity + r_F B_F - r_{D_i} B_D + r_{F\ equity} E_F - r_{equity\ i} E_D + r_{F\ FDI} F_F - r_{FDI_i} F_D$$

The next section should show if this in fact the case and if these risk sharing benefits differ across asset classes, and liabilities versus assets. A panel regression is performed on formula (4.a). In this section, panel regressions are performed over the whole sample and for the whole period (1999-2015) for six different interaction terms independently, the results are presented in table 2. In these regressions, the results on the non-interacting financial variable $\vartheta * FP$ are evidently negligable, and therefore not reported, which makes it easier to draw a conclusion on the effect of a certain position on risk sharing.

Table 2. Coefficients on Gross Positions, as resulting from equation 4.a

Coefficients (γ (σ,Z))	Equity Liabilities	Equity Assets	Debt Liabilities	Debt Assets	FDI Liabilities	FDI Assets
γ	-0.35**	-0.18*	-0.15*	-0.07	-0.18	-0.16
	0.14, -2.47	0.10, -1.71	0.08, -1.80	0.04, -1.51	0.13, -1.33	0.13,-1.27

Figures $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1% levels

Tested separately, all six forms of financial integration display a negative sign for the coefficient γ_i, which effectively means an increase in the position would enhance risk sharing. However only the only variable that is significant is equity liabilities, while equity assets and debt liabilities are merely significant at a 10% level.

The difference in the size of these coefficients (-0.35, -0.18 and -0.15) is hardly telling as debt positions are generally significantly higher than equity, so the practical effect on risk sharing may still be comparable. Nonetheless, we can also draw a conclusion on foreign debt asset, FDI assets and FDI liabilities, based on this result. It appears that the return that is received over these assets does not to show a signficantly higher correllation to European output than to local output, and therefore does not significantly improve risk sharing, while the return paid over the FDI liabilities does not display a higher correlation to local output than to European output.

The research of Bracke and Schmitz (2008) previously mentions that equity liabilities tend to have a greater effect on risk sharing than equity assets as the inflow of dividends remains fairly constant over time. However, this remark is not made in relation to debt positions. These regressions confirm in no way the potentially deteriorating effect debt (liabilities) could have on the degree of risk sharing that was mentioned in earlier research.

There is an obvious risk of ommited variables in these regressions, when taking a single position per regression into account. A measurement error can arise a specific high position in either debt, equity or FDI, is not directly related to a high degree of risk sharing, but merely suggestion of a high degree of openness and fund flow which consequently increases risk sharing. Consequently we would like to test these regressions on the measurement error that potentially arises when only using one

variable on financial openness. Because of this potential mechanism the distinct regressions on debt, equity and FDI liabilities and assets are tested for omitted variables with a Ramsey reset test. The Ramsey reset test is an indication of non-linearities in the estimates that are caused by ommitting relevant variables. This test concludes that we can not reject the null hypothesis of no ommitted variables for any of the significant regressions regarding equation (4.a).

Because of this result it may not be necessary to include all variables on Gross Financial Positions in one regression. At the same time, a multicollinearity problem may arise when all six variables on FP are incorporated. Multicollinearity arises when there is a linear link between two or more independent variables, which in this case is probable. When multicollinearity occurs the standard errors of the coefficients on these variables become inflated and therefore the estimates become unreliable. In Stata one can check for the variance inflation factor with a vif test. When all six variables, on debt, equity and FDI, are included, the vif value of FDI assets and liabilities, and asset positions in debt and equity are higher than 10, which indicates that these variables might be redundant. These variables are subsequently dropped and a vif test on a regression with two independent variables on gross financial positions, debt and equity liabilties, displays a sufficiently low degree of collinearity. However, when including both debt and equity liabilities, the coefficient on debt liabilities becomes insignificant while the coefficient on equity liabilities becomes negatively significant, although only at a 10% level.

5.3.2 Gross Financial Positions and Risk Sharing in Core and Periphery; Crisis and Non-Crisis

An interesting expansion on how gross financial positions affect risk sharing could be to investigate potential differences in these effects between core and periphery countries. In order to perform such a test equation (4.a) is expanded by adding a dummy variable

for periphery countries, thus testing equation (4.b). The previous section showed that positions either enhance risk sharing, or display a negative but insignificant coefficient. Thus any negative μ indicates that for that gross position, effects are stronger in periphery countries than in core countries and for any positive μ periphery countries benefit less from that position from a risk sharing perspective. Table 3 identifies the results from this test.

Table 3) Coefficients on Gross Positions, as resulting from equation 4.b, capturing the effects of gross financial positions in core countries (γ) and periphery (γ+μ)

Coefficients γ and μ (σ, Z)	Equity Liabilities	Equity Assets	Debt Liabilities	Debt Assets	FDI Liabilities	FDI Assets
γ	-0.70**	-0.29	-0.25*	-0.13	-0.11	-0.07
	0.28, -2.45	0.20, -1.43	0.13, -1.88	0.10, -1.30	0.14, -0.79	0.14, -0.49
μ (Periphery)	0.43	0.15	0.16	0.08	-0.49	-0.63*
	0.32, 1.37	0.23, 0.64	0.16, 1.01	0.11, 0.71	0.36, -1.35	0.33, -1.89

Figures $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1% levels

Table 3 shows that just one positions shows a significant difference between the effects in core and in periphery countries. For FDI assets goes that in core countries this asset class does not have a significant effect on risk sharing. In periphery countries however, FDI holdings contribute significantly more to risk sharing. A straightforward explanation for this difference is hard to motivate. Moreover, it proves that periphery countries could improve their level of risk sharing by enhancing exchange in FDI. Secondly from table 3 can be deduced that equity liabilities still demonstrate a significant negative coefficient for core countries. This appears to be partially nullified for periphery countries, by the positive coefficient μ, but this difference is not significant. Furthermore, a subsequent test will reveal whether the effects of gross positions on risk

sharing differ between crisis and non-crisis periods. This test is defined by equation (4.c) and the results are presented in table 4.

Table 4) Coefficients on Gross Positions, as resulting from equation 4.c capturing the effects of gross financial positions in non-crisis (γ) and crisis years (γ+φ)

Parameter (σ, Z)	Equity Liabilities	Equity Assets	Debt Liabilities	Debt Assets	FDI Liabilities	FDI Assets
γ	-0.07	0.05	0.04	0.03	0.35	0.75
	0.19, -0.35	0.13, 0.40	0.12, 0.32	0.06, 0.53	0.51, 0.67	0.61, 1.24
φ (Dummy on crisis	-0.57**	-0.48**	-0.30**	-0.20**	-0.56	-0.95
years)	0.26, -2.18	0.19, -2.53	0.15, -2.02	0.08, -2.56	0.53, -1.06	0.62, -1.54

Figures * , ** , and *** indicate statistical significance at the 10%, 5%, and 1% levels

Strikingly, table 4 demonstrates that none of the gross positions is significant during tranquil times, because γ is insignificant for all financial positions. At the same time, solely equity and debt positions display a significant effect on the level of risk sharing during the second period, characterised as stressed. It seems that during economically stable times, gross financial positions do not have any effect on risk sharing. Besides, the debt asset position has become significant during the crises, while it was not significant when estimated over the whole sample period, and equity assets and debt liabilites have become significant at a 95% confidence level. Based on our third hypotheses, φ is expected to be positive for debt liabilities; hence that debt liabilities especially penalise risk sharing during crisis periods. However this coefficient is significantly negative. In other words, this implies that countries benefit from the smoothing effect of foreign liabilities during the Great Recession and Sovereign Debt Crisis, which clearly contradicts our hypothesis.

5.4 Net Financial Positions

5.4.1 Net Financial Positions and Risk Sharing

The first regressions on gross financial positions generate the conclusion that most gross financial positions have a positive effect on risk sharing, at least in some periods. Likewise, according to these first regressions, high foreign debt liabilities also benefit the degree of risk sharing in a country. But theory (Lane, 2012; Bai and Zhang, 2012; Rodrik & Velasco, 2000) suggests not only that high debt liabilities could potentially increase national income volatility, a high net deficit on the foreign debt account could deteriorate income sharing effects. Therefore it is also interesting to look at the effect of a national net debt balance on the risk sharing coefficient. In case of high liabilities and low assets, the value of *net debt* becomes negative, which in combination with a positive coefficient would implicate a decrease in risk sharing. The results in table 2 would lead us to presume a positive coefficient on the variable *net debt* because debt liabilities display a significant coefficient of -0.15, while the estimated coefficient on debt assets is insignificant (-0.07). However, our second hypothesis presumes that risk sharing deteriorates in case of high debt liabilities and low debt assets, in which case the coefficient on this variable would be negative.

We expect a positive coefficient on *net equity* because the coefficient on equity liabilities is likely to be stronger than for equity assets, as can be seen in table 2, (-0.35 and -0.18). Because the regression on gross positions displays a comparable effect of inward and outward positions on risk sharing, the sign that is expected for the *net FDI* variable is uncertain.

The results of the regression are shown in table 5. This shows that over the whole sample, the variable associated with net equity is significant at a 5% level, net debt is significant at a 10% level, and net FDI is not significant. Another vif test is conducted on

multicollinearity because we would expect that high (or highly negative) net positions are associated with high general fund flow out of (or into) a specific country and therefore it is likely that the independent variables are highly correlated. If this would be the case, high net debt should be associated with high net equity and high net FDI, and a multicollinearity problem is likely to arise. However, a variance inflator factor test does not indicate any form of multicollinearity so we do not need to omit any variables.

Some noteworthy conclusions can be drawn from this outcome. First of all, the coefficient on the net equity position is positive. This means that relatively high foreign equity liabilities essentially smooth idiosyncratic output movements, which corresponds with the results in the previous section on gross positions. However, this also implies that a (high) equity surplus results in a decrease in risk sharing. This second notion does not directly correspond to the findings on gross positions. Still, the positive sign on net equity could merely be an indication that the positive effect of equity liabilities on the level of risk sharing is much stronger than the potentially positive effect of equity assets.

Most notably, in this case we do witness a negative effect of debt deficits, however weak, on risk sharing. This is an important finding and a step towards a confirmation of the second hypothesis in this paper. To this extent there is proof that debt liabilities do indeed have a progressive effect on the impact of idiosyncratic output movements on national income within the EMU. We can determine that financial integration does not necessarily promote risk sharing among EMU countries, because there is at least one exception.

Specifically, this result presents us a β that is almost equal to the β in a regression without the variables *net debt* and *net equity*. We can thus conclude that in general, over the whole sample, the debt balance and the net equity balance compensate eachother.

This ought to be the case because net financial positions are measured as positions with other EMU countries so the average value of these variables should be zero. It also implies for every euro deficit on the foreign equity balance, a country can show roughly 2.20 euros deficit on the foreign debt balance, and experience no impact of net positions on risk sharing. As is mentioned before, debt contracts make up 60% of global net foreign asset positions, so this could be a reasonable number. However, this also means that in a state where the net equity balance is close to zero, a large debt deficit can seriously deteriorate income smoothing through risk sharing. Essentially an increase in debt liabilities, all else equal, will decrease the risk sharing coefficient.

Furthermore, it is important to research whether the negative effects of debt liabilities on risk sharing are the main explanation for the differences in levels of risk sharing between core countries and periphery countries. To test whether an important differential factor was not taken into account in the regression a dummy variable is added resulting in equation (4.e). We find that, by including this dummy variable, our results slightly change, the new coefficients are laid down in table 5.

Table 5) Coefficients on Net Positions, as resulting from equation 4.d and 4.e on complete sample period

Parameters (σ, Z)	β	$\gamma(net\ Debt)$	$\delta\ (net\ Equity)$	$\rho\ (net\ FDI)$	μ (Periphery)
full sample	0.84***	-0.26**	0.56*	-0.06	0.37***
	0.04, 20.4	0.11, -2.30	0.30, 1.88	0.66, 0.09	0.09, 4.18
full sample	0.95***	-0.17*	0.37*	0.04	
	0.04, 24.8	0.10, -1.74	0.20, 1.87	0.66, 0.06	
non-PIIGS (core)	0.78***	-0.08	0.58*	0.01	
	0.04, 19.96	0.09, 0.87	0.31, 1.87	0.06, 0.15	
PIIGS	1.22***	-0.39**	1.37**	-3.19**	
(periphery)	0.08, 15.5	0.16, 2.45	0.7, 1.96	1.29, 2.48	

Figures $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1% levels

All variables are significant at a 5% level, except the net FDI position, which does not significantly affect risk sharing. This denotes that, although foreign debt deficits are negatively related to the degree of risk sharing, this correlation does not explain the difference in risk sharing between core and periphery countries to a significant extent. Moreover, comparing this μ (0.37) to the one in section 5.1, where $\mu = 0.33$, it seems that net financial positions do not explain the differences in risk sharing between the two groups of countries at all. We can conclude that a net foreign debt deficit does deteriorate risk sharing, however this does not explain the structural differences in the performance of risk sharing mechanisms between the two country categories.

5.4.2 Net Financial Positions and Risk Sharing in Core and Periphery

It may also be interesting to research the differences in risk sharing mechanisms between PIIGS and non-PIIGS countries by testing the parameters β, γ and δ over these categories. For core countries only *net equity* is significant, as is shown in table 5, *net debt* does not seem to have any effect in core countries. In this case, basic risk sharing has a β of 0.78, which is somewhat lower than in a simple regression, resulting from

equation (1), and δ is 0.58, both numbers are quite comparable to the results on the full sample. When testing this equation for periphery countries, the parameters on net debt and net equity positions give quite a strong image: both a debt deficit and an equity surplus would cause a weakening in risk sharing, while the opposite is also true. At the same time the regression demonstrates a rather strong effect of *net FDI* on risk sharing. This outcome is quite surprising and hard to place in a context. The most noteworthy conclusion that can be drawn from table 5 is that the deteriorating effect that a debt deficit has on risk sharing, is rather weak for the whole sample, not found for core countries, and significant for periphery countries. On the one hand, this does not explain the structural differences found in risk sharing between the two categories, however it does confirm our second hypothesis, that relatively high debt liabilities can weaken risk sharing, at least for some countries.

5.4.3 Net Financial Positions and Risk Sharing in Crisis and Non-Crisis Years

Thusfar this research has found that a equity deficit is positively related to income smoothing while a debt deficit has the opposite effect. The next step is to observe whether this relation varies across crisis and non-crisis periods. Data will be assembled in the period 1999-2007 and the crisis years of 2008-2015. The results of these regressions are presented in table 6.

Table 6) Coefficients on Net Positions, as resulting from equation 4.d, per period. Net FDI was insignificant for all period and is not reported on.

Parameters (σ, Z)	β	γ $(net\ debt)$	δ $(net\ equity)$
1999-2007	0.93***	-0.06	0.66*
	0.05, 19.19	0.10, -0.55	0.39, 1.71
2008-2015	0.98***	-0.22	0.24
	0.06, 16.95	0.11, -2.05	0.57, 0.43
1999-2006	0.92***	-0.10	1.05***
	0.04, 20.41	0.10, -1.07	0.40, 2.65
2007-2010	0.85***	-0.06	0.33
	0.07, 12.18	0.35, -0.17	0.91, 0.36
2011-2015	1.18***	-0.51**	-0.44
	0.07, 17.89	0.25, 2.01	0.62, 0.72

Figures $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1% levels

The first regression on equation (4.d) over the period 1999-2007, shown in table 6, displays that during regular times, *net debt* (γ) is not significant and an equity deficit has a significant income smoothing effect during the non-crisis years (at 10% significance). It is quite notable that net debt positions have no significant effect on risk sharing during regular times, especially because during crisis years, this effect is rather distinguished. When running the regression on stressed times (2008-2015), the influence of the net debt position on risk sharing ís significant, while the variable associated with net equity is not. This corresponds with theory as well as history. During a crisis very high debt liabilities, and thus a debt deficit, can become visible so that these positions are penalised by other countries through assets that are reclaimed or by the demand of higher interest rates. This aggravates the situation in an already stressed economy, thus increasing volatility and diminishing the effects of international risk sharing. Ultimately we can conclude that the effects of different forms of financial integration is twofold. In regular times, countries predominately benefit from the

exchange in equity, because it significantly reduces volatility. But when high debt liabilities, in combination with low debt assets subsist during a financial crisis, local default risk can be perceived as higher, resulting in limitations for risk sharing mechanisms.

Additionally we zoom in on the development in the influence of net foreign debt and net foreign equity on the risk sharing coefficient by further breaking down the sample period into different periods. Equation (4.d) is regressed over three different periods that were specified in the previous section, 1999-2006, 2007-2010 and 2011-2015, periods that were respectively characterised as economically stable, the Great Recession and the Euro crisis. This in order to give an understanding on how the influence of net debt and net equity evolved through time. We find that for the first period, γ is not significant. So any deteriorating effect of relatively high debt liabilities has not yet become perceptible. At the same time, an equity deficit is associated with higher levels of risk sharing during this period of gradual economic growth.

During the second period neither variables on net financial positions are significant. Table 6 confirms that risk sharing during this period risk sharing was generally high, although this periods marks the manifestation of the Great Recession. Apparently financial crises are not necessarily associated with lower levels of risk sharing althoug any development in financial integration does not seem to explain this progress. This is yet another indication that other mechanisms may substantially influence risk sharing aside from financial integration.

The last period, characterised by the sovereign debt crisis, produces the most striking results in relation to the hypotheses in this research. The estimate on *net equity* is not significant. However, the coefficient on net debt position is signficiant. and negative.

Thus there is a potential relation between the manifestation of the sovereign debt crisis and the significance of a debt deficit. This result could potentially offer an explanation as to why countries that suffered most through the sovereign debt crisis also display significantly lower levels of income risk sharing. To test for this hypothesis equation (4.e) is tested on each particular periods the results are presented in table 7.

Table 7. Coefficients on Net Positions, as resulting from equation 4.e, per period. Net FDI was insignificant for all period and is not reported on.

Parameter (σ, Z)	β	$\gamma(net\ Debt)$	$\delta(net\ Equity)$	μ *(Periphery Dummy)*
1999-2007	0.86***	-0.14	0.77**	0.25**
	0.05, 16.2	0.11, 1.27	0.39, 1.97	0.11, 2.19
2008-2015	0.80***	-0.24**	-0.03	0.49***
	0.06, 13.3	0.10, 2.45	0.56, 0.05	0.12, 4.18
1999-2006	0.85***	-0.20**	1.07***	0.36***
	0.05, 17.6	0.10, -2.05	0.38, 2.79	0.11, 3.21
2007-2010	0.78***	0.05	-0.52	0.41**
	0.07, 11.0	0.33, 0.14	0.87, 0.60	0.18, 2.31
2011-2015	0.99***	-0.48**	-0.37	0.26**
	0.10, 10.4	0.25, -1.92	0.65, 0.57	0.13, 1.96

Figures $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1% levels

The dummy variable is shown to be significant for all periods, thus *net debt* and *net equity* cannot explain the difference between core and periphery for any of the periods in table 7. Moreover, the dummy seems quite constant and comparable to the periodical results in table 1.

Besides, the coefficients on net positions become more distinct by including the dummy variable. *Net debt* is both significant during the first and the last period. Most importantly, in the years that are categorised as the sovereign debt crisis (2011-2015), the coefficient on *net debt* is shown to be most pronounced with the estimate $\gamma = -0.48$.

Thus, during the sovereign debt crisis, a foreign debt deficit had the most severe effect on risk sharing, especially considering the fact that deficits were at their highest ratio's during those years. At the same time, net foreign equity deficits had significantly a smoothing effect on income in the first years of EMU existence. However, this effect became completely insignificant during the years of crisis, both during the Great Recession and the sovereign debt crisis.

Table 7 obviously shows that *net debt* is significant in both the first and the last period, and therefore signifies a considerable negative effect of high liabilities (in combination with low debt assets) on risk sharing while at the same time countries seem to benefit from issuing equity internationally during non-crisis times. However, the significance of μ during each period proves that this does not explain the difference between risk sharing in PIIGS and non-PIIGS. Comparing the different values of μ in table 7, to the values of μ in table 1, one can conclude that by including variables on net positions, the difference between core and periphery in risk sharing has merely become more pronounced. This indicates that high foreign debt deficits do not explain the structural differences between core and periphery countries, found in the previous chapter, neither during economic stable times, nor during a crisis.

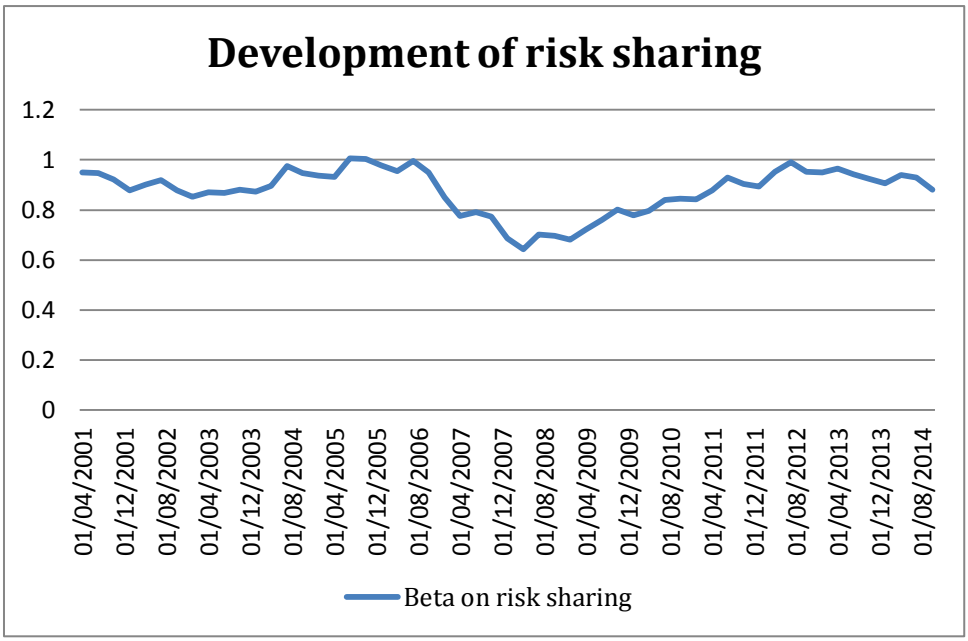
5.5 Time-Adjusting Models

5.5.1 Quarter-by-Quarter Estimations

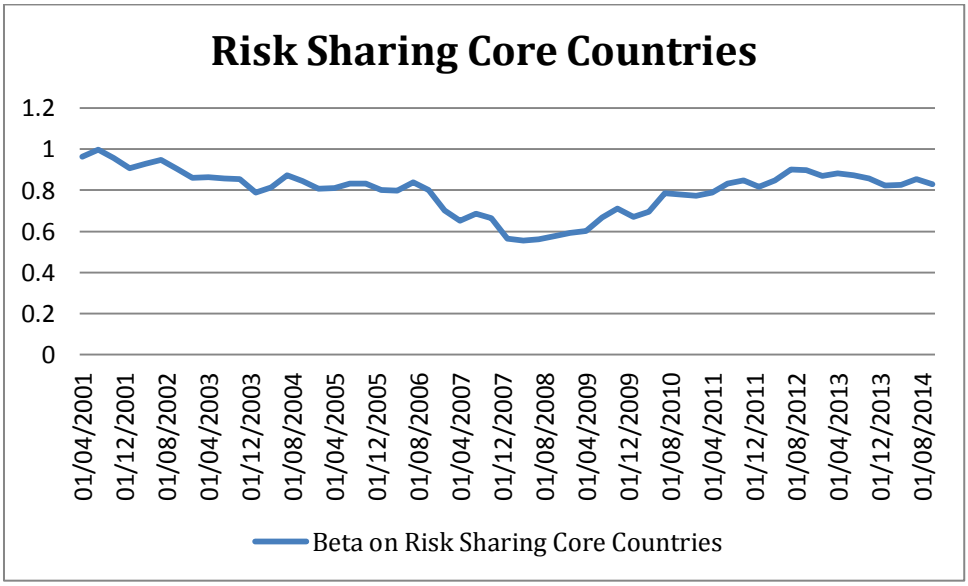
The next step in this paper is to perform an analysis on the development of risk sharing from quarter to quarter in the period 2001-2014. This could provide an image on the evolution of risk sharing through time in a period that the EMU assimilated but also a period in which economies suffered from two major crises. For every quarter a simple linear panel regression estimates β_{it} on a ten-period rolling window, which covers a

period of two-and-a-half years. The goal is to research if specific trends become visible over the sample period. The first β_{it} that is estimated is thus on the second quarter in 2001 as is shown in graphs 2, 3 and 4. The plot represents an average in β_{it}'s for all countries in the sample at time *t.*

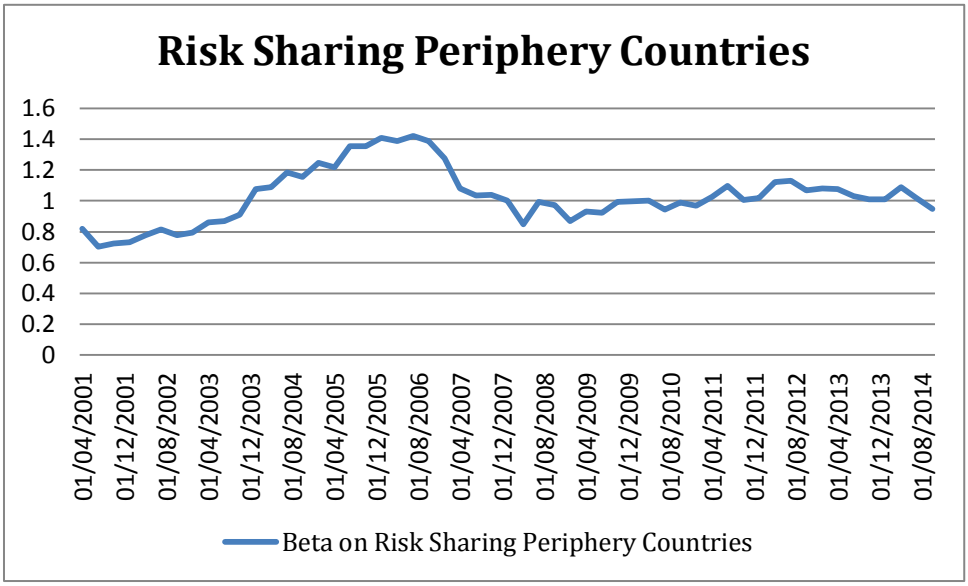
Graph 2. β (or 1 - risk sharing) in the EMU plotted over time



Graph 3. β (or 1 - risk sharing) in Core Countries plotted over time



Graph 4. β (or 1 - risk sharing) in the Periphery plotted over time



Graph 2 shows an image that is in line with the results when β was estimated over three distinct periods ('99-'06, '07-'10 and '11-'15) in table 1. The first few years after the creation of the EMU β_t was still very close to 1, so risk sharing was minimal. It was only after 2006 that risk sharing showed a considerable increase (a decrease in the graph), up onto 2010 risk sharing was around 0.20. This is remarkable because in this period the Great Recession had a significant impact on the global economy. Graph 2 seems to confirm that financial crises do not necessarily harm the degree of risk sharing. But after 2010 risk sharing seemed to have steadily decreased for a period of two-and-a-half years up onto the point where it was very close to zero. This might have been caused by the sovereign debt crisis, although this is not a conclusion one can draw explicitly.

The third graph displays a very nuanced development of risk sharing among core countries. In this image β_{it} seems to have quite steadily declined ever since the creation of the EMU until the start of the Great Recession in 2008. This decline is associated with gradual progress in risk sharing. It appears to correspond with theoretical predictions. Simply put, the development of a monetary union will enhance financial integration and

therefore risk sharing will gradually increase. But after 2008, β_{it} seems to have been progressively increasing, relating to a steady decrease in risk sharing among core countries. The latter development is quite noteworthy. For whatever reason, risk sharing seems to have been deteriorating over the last eight years. This could be a consequence of the sovereign debt crisis, however, this is still merely a hypothesis.

The last graph is noteworthy, in the first place because it displays β_{it}'s that are significantly higher than 1, and are so for a longer period of time. There is no clear-cut interpretation of this finding. It suggests that a relative increase in productivity would cause an even higher relative increase in income and at the same time a relative decrease in productivity would cause a bigger fall in income. Going back to the basic mechanism behind delinkage between productivity and income:

$$Income = Productivity + r_{F\ debt}B_F - r_{D_i}B_D + r_{F\ equity}E_F - r_{equity\ i}E_D + r_{F\ FDI}F_F - r_{FDI_i}F_D$$

We assume there is always some amount of foreign financial exchange, it seems to imply that r_F on debt, equity or FDI is more correlated with local output than r_{D_i}. This seems unrealistic but could be accurate when for example interest paid on liabilities paid to foreign countries go up when output falls because an increase in (default) risk. However, if this would be the appropriate explination it seems contradictory that the highest value of β_t (1.42) is found in 2006, a period of relatively constant economic growth, and a period in which the ten-period window does not consist of periods of crisis. Therefore, the very high β_{it}'s that are found are still ambiguous and inconsistent with current theories on risk sharing.

Another important notion that can be found in these graphs is that at the conception of the EMU, risk sharing in periphery countries was higher than in core countries.

However, risk sharing in core countries outpaced that of periphery countries in the middle of 2003. This could potentially be related to the fact that the ratio of foreign debt liabilities to GDP doubled in most PIIGS countries, and sometimes almost tripled during their first years of EMU membership. This was, as is described in the first chapter of this paper, probably a consequence of the sudden access to foreign credit. At the same time, most core countries did not increase their net foreign debt to GDP position at all during this period. Results in table 7 demonstrate that foreign debt deficits did actually have a significant negative effect on risk sharing during the first years of EMU existence. This notion could be part of the explanation why risk sharing has historically been somewhat explosive for PIIGS countries, while the development of risk sharing has been much smoother for core countries. However this explanation is statistically rejected because a dummy variable on the periphery is also clearly significant for this period.

5.5.2 Quarter-by-Quarter Estimates and Periodic Discrepancies

This section aims to find whether the periods defined in the previous sections, crisis versus non-crisis and the threeway division of the sample period, actually delivers significantly different results in risk sharing. In order to test for any significant divergences in risk sharing per period, equation (5.a) is regressed with the dummy showing a value of 1 when β_{it} is estimated over the crisis years, 2008-2015. The results are shown in table 8.

Table 8. Coefficients on time variables, as resulting from equation 5.a on two periods using quarterly estimates β_{it}

β (σ, Z)	β_0*(constant)*	β_1*(time trend)*	β_2 *(Dummy 1999-2007) non-crisis*	β_3 *(Dummy 2008-2015) crisis*
EMU	1.03***	0.04**		-0.32***
	0.21, 4.97	0.02, 2.39		0.12, -2.68
Core Countries	0.92***	0.04		-0.17
	0.26, 3.53	0.02, 1.63		0.17, -1.00
Periphery Countries	1.24***	0.04 *		-0.53***
	0.40, 3.13	0.02, 1.82		0.15, -3.54

Figures $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1% levels

Over the whole EMU, all variables are significant. The development over time these results imply are quite the opposite of what would be expected. There is a significant time trend with a positive sign, which implies that risk sharing gradually deteriorates over time. However, risk sharing significantly improves during the crisis years, which is shown by the considerable negative coefficient on the crisis period dummy variable. Essentially the degree of risk sharing is the result of: $1 - \beta_0 - \beta_1(\Delta t) - \beta_2(2008 - 2015)$. This does not imply that risk sharing improved in periphery countries between 2001 and 2008 in absolute numbers; $\beta_1 = 0.04$ which means that when the crisis period begins in 2008, $t = 36$ (but the first estimate is made at $t = 11$). So the difference amounts to $\beta_1 t - \beta_3 = 1.00 - 0.53 = 0.47$, which means that risk sharing was significantly worse in 2008 than in 2001 among periphery countries.

The same method can be applied to dummy variables dividing the sample in three distinct periods; non-crisis, Great Recession and Euro Crisis. These results are presented in table 9.

Table 9. Coefficients on time variables, as resulting from equation 5.a on three periods using quarterly estimates β_{it}

β(σ, Z)	β_0(constant)	β_1(time trend)	β_2 (Dummy 1999-2006)	β_3 Dummy 2007-2010	β_4 (Dummy 2011-2015)
EMU	1.40***	-0.02		-0.08	0.27
	0.22, 6.24	0.02, -0.82		0.13, -0.63	0.20, 1.32
Core Countries	1.55***	-0.07**		0.22	0.96***
	0.28, 5.55	0.03, -2.26		0.18, 1.24	0.28, 3.45
Periphery	1.15***	0.06**		-0.54***	-0.78***
Countries	0.42, 2.78	0.03, 2.00		0.16, -2.98	0.16, -3.29

Figures $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1% levels

Table 9 shows ambiguous results when regressing equation (5.a) over all EMU countries, neither the time trend nor the both dummy variables are significant. The results on the regression on core country data however show the effects that would be predicted from a theoretical point of view. Here, the time trend shows a negative sign, implying a gradual increase in the level of risk sharing among these countries, while the dummy variable on the Euro Crisis is significantly positive, an indication of a sudden fall in risk sharing. At the same time periphery countries show quite the opposite development in risk sharing through time. Comparable to the results in table 1, β_{it} shows a steady increase, but also demonstrates a significant drop at the start of the Great Recession and at the start of the Euro Crisis, quite contradictory to the development that would be predicted. These results determine that countries that are prone to crisis do not particularly show a fall in the level of risk sharing at the start of such a crisis.

5.6 Gross Financial Positions and Time-Dependent Estimations

The next step in this paper is to investigate whether country-specific, time-specific risk sharing coefficients can be explained by differences in foreign asset allocation. For every

country *i* at time *t* risk sharing β_{it} is tested against a measure of time and a form of financial integration in a panel regression. Equation (5) illustrates the panel regression that is performed to incorporate both the time effect and the effect of relative financial positions on local and time specific risk sharing.

Table 10. Coefficients on Gross Positions, as resulting from equation 5 using quarterly estimates β_{it}

β (σ, Z)	*t*	Equity Liabilities	Equity Assets	Debt Liabilities	Debt Assets	FDI Liabilities	FDI Assets
β_n	-0.00 0.00, -0.05	-0.33** 0.17, -2.01	-0.02 0.2, -0.12	0.23*** 0.09, 2.63	-0.07 0.11, -0.64	0.05 0.29, 0.16	-0.04 0.30, -0.13
β_n (corrected for multicollinearity)	-0.00 0.00, -0.07	-0.45*** 0.12, -3.85		0.15*** 0.06, 2.72			

Figures $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1% levels

Table 10 shows that the time variable is completely insignificant. The absence of a linear time trend was expected after graphs 2-4 were computed, but not after the results in table 10. Furthermore table 10 shows quite a noteworthy result, namely, a significant positive coefficient for the variable on debt liabilities, while all other gross positions show a neutral or negative correlation with the estimated β_{it}'s. At the same time, table 10 demonstrates that the variable on equity liabilities significantly promotes risk sharing. Comparing these results to the ones in table 2 indicates some disagreements. In this regression, *equity assets* is insignificant altogether. At the same time, the sign on *debt liabilities* has flipped and the parameter has become significant at a 99% confidence level.

A subsequent test could point out whether the six different variables show multicollinearity when all incorporated in one regression. When a test on the value

inflated factor within this regression is performed we find all variables except debt liabilties, equity liabilities and the time trend to be problematic from a multicollearity perspective. Subsequently another test is executed on three independent variables: time, debt- and equity liabilities, the outcome is presented in table 10. The results have become more significant, both financial variables are significant at a 99% confidence level. Moreover a definite negative correlation manifests between debt liabilities and risk sharing. This is still not an unequivocal confirmation of our second hypothesis. Note that it entails that lower levels of risk sharing are merely associated with- and not necessarily caused by high levels of debt liabilities. Specifically, these lower levels of risk sharing are measured over the current period *t,* and nine past periods, while the level of debt liabilities are yearly observations. This could imply that countries that display lower levels of risk sharing are inclined to borrow more internationally. Another explanation could be that a ten-period window generates estimates that are more stable and therefore better able to capture the effect gross positions have on idiosyncratic output risk sharing. We can conclude that equity liabilities promote risk sharing unmistakenly, while debt liabilities are associated with structurally lower levels of risk sharing.

6. Conclusion

Past research has shown that risk sharing mechanisms do not work as well as predicted, and researchers have focused on economic mechanisms that deterred risk sharing. After the EMU came into existence, studies focused on whether this monetary union could cause income risk sharing to assimilate. Because fiscal policies among member states are practically non-integrated risk sharing should occur through financial integration. The manifestation of the sovereign debt crisis made economists and policy makers well-aware of the country-specific differences in productivity growth and fiscal policy. Specifically, Greece, Ireland and Portugal were most severely affected by the sovereign debt crisis, while additionally Spain and Italy were labelled as fiscally vulnerable.

In a world with complete markets and maximum financial integration, negative shocks do not need to harm national income, because income is delinked from productivity shocks through risk sharing mechanisms. However, some academics suggest that the level of idiosyncatic output movements that is shared internationally actually decreases during a persistent financial crisis, especially in the countries most affected. Other researchers mention that countries that depend heavily on foreign debt, may be less able to benefit from income risk sharing. These phenomena could even be linked; countries that demonstrate high (foreign) debt liabilities are more prone to economic crises and therefore are less able to share local output risk during those crises, because of the potential pro-cyclical characteristics of debt. When debt positions become more visible during a crisis, their pro-cyclical characteristics could be enhanced, resulting in an smaller degree of risk sharing.

The results in section 5.1 show an obvious difference in the level of risk sharing between core and periphery countries. Periphery countries benefit significantly less from income

risk sharing among EMU countries than core countries. It is noteworthy to highlight that risk sharing did improve significantly during the first ten years of the EMU, thus the degree to which output risk was hedged was higher during the Great Recession than in the early 2000's. However, risk sharing did deteriorate for both core and periphery countries during the sovereign debt crisis, between 2011 and 2015. Going back to the first hypothesis in this research, we witness that even though risk sharing levels are significantly lower in periphery countries than in core countries, this gap is not particularly enhanced druing crisis periods. There is an apparent negative relationship between a susceptibility to crises and risk sharing, however this is not time specific.

The first tests on the relationship between financial integration and risk sharing indicate that in general, gross financial positions have an either neutral or positive effect on the degree of risk sharing. A succeeding test is conducted on net financial positions, to some extent because a particular high position may merely be a sign of general fund flow because of expectations about future productivity. But moreover because other researchers state that a high debt deficit may weaken risk sharing rather than merely high debt liabilties. Debt assets could potentially function as a buffer to shocks in the debt market in relation to income volatility. Section 5.4 confirms that there is a significant negative relation between foreign debt deficits and the degree of risk sharing. We can conclude that countries experience negative consequences of a debt deficit, particularly during a crisis.

The fact that the negative relation between a debt deficit and risk sharing becomes visible during the Euro Crisis appears to be a sign that this mechanism explains the relation between a vulnerability to crisis and lower levels of risk sharing, According to academics, (relatively) high debt liabilities are linked to an exposure to crises. During

such a crisis, debt liabilities become more visible, leading to lower levels of risk sharing. However, including variables on net financial positions does not explain the structurally lower levels in risk sharing that are demonstrated by periphery countries. A subsequent test points out that for any distinct period, the structural difference between the two country categories remains significant and quite constant when variables on net financial positions are included. In other words, the deteriorating effect a debt deficit has on risk sharing does not seem to be related to a vulnerability to financial crises in practice, in any economic circumstances.

Furthermore this research dives deeper into the question whether risk sharing deteriorated significantly when the two crises manifested. This was done by modelling the regression parameter between relative income and relative productivity over time and across countries. In core countries, risk sharing developed as expected. The time trend displayed a gradual growth and a significant depreciation at the start of the sovereign debt crisis. However, in periphery countries, risk sharing gradually weakened over time and experienced a positive shock at the start of both the global financial crisis as well as in 2011, when the sovereign debt crisis was most momentous.

The results in this research clearly confirm our first hypothesis. Countries that experienced more persistent negative shocks have benefitted less from risk sharing than countries that experienced less persistent shocks. However, this divergence is comparable across a period of relative stable economic progression and periods of financial crises. So, an amplified vulnerability to crises is associated with a lower level of risk sharing but the occurrence of a crisis does not lead to an even lower level of risk sharing as compared to less vulnerable countries. The second hypothesis focused on the effects of foreign financing compostition on risk sharing, that potentially vary among

different forms of financing. The composition of international financial positions is relevant for the way financial integration affects risk sharing, as becomes apparent from section 5.4 and 5.5. Over the whole sample, a moving window estimate in risk sharing is negatively related to foreign debt liabilities. This is a clear confirmation of the presumption raised by multiple earlier papers, and moreover of our second hypothesis. Most noteworthy, the negative effect of a foreign debt deficit on risk sharing becomes significant during the sovereign debt crisis. However, this process seems unrelated to the differences in risk sharing mechanisms among the two country categories, and therefore our third hypothesis cannot be supported by the findings in this research.

This model cannot explain the structural variances between core and periphery. A more complex model is needed to capture the underlying mechanisms that explain this pattern. Such a model could further investigate the negative effects of debt liabilities from the perspective of risk sharing. An extensive research could additionally focus on the composition of debt liabilities. In light of the sovereign debt crisis it makes sense to divide positions into long-term and short-term liabilities, and public and private debt. It may also be usefull to include a measure on banking consolidation in the EMU or some measure on general national solvency as a proxy for the completeness of markets.

Another suggestion is that countries need to be perceived as stable economies above a certain standard within the union in order for fundflow to have a countercyclical effect on income. When a state is perceived as relatively vulnerable within a union, other states are likely to withdraw funds first during a general output shock which deteriorates risk sharing.

Furthermore, more advanced research could focused on what happened to risk sharing between the EMU and the rest of the world. It could be interesting to research what

happened to financial integration with the rest of the world as financial integration among member states intensified. The creation of the EMU likely lead to a perception of (fiscal) stability to the outside world especially for smaller economies. This could have contributed to risk sharing because hedging opportunities are greater when foreign output is less correlated to domestic output, so preferably by integrating with an economy completely incomparable to the domestic economy. Global financial integration could have potentially benefitted (smaller) European economies to a great extent.

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