SPECIALIZATION, RISK SHARING AND THE EURO

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Abstract

Under the prospects of productive specialization, the degree of success of the euro was seen since its inception as closely linked to the development of effective risk-sharing mechanisms across union members. Without shared fiscal resources, financial integration was expected to play a leading role in this respect. This paper documents the failure in the task of fulfilling this expectation: along with an analysis of the evolution of specialization and risk-sharing, we present evidence supporting the claim that progress in financial integration has not been conductive for income risk-sharing across euro members, while it might have favoured a specialization split between countries with low-medium and high technology productive structures. As a result, monetary union members face higher income fluctuation risk without enhanced insurance protection. Additionally, evidence suggests a differential impact of the specialization split on sector productivity, contributing to make the monetary union a club of less equals.

JEL Classification: F15, F20, F36.

Keywords: European Integration, Specialization, Risk-Sharing.

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[†] Acknowledgements: We are grateful to two anonymous referees and the editor of the journal for useful comments that significantly improved the current version of the paper. We thank Banco Sabadell and AGAUR – Generalitat de Catalunya for financial support.

Introduction

Soon after Europe was taking stock of the first ten years of the single currency experience, acknowledging challenges ahead but mainly celebrating its success (European Commission (2008), European Central Bank (2009)), the euro crisis erupted. The crisis has turned out to be deep and lasting, and has reopened the debate about the long rung sustainability of the euro. A useful way to frame this debate is to state that the economic and monetary union (EMU) is incomplete, and that the missing pieces make the union prone to crisis (see e.g. JCMS (2012) and VoxEU (2016)). These pieces tend to combine economic and political elements, reflecting the hybrid nature of currencies. One piece that has always been a main focus of the debate is the lack of a euro wide federal government structure. Economic research has highlighted two shortcomings associated with this missing piece. On the one hand, the inexistence of fiscal resources for risk sharing and the difficulty to implement euro wide fiscal actions (e.g. De Grauwe (2006)). On the other hand, the difficulty to coordinate euro wide fiscal and monetary policies in order to effectively comply with the mandate of guaranteeing price and financial stability (Sims (2016)). Political science has also emphasized the need for a central fiscal authority in the euro area, taking an even more extreme position than economists to assert that in the long run a single monetary space cannot exist without a single political sovereign (e.g. Otero-Iglesias (2015)). At a level closer to the political praxis, political science has also highlighted the important influence of politics in the euro adoption decisions of EU members (Dandashly and Verdun (2016)).

A bottom-line message of this economic and political views about the important role of a federal level and politics more generally to understand the working of currencies is that the stateless, apolitical currency that the theory of optimal currency areas (OCA) proposes is fundamentally flawed. However, the OCA tradition has provided the workhorse theory for the economics of single currencies, and was the main intellectual foundation for the launch and adoption of the euro (Kunroo (2015)). So the question of what has gone wrong with the euro according to the OCA framework is certainly of interest, and this paper intents to shed some light on it.

From the OCA perspective, much of the debate during the run up years to the adoption of the euro focused on the degree of asymmetric macroeconomic fluctuations across would-be-member countries. These were countries with low cross border labour mobility, different productive structures, regulatory frameworks and macro policy traditions that could hardly be seen as defining an optimal currency area. Therefore, the giving up of their monetary stabilization tools could be expected to have a negative welfare impact in a context of likely asymmetric fluctuations. In fact, the empirical evidence of the time (e.g. Bayoumi and Eichengreen (1993); Ballabriga, Sebastian, and Valles (1999)) pointed towards a rather high degree of asymmetry in the business cycle variability of the European countries involved in the EMU process.

In spite of this, the optimistic view was predominant, based on the argument that optimal currency areas could be made along the way: prospective structural reforms would make regulatory frameworks more homogeneous and would activate market stabilizers; fiscal policy coordination would tame differences in traditions, minimizing asymmetric policy shocks and guaranteeing it would remain ready for use as an effective macro stabilizer; capital market integration[1] would allow both for higher risk-sharing through increased cross-ownership of assets across borders, activating and additional stabilizer, and for higher productive specialization across countries, leading to a productivity catch-up process that would make the monetary union a club of equals. More than a decade later, we know that fiscal coordination has failed, but we do not know whether the euro has had any significant impact on the implementation of structural reforms and whether country specialization has taken place and has helped in the productivity catch-up process. Early evidence suggests that some increase in risk-sharing and

[1] See Mckinnon (2004) for hopeful expectations about the role of the euro in the activation of this mechanism.

specialization took place during the 1990s (Kalemli-Ozcan, Sorensen, and Yosha (2004)), and that the euro may have initially accelerated some structural reforms during the period 1999-2003 (Alesina, Ardagna, and Galasso (2010)). But this is basically pre-euro evidence. The current euro zone difficulties seem to suggest that the euro has operated as a brake on structural reforms and also that has favoured a split of countries between those specializing in high productivity sectors and those specializing in low productivity ones. Southern Europe would be in the latter bloc, lacking resilience and effective growth drivers and being especially vulnerable to global competitors and the crisis impact.

This paper focuses on the specialization dimension. We specifically look at the evolution of specialization and risk-sharing and their connection with capital market integration in the euro area. As mentioned, the expectation was that the euro would trigger capital market integration, which would allow for increased risk-sharing and productive specialization. What we find is that specialization has been enhanced, but in the direction of increasing the productivity distance between North and South. At the same time, we find that risk-sharing decreased during the 2000s, suggesting that the kind of financial integration at work was not the appropriate to allow for higher risk-sharing among euro area countries. This implies that the theoretical causal chain running from risk-sharing to specialization has not been allowed to operate in the euro area, and suggests that financial integration can actually happen in parallel to (and even enhance) specialization without the connecting ring of risk-sharing.

Based on this evidence we conclude that a specialization split is visible in Europe that has negatively affected productivity in the South and has not been accompanied by the addition of risk sharing mechanisms. We then finally explore the impact of financial integration on this specialization process in the last section of the paper. There are different strands of the literature that emphasize the impact of trade, factor, and financial integration on specialization.

Regarding the trade channel, Ricardian classical theory claims that the reduction of obstacles to trade increases trade intensity, allowing countries to exploit their comparative advantage and leading to inter-industry specialization. Dornbusch, Fischer, and Samuelson (1977) provide an example of this channel. On the other hand, the theory of New Economic Geography claims that increases in trade intensity will lead to intra-industry specialization when product differentiation and economies of scale are important. This theoretical idea underlies the results in Frankel and Rose (1998). In addition, the theory of New Economic Geography can also lead to inter-industry specialization when trade integration is complemented with factor integration. This allows considering the existence of agglomeration economies associated for example with pools of specialized suppliers, which makes optimal for companies belonging to the same industry to cluster in specific locations (see the seminal work by Krugman (1991)). Notice that the theoretical arguments mentioned so far predict monotonic trends of sectoral specialization as economic integration proceeds: as they integrate, regions head monotonically toward inter-industry or intra-industry productive configurations. However, Imbs and Wacziarg (2003) provide solid evidence to claim that specialization and diversification occur in fact at different stages of country development. This led them to conclude that although the evidence seems compatible with some combination of existing theories, its explanation remains as an unresolved question.

At the same time, a separate strand of the literature has explored the role of financial integration as an additional channel for specialization. The argument here is that by facilitating risk sharing financial integration can allow countries to exploit comparative advantages via inter-industry specialization and trade (see Kalemli-Ozcan, Sorensen, and Yosha (2003) on this channel). On the other hand, in the European context there is recent evidence that suggest that part of the lower productivity growth in Southern Europe is related to the boom in the construction sector and the shift of financial resources from traded to non-trade sectors (Reis (2013), Benigno and Fornaro (2014)). In recent work, Gopinath, Kalemli-Ozcan, Karabarbounis, and Villegas-Sanchez (2015) highlight an alternative (but complementary) view of how the euro convergence process may have impacted productivity in Southern Europe, arguing that following the introduction of the euro and the lowering of interest rates, capital was not allocated efficiently across firms in the South. In turn, the misallocation of capital flows generated declines in total factor productivity.

Given the different views regarding the impact of economic integration on specialization, the empirical analysis becomes key to try to disentangle the mechanism at work in particular historical episodes. With this objective in mind, this paper is organized as follows. Next section looks at the evolution of specialization in the euro area and its effect on productivity. After, we explore the evolution of risk-sharing. Finally, we proceed to analyze the connection between financial integration, risk-sharing and specialization.

Specialization Trends in the Euro Area

In this section we describe the main data used in the analysis, provide evidence on the evolution of sector specialization trends in the euro area, and link sector specialization to productivity differences across euro area countries as well as the potential role played by the introduction of the euro.

Data

We make use of the EU KLEMS database on sectoral data by country. This database originally includes 29 OECD countries.[2] We are interested in patterns of specialization across European countries in the euro area regions before the Great Recession, so we focus on the following list of countries reporting data from 1970 to 2006: Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, the Netherlands and Portugal.

[2] Australia, Austria, Belgium, Cyprus, Czech Republic, Denmark, Spain, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Sweden, United Kingdom and United States.

For each country and year there is industry level information on gross value added at current basic prices (in millions of national currency), value added deflators and the number of employees. There are 16 sectors at the one-digit NACE Rev 1.1. classification level and 19 sectors at the two-digit NACE Rev 1.1. classification. In the most disaggregated version of the data (two-digit industry classification) we work with 8,433 observations corresponding to 12 countries, 19 sectors and 37 years.

Specialization Index

We construct an index of sector specialization at the two-digit industry level for a sub-sample of sectors for which EU KLEMS provides consistent data over time.[3] In each period, the index is computed for each country and then averaged across countries. The index compares the share of a given sector in one country with the share of the same sector in the euro area as a whole. Values above (below) one indicate specialization (lack of specialization) of the country in that sector, and the higher the value of the indicator the higher the country's specialization compared to the euro area average. The degree of specialization in a country is measured as the Euclidean distance between the country's vector of specialization and the vector corresponding to the hypothetical non-specialization case (the specialization coefficient would be equal to one).[4]

Figure 1 in panel (a) shows the over time evolution of the average specialization index at the two-digit industry level in the euro area. It is clear from the graph that after a moderate initial decrease in the rate of specialization at the beginning of the sample (from 1970 to the early 80s) there has been a continuous increase in the average specialization index that has been clearly accentuated starting in the late 90s until

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[3] The two-digit sectors are: 15t16, 17t19, 21t22, 23, 24, 25, 26, 27t28, 30t33, 34t35, 36t37, 45,50,51,52, 60t63, 64, 70, 71t74, that correspond to one-digit sectors D (Manufacturing), I (Transport, Storage and Telecommunication), K (Real State) and F (Construction). See Table A.1. in the appendix for a description of the sectors under analysis.

[4] See the footnote in Figure 1 and appendix C.1. for a full description of how the specialization index is calculated.

nowadays.[5] Panel (b) of Figure 1 shows that the pattern of specialization has not been the same across countries in the euro area. Southern European countries like Spain, Italy, Greece and Portugal but also Ireland, report above average specialization rates.[6]

[Insert Figure 1 here]

The potential economic effects of specialization depend on two key aspects: the type of sector countries specialized in, with potential impact on output per worker, and the type of specialization pattern (intra-industry or inter-industry), with potential impact on output fluctuations. In order to elaborate on these aspects we follow the OECD classification of sectors according to their technological content.[7] Figure 2 shows the evolution of the average specialization index according to the sector technology classification. Since the beginning of the period there has been a steady increase in specialization in low technology industries within the euro area. Only since the 1990s the euro area has increased the specialization in high technology industries. Similarly to the aggregate specialization index not all geographical areas followed the same pattern of specialization.

[Insert Figure 2 here]

Figure 2 also shows that Southern European countries always had on average higher specialization in low technology industries and witnessed a rapid increase in the case of medium-low technological sectors

[5] Based on a Wald test for a structural break in the specialization series we can reject the null hypothesis that there is no structural break in 1999 (See section F.3. in the appendix).

[6] Similar results are obtained if Italy and Ireland are excluded from the South sample.

[7] See Table A.1 in the appendix for a description of the sector classification according to technology intensity and Table A.2 for the number of observations.

starting in the late 1990s.[8] In contrast, Northern European countries experienced an accelerated growth in the specialization rate in high-technology sectors starting in the late 1990s. The aggregate patterns shown in Figure 2 are confirmed by country.[9] For example, Spain experienced almost no change in the specialization index of high and medium-high technologies while a notable increase in low and medium-low technological sectors.

So there are two main aspects to the specialization process endured by the euro area countries during the last decade of the sample. First, graphical inspection of Figure 2 shows a clear upward trend in the medium-low and high technology specialization indexes around the time the euro was introduced (year 1999). Second, it is clear from Figure 2 that the countries behind the upward trend in medium-low technology industries are mainly Southern European while those behind the upward trend in high technology industries are mainly Northern European.

Therefore, we can conclude that there were significant changes in the allocation of countries' resources across sectors after the introduction of the euro. Some of these changes may be consistent with existing differences in comparative advantage and would not be problematic if accompanied by risk sharing mechanisms. On the other hand, the fact that specialization in some euro area countries took place in low technology-intense sectors can have consequences for aggregate productivity. So based on this evidence we first explore the impact of sector specialization on output per capita, and then turn to the discussion of its implications for output fluctuations in the rest of the paper.

Specialization and Productivity

The question we would like to address is whether specialization had any effect on sector productivity and if we can identify a differential effect after the implementation of the euro. In order to do so, we estimate

[8] Figure B.1 in the appendix shows similar patterns when Italy and Ireland are excluded from the South region.
[9] See Figure B.2. in the appendix.

a model where we regress the log of country-sector-year productivity on a country-sector-year specialization variable. The coefficient of interest would be the interaction between the specialization variable and a step function that equals one in the year the euro was introduced and thereafter, and zero otherwise. In addition, we control for time dummies and country-sector fixed effects.[10]

Results are reported in Table 1. Column (1) shows that on average sectors with higher relative specialization are also more productive. However, as shown in column (2), after the introduction of the euro, higher sector specialization had a detrimental impact on average sectoral productivity. The total effect is statistically significant. Other sectoral events correlated with specialization might have had an impact on sectoral productivity. For example, the deregulation of specific sectors might increase competition forcing low productivity firms out of the market and mechanically increasing the average productivity in the sector. To avoid these confounding factors in this study it is crucial the introduction of sector-year fixed effects that capture global sectoral trends. Results are reported in column (3) and confirm that controlling for omitted sectoral trends are key to identify the total effect of specialization after the introduction of the euro. Removing the sectoral confounding factors shows the direct negative effect of specialization after the introduction of the euro. Similar to global sectoral trends we could think that country specific events might impact productivity through channels other than specialization, for example, political change or a technology breakthrough in a particular country could drive our results. In order to isolate the effect of specialization, column (4) includes both sector-year and country-year fixed

[10] See the footnote in Table 1 and section C.2. in the appendix for a full description of the model. We thank an anonymous referee for suggesting running a Granger causality test in heterogeneous panels on the model. We follow Dumitrescu and Hurlin (2012) and based on the results of the test we cannot reject the hypothesis that in at least one of the sectors of the panel there is a Granger causality relationship between specialization and productivity (see section F.1. in the appendix for further details on the test). This reinforces the robustness of our results in Table 1.

effects and confirm our previous findings. Notice regardless of the negative effect after the euro, the total effect of specialization is positive. Finally, column (5) reports the effect of specialization on productivity *growth* after the euro. The total effect is significant but smaller in magnitude compared to the level effect and mainly driven by the direct effect of specialization.

[Insert Table 1 here]

From Table 1 we can conclude that there is a positive correlation between sector specialization and productivity that was lower after the introduction of the euro. We hypothesize that the decline in sector productivity after the introduction of the euro is related to the specialization by some countries in low-productivity sectors. To explore whether there is a differential effect for Southern European countries we estimate a complementary model including a triple interaction between the specialization variable, the euro step function and a new variable South which is a dummy that equals one in Spain, Italy, Greece, Portugal and Ireland. In this model we expect the coefficient on the triple interaction to be negative and significant so that Southern European countries that specialized more after the introduction of the euro show lower productivity. This specification is similar to a difference-in-difference strategy.[11]

Table 2 reports our main results. Column (1) supports our main hypothesis: specialization has on average a positive effect on sector productivity and the negative effect after the introduction of the euro is mainly driven by Southern European countries. The difference-in-difference strategy requires that South and North had similar specialization trends prior to the euro.[12] Visual inspection of Figure 1 suggests we should concentrate on the period 1995-2006. Columns (2) to (4) in Table 2 report the results for the

[11] See the footnote in Table 2 and appendix C.2. for a full description of the model and interpretation of the coefficients.

[12] We would like to attribute differences between South and North to the introduction of the euro and not to other prior events.

period 1995-2006 and confirm the findings in column (1) for the total sample. Results in column (3) suggest that specialization had on average a positive effect on sector productivity (0.537), but that effect was lower in Southern Europe after the introduction of the euro (-0.109).

[Insert Table 2 here]

Risk Sharing

Specialization does not necessarily make a region more prone to output fluctuations. It will if the pattern of specialization is inter-industry, but not if intra-industry specialization predominates. The pre-euro debate about this matter led to well-known contrasting views in the literature. On one view, Krugman (1993) argued that agglomeration economies would make Europe look like the US, with inter-industry specialization as the dominant pattern. On an alternative view, Frankel and Rose (1998) argued that the available evidence on trade and specialization across countries and across time made more realistic to think about a future scenario for the euro area characterized by intra-industry specialization. The evidence presented in the previous section points toward inter-industry (medium-low versus high tech) specialization during the early years of the euro, thus initially supportive of Krugman's view. In such a context, euro countries become more vulnerable to idiosyncratic fluctuations and the associated welfare loss. Thus, with risk-averse residents, one would expect risk-sharing to be concomitant of region specialization. Kalemli-Ozcan, Sorensen and Yosha (2003) go even further and present empirical evidence supporting the claim that risk-sharing may in fact be a causal determinant of regional specialization.

Regional risk-sharing can take several forms, but a main mechanism for spreading risk among regions is geographical diversification of income sources via financial markets, especially in the absence of own monetary tools and shared fiscal resources. This section looks at the evolution of risk-sharing in the euro area and the next will explore whether financial integration has actually led to more risk-sharing among its member countries.

We follow the decomposition proposed in Sorensen and Yosha (1998) and specify year by year regressions that quantify deviations from perfect income risk sharing. We focus on the Eurozone countries and for each year we regress the deviation of each country Gross National Income (GNI) from the group´s average GNI on the country Gross Domestic Product (GDP) deviation from the average group's GDP. The coefficient measures the average co-movement of country-specific GNI growth with country-specific GDP growth in a particular year. Under perfect risk sharing, the left-hand side of the model will be zero implying that the coefficient is zero. The smaller the co-movement of idiosyncratic GNI with GDP, the more GNI is buffered against GDP fluctuations and the smaller the estimated value of the coefficient. Since GNI equals GDP plus net factor income from abroad, this regression measures the amount of income risk sharing provided by net factor income flows, the lower the coefficient the higher is income risk sharing. The estimated coefficients for each year, measure the evolution of risk sharing over time. Often it is more instructive to look at the equivalent series: one minus the estimated coefficient. This series will take the value one if risk sharing is perfect and the value zero if GNI moves one-to-one with output.[13]

Figure 3 displays the smoothed series of risk sharing measures for the euro area countries and the period 1960-2013. We display the estimated values of 100 x (1 - estimated coefficient) which are interpreted as the percentage of income risk sharing obtained. Income risk sharing improved during the 1990s but has declined since 1999, year of the introduction of the euro.[14] Similar to Sorensen and Yosha (1998) we find no substantial income risk sharing before 1990. These results are also consistent with those

[13] See the footnote in Figure 3 and section D.1. in the appendix for a full description of the model.

[14] Based on a Wald test for a structural break in the risk sharing series of Figure 3 panel (a) we can reject the null hypothesis that there is no structural break in 1999 (See section F.3. in the appendix).

in Demyanyk, Ostergaard, and Sorensen (2008) who find that income risk sharing has improved over time for EMU countries although its level is still quite modest.[15] [16]

[Insert Figure 3 here]

Specialization, Risk Sharing and Financial Integration

In this section we explore the role of financial integration in the process of risk-sharing and sector specialization.

Financial Integration and Risk-Sharing

One of the expected benefits from the euro adoption was an increase in financial integration among euro area countries. This increase in financial flows was supposed to positively contribute to an increase in income risk sharing. To explore the effects of financial integration on income risk sharing we follow Sorensen, Wu, Yosha, and Zhu (2007) and Kose, Prasad, and Terrones (2009) and estimate a complementary model that explores the interaction between country GDP deviations from the group averages and measures of financial integration. In particular, we explore the role of the gross stocks of external assets plus liabilities scaled by GDP, or a subset of those when we split financial stocks differentiating among equity, foreign direct investment (FDI), debt, and private flows, the latter

[15] Table A.3 in the appendix shows the individual coefficients from yearly cross-sectional regressions from estimating the model in section D.1. There is no evidence of income risk sharing among the euro area countries prior to 1995. Since then, income risk sharing has been about 7 percent on average.

[16] Section F.2. in the appendix follows Kose, Prasad, and Terrones (2009) and explores the robustness of our results to alternative estimation techniques using 9-year rolling windows to smooth the risk-sharing coefficients.

representing the sum of equity and FDI. We expect a negative coefficient on the interaction to positively contribute to an increase in income risk sharing.[17]

To measure financial integration we use the updated and extended version of the dataset constructed by Lane and Milesi-Ferreti (2007). This database contains information on foreign assets and foreign liabilities for a large sample of countries for the period 1970-2011. It also reports, where available, the split between "portfolio investment: debt securities" and "other investment" for both the category "external debt assets" and the category "external debt liabilities".

We do not find a significant effect of financial integration on income risk sharing when the index of financial integration is the total stock of assets and liabilities.[18] Therefore, we go one step further and explore the possibility that foreign assets and liabilities have a differential impact on income risk sharing. We estimate the model differentiating among the stock of foreign assets and foreign liabilities. A priori we expect foreign assets to positively contribute to an increase in income risk sharing. Again a negative coefficient on the interaction term translates in higher income risk sharing. Table 3 shows the results when the full sample is considered (period 1970-2011). Column (2) focuses on FDI and contrary to what is usually argued there is no significant effect. By contrast, columns (3) and (4) show a positive effect of debt and equity foreign assets on income risk sharing while a negative impact of liabilities. Column (6) pools all variables and confirms that an increase in private assets is correlated with increases in income risk sharing, not the case for foreign debt assets any more. Additionally, debt and private liabilities keep their

[17] See the footnote in Table A.4. and section D.2. in the appendix for a full description of the model.

[18] See Table A.4. in the appendix on the results.

significant positive sign, confirming that they are consistently associated with a deterioration in income risk sharing.[19]

[Insert Table 3 here]

Overall, the results in Table 3 confirm that, with the exception of equity assets, different types of capital flows do not appear to have been conductive of income risk-sharing in the euro area, but rather the opposite, with foreign liabilities standing as a significant obstacle. These results are consistent with Kalemli-Ozcan, Manganelli, Papaioannou, and Peydro (2009), who also find opposing effects of assets and liabilities in macroeconomic volatility. The results support the interpretation that in order to be helpful financial integration has to be deep enough and inclusive of the right type of financial flows. When it is just incipient and dominated by plain borrowing, the integration may actually end up having negative results in terms of country income fluctuations. Arguably, this has likely been the euro area case, where the introduction of the euro initiated a process of financial integration mainly dominated by borrowing of the South from the North, eventually leading to a highly indebted South. This is clearly not an integration process that should be expected to provide risk sharing through geographical diversification.

Financial Integration and Specialization

Results so far point to an increased specialization with different technological content in the South and the North, and to a financial integration process that has not been conductive for risk-sharing improvements. So the euro area evolution in regard with these dimensions does not conform with a

[19] Table A.5 in the appendix shows that these results are reinforced for the period 1996-2011. In addition, we conduct a Granger causality test in heterogeneous panels based on the model estimated in column (6) of Table 3. We show in appendix F.1. that we cannot reject the hypothesis that in at least one of the sample countries, financial integration (based on disaggregated type of positions) Granger causes risk sharing.

conventional pattern whereby financial integration acts as a main provider of risk-sharing (Asdrubali, Sorensen, and Yosha (1996)) and risk-sharing as a determinant of specialization (Kalemli-Ozcan, Sorensen, and Yosha (2003)), providing an example where financial integration may have enhanced specialization without the intermediation of risk-sharing, thus leaving countries exposed to the greater income risk associated with specialization.

In fact, given the process of frenzy indebtness in Southern Europe fed by Northern Europe which characterized the pre-Great Recession euro years, one can pose the hypothesis that, rather than trade integration, it was actually disorderly financial integration leading to increasing indebtedness in the South the force that not only failed to provide risk sharing, but may have act as a disruptive specialization driver in this particular episode.[20]

To test this later possibility, whether financial integration has contributed to greater specialization in the South, we estimate a model where country-sector-year specialization is the dependent variable to be explained by country level measures of financial integration and the interaction between financial integration and the Euro step function. We focus on the subsample of low and medium-low technology industries in a reduced version of the South including Spain, Portugal and Greece. Financial integration is measured according to the split of the gross stocks of external assets and liabilities scaled by GDP,

[20] We focus on the impact of higher financial integration on specialization and given data availability leave out of the scope of this paper to explore in further detail the micro founded mechanism. However, recent evidence in Gopinath, Kalemli-Ozcan, Karabarbounis, and Villegas-Sanchez (2015) points to the role of relatively underdeveloped financial systems in the misallocation of resources, showing how capital inflows were misallocated toward firms that had higher net worth but were not necessarily more productive.

differentiating among equity, foreign direct investment (FDI), and debt and the model includes time and sector-year fixed effects.[21]

Table 4 presents the results for the total sample 1970-2006 in column (1) and for the sample 1995-2006 in columns (2) and (3). As can be seen in column (3), while the overall impact of debt liabilities turns out to be negative, a positive significant impact on specialization during the euro years is detected, supporting our hypothesis. Notice the positive and significant effect of debt liabilities on specialization during the euro years is not there if we were to consider the full panel, emphasizing the differential effect that the euro adoption had across European countries. Finally, as discussed in the introduction there are two main omitted variables that might raise concerns about the interpretation of the results. First, given the work by Imbs and Wacziarg (2003) on the link between income (GDP) and specialization, column (4) conditions on the log of GDP confirming our main results. Second, as stressed in the introduction, sectoral trade patterns can be a confounding factor driving both specialization and financial integration. Column (5) includes the share of sectoral trade (exports plus imports normalized by country GDP) in each country without major changes in the results.[22]

[Insert Table 4 here]

Concluding Remarks

The euro was adopted knowing that country members were far from conforming an optimal currency area, but with the expectation that it would endogenously become one along the way. This expectation was mainly grounded on the future ability of the monetary union for developing effective country income

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[21] See the footnote in Table 4 and section E in the appendix for a full description of the model.

[22] Notice the drop in the number of observations is driven by data availability. Export and Import data is only available for manufacturing sectors.

stabilization mechanisms, since a landscape characterized by asymmetric income variability across countries was projected to remain under the likely prospects of inter-industry productive specialization. Without own monetary tools and without shared fiscal resources, stabilization via national fiscal policy, market adjustment, and geographical diversification of income sources were seen as key elements for a successful union. The first called for effective fiscal coordination of national fiscal policies, the second for market structural reforms, and the third for effective financial integration. This paper has focused on the latter, assessing the empirical evolution of specialization and risk-sharing and their connection with financial integration. Our results point to a failure in the task of fulfilling the endogenous OCA expectation in this dimension: progress in financial integration has not been conductive for income risk-sharing across euro members, while it has favored a specialization split between countries with low-medium and high technology productive structures. As a result, monetary union members face higher income fluctuation risk without enhanced insurance protection. Additionally, evidence suggests that the specialization split has had differential impacts on sector productivity, affecting negatively to euro members specializing in low-medium technologies, and so helping to make the monetary union a club of less equals.

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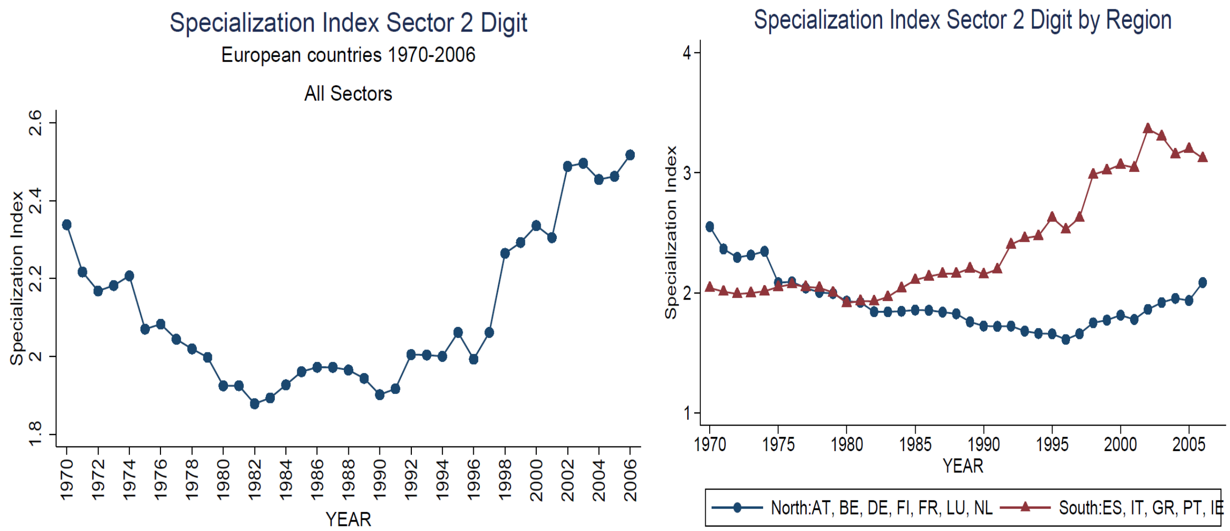
Figures



(a) Overall Index (b) North/South Index

Figure 1: Specialization Index (2 digit sector). The two-digit sectors are: 15t16, 17t19,21t22, 23, 24, 25,26, 27t28, 30t33, 34t35, 36t37, 45, 50, 51,52, 60t63, 64, 70, 71t74, that correspond to one digit sectors D (Manufacturing), I (Transport, Storage and Telecommunication), K (Real State) and F (Construction). See the text for a description of how the index is constructed. For each country "i" and sector s = 1,…,S the country specialization index is constructed as:

$$SPEC_i = \sqrt{\sqrt{(1-SPEC_{i,1})^2 + (1-SPEC_{i,2})^2 + \cdots + (1-SPEC_{i,S})^2}}$$

where $\mathrm{SPEC}_{i,s} = \left(\frac{VA_{i,s}}{\sum_s VA_{i,s}}\right) / \left(\frac{VA_{EA,s}}{\sum_s VA_{EA,s}}\right)$ and VA stands for value added. Sample of countries: Austria, Belgium, Germany, Spain, Finland, France Greece Ireland, Italy, Luxembourg, the Netherlands, and Portugal. The figure plots the average value of the index across countries over time. In Panel (b), North: Austria (AT), Belgium (BE), Germany (DE), Finland (FI), France (FR), Luxembourg (LU) and the Netherlands (NL). South: Spain (ES), Italy (IT), Greece (GR), Portugal (PT) and Ireland (IE). The figure plots the average value of the index by country group (North/South) over time.

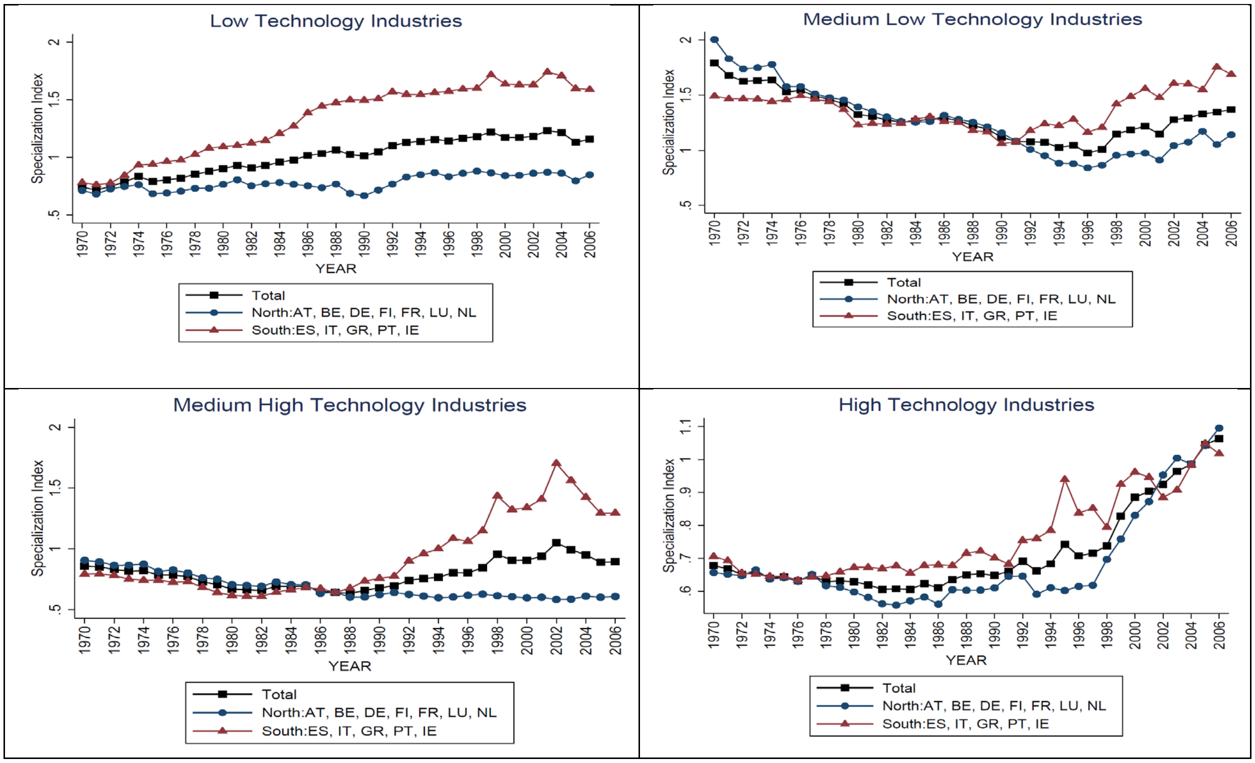


Figure 2: Specialization Index (2 digit sector) by Sector Technology Classification. The figure plots the average value of the index by country group (North/South) over time. See Table A.1. in the appendix for a description of the sectors included under Low Technology, Medium Low Technology, Medium High Technology and High Technology (Source sector classification: OECD). See section C.1. in the appendix for a description of how the specialization index is constructed. North: Austria (AT), Belgium (BE), Germany (DE), Finland (FI), France (FR), Luxembourg (LU) and the Netherlands (NL). South: Spain (ES), Italy (IT), Greece (GR), Portugal (PT) and Ireland (IE).

(a) Period 1960-2013 (b) Period 1996-2013

Figure 3: Income Risk Sharing over the period. Sample of countries: Austria (AT), Belgium (BE), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), the Netherlands (NL) and Portugal (PT). The figure plots ($1-\beta_{k,t}$) where $\beta_{k,t}$ is obtained from estimating the following equation year by year: $\Delta logGNI_{it} - \Delta logGNI_t = \beta_0 + \beta_{k,t} (\Delta logGDP_{it} - \Delta logGDP_t) + \varepsilon_{it}$. A LOWESS smoothing "locally weighted scatterplot smoothing" with a bandwidth of 0.15 in panel (a) and bandwidth of 0.4 in panel (b) is applied.

Tables

Table 1: Productivity, Specialization and the Euro

Sample Period: 1970-2006					
Dependent Variable	*ln(VA/L)*	*ln(VA/L)*	*ln(VA/L)*	*ln(VA/L)*	*Δln(VA/L)*
	(1)	(2)	(3)	(4)	(5)
Sector Specialization	0.679***	0.740***	0.717***	0.692***	0.039***
	(0.107)	(0.130)	(0.111)	(0.104)	(0.011)
Sector Specialization × Euro		-0.124	-0.152**	-0.140**	-0.013
		(0.076)	(0.067)	(0.064)	(0.010)
Observations	8,396	8,396	8,396	8,396	8,168
R^2	0.56	0.56	0.68	0.73	0.22
F-test (p-value)		0.000	0.000	0.000	0.000
Year Fixed Effects	yes	yes	yes	yes	yes
Country-Sector Fixed Effects	yes	yes	yes	yes	yes
Sector Fixed Effects	no	no	yes	yes	yes
Country-Year Fixed Effects	no	no	no	yes	yes

Notes: The dependent variable in columns (1) to (4) is the log of value added (VA) over employment (L). In column (5) the dependent variable is the annual growth rate in value added over employment. For each country "i" and sector s = 1,…,S the sector specialization index is computed as: $\mathrm{SPEC}_{i,s} = \left(\frac{VA_{i,s}}{\sum_s VA_{i,s}}\right) / \left(\frac{VA_{EA,s}}{\sum_s VA_{EA,s}}\right)$ and VA stands for value added. *Euro* is a dummy variable that takes the value of one (for countries that implemented the euro) in the year the euro was implemented (1999) and thereafter and zero otherwise. The F-test is a joint test for the hypothesis that the coefficients on "*Sector Specialization*" and "*Sector Specialization × Euro*" are jointly significant. Standard errors clustered at the country-sector level are in parentheses. ***, **, *, denote significance at 1, 5, and 10 percent levels.

Table 2: Productivity, Specialization and the South

Sample Period	1970-2006	1995-2006	1995-2006	1995-2006
Dependent Variable	ln(VA/L)	ln(VA/L)	ln(VA/L)	*Δ*ln(VA/L)
	(1)	(2)	(3)	(4)
Sector Specialization × Euro × South	-0.285*	-0.103*	-0.109*	0.037
	(0.165)	(0.055)	(0.050)	(0.045)
Sector Specialization × South	-0.006	0.069	0.164	-0.052
	(0.260)	(0.206)	(0.207)	(0.073)
Sector Specialization × Euro	0.048	0.052*	0.031	-0.064
	(0.145)	(0.031)	(0.030)	(0.042)
Sector Specialization	0.785***	0.572***	0.537***	0.209**
	(0.224)	(0.079)	(0.095)	(0.076)
Observations	8,396	2,724	2,724	2,724
R^2	0.39	0.41	0.71	0.2
F-test (p-value)		0.000	0.000	0.022
Year Fixed Effects	yes	yes	yes	yes
Sector-Year Fixed Effects	no	no	yes	yes
Country-Year Fixed Effects	no	no	yes	yes

Notes: The dependent variable in columns (1) to (3) is the log of value added (VA) over employment (L). In column (4) the dependent variable is the annual growth rate in value added over employment. For each country "i" and sector s = 1,…,S the sector specialization index is computed as: $\text{SPEC}_{i,s} = \left(\frac{VA_{i,s}}{\sum_s VA_{i,s}}\right) / \left(\frac{VA_{EA,s}}{\sum_s VA_{EA,s}}\right)$ and VA stands for value added. *Euro* is a dummy variable that takes the value of one (for countries that implemented the euro) in the year the euro was implemented (1999) and thereafter and zero otherwise. *South* is a dummy variable equal to one for Spain, Italy, Greece, Portugal and Ireland. The F-test is a joint test for the hypothesis that all the coefficients are jointly significant. Standard errors clustered at the country-sector level are in parentheses. ***, **, *, denote significance at 1, 5, and 10 percent levels.

Table 3: Financial Integration and Risk Sharing: Assets and Liabilities

Sample period 1970-2011	(1)	(2)	(3)	(4)	(5)	(6)
		FDI	Equity	Debt	FDI+Equity	All
(Δlog GDP_{it} - Δlog GDP_t)	1.001***	1.027***	1.036***	0.988***	1.034***	0.986***
	(0.017)	(0.025)	(0.015)	(0.022)	(0.029)	(0.041)
(Δlog GDP_{it} - Δlog GDP_t) × Liabilities		-0.170	0.528**	0.057**	0.218**	
		(0.173)	(0.144)	(0.016)	(0.069)	
Liabilities		0.005	-0.003	-0.004**	-0.002*	
		(0.005)	(0.003)	(0.001)	(0.001)	
(Δlog GDP_{it} - Δlog GDP_t) × Assets		0.047	-1.012**	-0.058**	-0.385**	
		(0.318)	(0.300)	(0.019)	(0.134)	
Assets		-0.006	0.007	0.002**	0.003	
		(0.008)	(0.007)	(0.001)	(0.002)	
(Δlog GDP_{it} - Δlog GDP_t) × Debt Liabilities						0.133**
						(0.060)
Debt Liabilities						*-0.004*
						(0.002)
(Δlog GDP_{it} - Δlog GDP_t) × Debt Assets						-0.132
						(0.078)
Debt Assets						0.003
						(0.004)
(Δlog GDP_{it} - Δlog GDP_t) × PrivateLiabilities						0.283**
						(0.098)
Private Liabilities						*-0.004*
						(0.004)
(Δlog GDP_{it} - Δlog GDP_t) × PrivateAssets						-0.433**
						(0.113)
Private Assets						0.003
						(0.003)
Observations	552	439	423	438	423	422
Country Fixed Effects	yes	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes	yes

Notes: Results are obtained from estimating the following equation:

$$\begin{aligned}\Delta logGNI_{it} - \Delta logGNI_t = \mu_i &+ \beta_k(\Delta logGDP_{it} - \Delta logGDP_t) \\ &+ \beta_2(\Delta logGDP_{it} - \Delta logGDP_t) \times FI_{it} \\ &+ \beta_3 FI_{it} + \delta_t + \epsilon_{it}\end{aligned}$$

FI_{it} refers to financial assets or liabilities scaled by GDP depending on the specification. Column (2) uses foreign direct investment (FDI), column (3) equity, column (4) debt, column (5) private flows which are the sum of FDI and equity and finally, column (6) shows the results aggregating the three different types of flows: FDI, Equity and Debt. Standard errors clustered at the country-sector level are in parentheses. ***, **, *, denote significance at 1, 5, and 10 percent levels.

Table 4: Specialization and Financial Integration in the South

	Medium-Low and Low Specialization Index				
Sample Period	1970-2006	1995-2006	1995-2006	1995-2006	1995-2006
	(1)	(2)	(3)	(4)	(5)
FDIAssets/GDP	-1.191	-0.873	-3.441	0.606	1.597
	(1.198)	(0.950)	(3.131)	(1.774)	(3.343)
FDILiab/GDP	-0.004	0.222	4.693	1.126	1.528
	(0.802)	(0.357)	(3.270)	(1.143)	(2.008)
EquityAssets/GDP	1.025	0.801	2.329	-2.381	-3.479
	(1.071)	(1.046)	(2.620)	(2.256)	(3.241)
EquityLiab/GDP	-0.246	0.208	4.423	1.445	1.612
	(0.798)	(0.623)	(2.707)	(0.988)	(1.041)
DebtAssets/GDP	0.167	-0.255	-0.369	0.537	0.766
	(0.260)	(0.333)	(0.561)	(0.480)	(0.682)
DebtLiab/GDP	-0.039	0.206	-1.508*	-1.281*	-1.652
	(0.170)	(0.301)	(0.814)	(0.687)	(1.009)
FDIAssets/GDP × Euro			3.896	-0.309	-0.970
			(3.529)	(2.169)	(3.955)
FDILiab/GDP × Euro			-4.481	-0.383	0.056
			(3.332)	(1.409)	(2.454)
EquityAssets/GDP× Euro			-1.442	1.913	2.523
			(1.669)	(1.967)	(2.869)
EquityLiab/GDP× Euro			-3.592	-0.620	-0.314
			(2.838)	(1.407)	(1.866)
DebtAssets/GDP× Euro			-0.023	-1.674	-2.638*
			(0.849)	(1.102)	(1.533)
DebtLiab/GDP× Euro			1.551*	1.799*	2.574*
			(0.887)	(1.016)	(1.454)
ln(GDP)				-1.028	-1.986*
				(0.773)	(1.060)
Trade Share					-3.814
					(12.256)
Trade Share × Euro					2.935
					(7.239)
Observations	1089	432	432	432	288
R^2	.9	.96	.96	.96	.96
Year Fixed Effects	yes	yes	yes	yes	yes
Sector-Year Fixed Effects	yes	yes	yes	yes	yes
Country-Sector Fixed Effects	yes	yes	yes	yes	yes

Notes: The dependent variable is the sector specialization index. South: Spain, Portugal and Greece. Subsample of sectors classified as medium-low and low technology. *Euro* is a dummy variable in the year the euro was implemented and thereafter. ln(GDP) refers to the log of GDP. Trade Share refers to the sum of exports and imports in country "i" – sector "s" normalized by country GDP. Standard errors clustered at the country-sector level are in parentheses. ***, **, *, denote significance at 1, 5, and 10 percent levels.

Online Appendix (Not to be included in the paper copy of the journal)

A. Tables

Table A.1: Sector Classification according to Technology Sector

	Manufacturing	Non-Manufacturing
Low Technology	15t16, 17t19, 21t22	45
Medium Low Technology	23, 25,26, 27t28,36t37	50, 51, 52
Medium High Technology	24	60t63, 70, 71t74
High Technology	30t33, 34t35	64

Notes: **Low Technology**: Manufacturing (15t16 “Manufacture of food products, beverages and to- bacco”; 17t19 “Manufacture of textiles, textile products and leather”; 21t22 “Manufacture of pulp, paper and paper products; publishing and printing”) Non-Manufacturing (45 “Construction”). **Medium Low Technology**: Manufacturing (23 “Manufacture of coke, refined petroleum products and nuclear fuel”; 25 “Manufacture of rubber and plastic products”; 26 “Manufacture of other non-metallic mineral prod- ucts”; 27t28 “Manufacture of basic metals and fabricated metal products”; 36t37 “Manufacturing n.e.c.”) Non-Manufacturing (50 “Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel”; 51 “Wholesale trade and commission trade, except of motor vehicles and motorcycles” 52 “Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods”). **Medium High Technology**: Manufacturing (24 “Manufacture of chemicals and chemical products”) Non-Manufacturing (60t63 “Transport and storage”; 70 “Real estate activities”; 71t74 “Renting and business activities”). **High Technology**: Manufacturing (30t33 “Manufacture of electrical and optical equipment”; 34t35 “Manufacture of transport equipment”) Non-Manufacturing (64 “Post and telecommunications”). *Source sector classification: OECD*

Table A.2: Number of Observations according to Technology Sector

	Manufacturing		Non-Manufacturing	
Sector Classification	Observations	Percent	Observations	Percent
Low Technology	1,332	27.27	444	12.50
Medium Low Technology	2,220	45.45	1,332	37.50
Medium High Technology	444	9.09	1,332	37.50
High Technology	888	18.18	444	12.50
Total	4,884	100	3,885	100

Notes: **Low Technology**: Manufacturing (15t16 "Manufacture of food products, beverages and tobacco"; 17t19 "Manufacture of textiles, textile products and leather"; 21t22 "Manufacture of pulp, paper and paper products; publishing and printing") Non-Manufacturing (45 "Construction"). **Medium Low Technology**: Manufacturing (23 "Manufacture of coke, refined petroleum products and nuclear fuel"; 25 "Manufacture of rubber and plastic products"; 26 "Manufacture of other non-metallic mineral products"; 27t28 "Manufacture of basic metals and fabricated metal products"; 36t37 "Manufacturing n.e.c.") Non-Manufacturing (50 "Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel"; 51 "Wholesale trade and commission trade, except of motor vehicles and motorcycles" 52 "Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods"). **Medium High Technology**: Manufacturing (24 "Manufacture of chemicals and chemical products") Non-Manufacturing (60t63 "Transport and storage"; 70 "Real estate activities"; 71t74 "Renting and business activities"). **High Technology**: Manufacturing (30t33 "Manufacture of electrical and optical equipment"; 34t35 "Manufacture of transport equipment") Non-Manufacturing (64 "Post and telecommunication"). *Source sector_classification: OECD*

Table A.3: Income Risk Sharing

	1960-1969 (1)	1970-1979 (2)	1980-1989 (3)	1990-1994 (4)	1995-1999 (5)	2000-2006 (6)	2007-2013 (7)
Income Risk Sharing	-0.7	1.7	-1.2	-3.8	14.2	5.1	2.2
	(0.008)	(0.011)	(0.058)	(0.014)	(0.054)	(0.068)	(0.060)

Notes: The table reports the average amount of risk sharing during the time-period considered among the countries included in the sample: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain. Risk sharing is (1 - β_k) where β_k is obtained from estimating the following equation for the period under consideration: $\Delta logGNI_{it} - \Delta logGNI_t = \beta_0 + \beta_k(\Delta logGDP_{it} - \Delta logGDP_t) + \varepsilon_{it}$. Standard errors clustered at the country level are reported in parenthesis.

Table A.4: Financial Integration and Risk Sharing

Sample Period 1970-2011	(1)	(2)	(3)	(4)	(5)
Stock Measure:		FDI	Equity	Debt	FDI+Equity
(Δlog GDP$_{it}$ - Δlog GDP$_t$)	1.001***	1.024***	1.008***	1.007***	1.015***
	(0.017)	(0.030)	(0.025)	(0.027)	(0.028)
(Δlog GDP$_{it}$ - Δlog GDP$_t$) × Stock		-0.051	0.005	-0.001	-0.005
		(0.082)	(0.017)	(0.008)	(0.019)
Stock		-0.000	-0.001**	-0.000**	-0.001*
		(0.002)	(0.000)	(0.002)	(0.000)
Observations	552	439	423	438	423
R^2	0.94	0.94	0.93	0.93	0.93
Country Fixed Effects	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes

Notes: Results are obtained from estimating the following equation:

$$\begin{aligned}\Delta logGNI_{it} - \Delta logGNI_t = \mu_i &+ \beta_k(\Delta logGDP_{it} - \Delta logGDP_t) \\ &+ \beta_2(\Delta logGDP_{it} - \Delta logGDP_t) \times FI_{it} \\ &+ \beta_3 FI_{it} + \delta_t + \epsilon_{it}\end{aligned}$$

Stock refers to the measure of financial integration (FI_{it}) used in each column. FI_{it} refers to the gross stocks of external assets plus liabilities scaled by GDP. Column (2) uses foreign direct investment (FDI), column (3) equity, column (4) debt and column (5) private flows which are the sum of FDI and equity. Standard errors clustered at the country-sector level are in parentheses. ***, **, *, denote significance at 1, 5, and 10 percent levels.

Table A.5: Financial Integration and Risk Sharing: Assets and Liabilities

Sample period 1996-2011	(1)	(2)	(3)	(4)	(5)	(6)
		FDI	Equity	Debt	FDI+Equity	All
(Δlog GDP$_{it}$ - Δlog GDP$_t$)	0.956***	1.021***	1.013***	0.605**	0.995***	0.688**
	(0.038)	(0.075)	(0.029)	(0.163)	(0.089)	(0.289)
(Δlog GDP$_{it}$ - Δlog GDP$_t$) × Liabilities		-0.282	0.695***	0.432**	0.346**	
		(0.335)	(0.150)	(0.193)	(0.153)	
Liabilities		0.014**	-0.002	-0.003	-0.002	
		(0.003)	(0.003)	(0.004)	(0.002)	
(Δlog GDP$_{it}$ - Δlog GDP$_t$) × Assets		0.103	-1.309**	-0.312**	-0.562*	
		(0.626)	(0.326)	(0.140)	(0.295)	
Assets		-0.013	0.007	0.000	0.005	
		(0.007)	(0.006)	(0.002)	(0.005)	
(Δlog GDP$_{it}$ - Δlog GDP$_t$) × Debt Liabilities						0.52
						(0.368)
Debt Liabilities						*-0.002*
						(0.005)
(Δlog GDP$_{it}$ - Δlog GDP$_t$) × Debt Assets						-0.539
						(0.377)
Debt Assets						*0.001*
						(0.004)
(Δlog GDP$_{it}$ - Δlog GDP$_t$) × PrivateLiabilities						0.622**
						(0.258)
Private Liabilities						*-0.003*
						(0.003)
(Δlog GDP$_{it}$ - Δlog GDP$_t$) × PrivateAssets						-0.582*
						(0.303)
Private Assets						0.005
						(0.007)
Observations	165	165	165	165	165	165
Country Fixed Effects	yes	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes	yes

Notes: Results are obtained from estimating the following equation:

$$\begin{aligned}\Delta logGNI_{it} - \Delta logGNI_t = {} & \mu_i + \beta_k(\Delta logGDP_{it} - \Delta logGDP_t) \\ & + \beta_2(\Delta logGDP_{it} - \Delta logGDP_t) \times FI_{it} \\ & + \beta_3 FI_{it} + \delta_t + \epsilon_{it}\end{aligned}$$

FI_{it} refers to financial assets or liabilities scaled by GDP depending on the specification. Column (2) uses foreign direct investment (FDI), column (3) equity, column (4) debt, column (5) private flows which are the sum of FDI and equity and finally, column (6) shows the results aggregating the three different types of flows: FDI, Equity and Debt. Standard errors clustered at the country-sector level are in parentheses. ***, **, *, denote significance at 1, 5, and 10 percent levels.

B. Figures

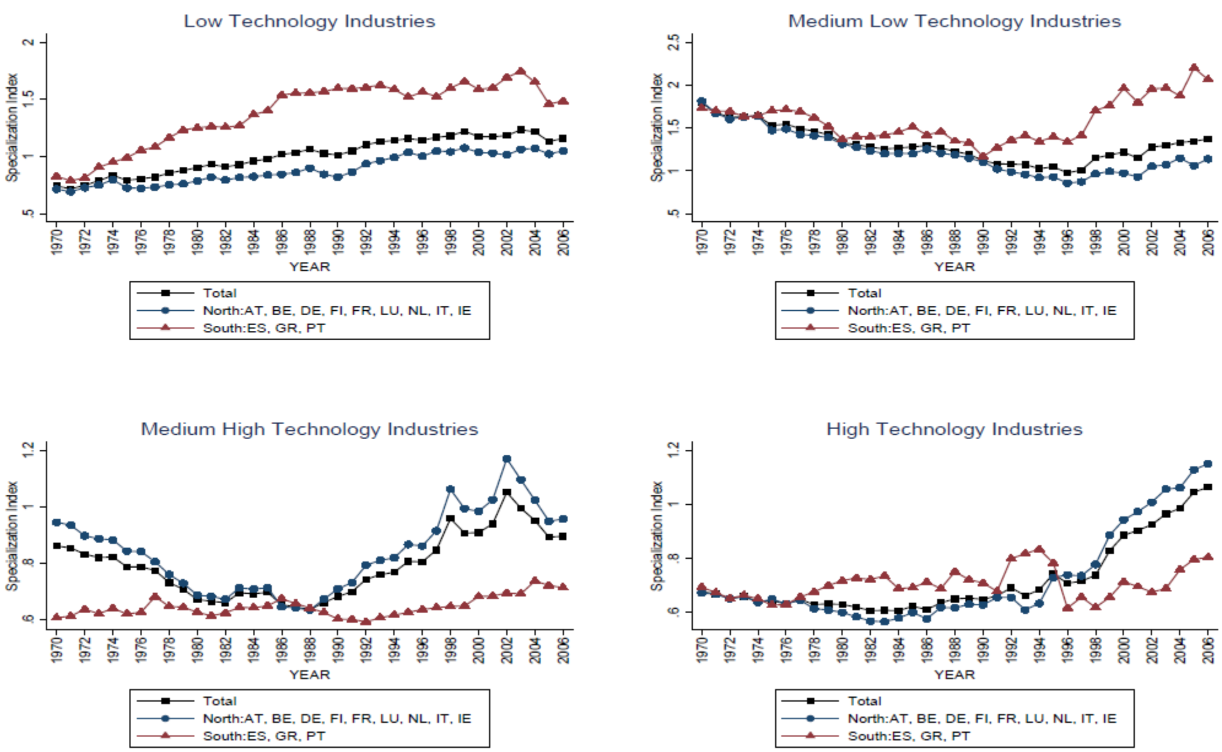


Figure B.1: Specialization Index (2-digit sector) by Sector Technology Classification. **Low Technology**: Manufacturing (15t16 "Manufacture of food products, beverages and tobacco"; 17t19 "Manufacture of textiles, textile products and leather"; 21t22 "Manufacture of pulp, paper and paper products; publishing and printing") Non-Manufacturing (45 "Construction"). **Medium Low Technology**: Manufacturing (23 "Manufacture of coke, refined petroleum products and nuclear fuel"; 25 "Manufacture of rubber and plastic products"; 26 "Manufacture of other non-metallic mineral products"; 27t28 "Manufacture of basic metals and fabricated metal products"; 36t37 "Manufacturing n.e.c.") Non-Manufacturing (50 "Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel"; 51 "Wholesale trade and commission trade, except of motor vehicles and motorcycles" 52 "Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods"). **Medium High Technology**: Manufacturing (24 "Manufacture of chemicals and chemical products") Non-Manufacturing (60t63 "Transport and storage"; 70 "Real estate activities"; 71t74 "Renting and business activities"). **High Technology**: Manufacturing (30t33 "Manufacture of electrical and optical equipment"; 34t35 "Manufacture of transport equipment") Non-Manufacturing (64 "Post and telecommunications"). *Source sector classification: OECD*.

See the text for a description of how the index is constructed. For each country "i" and sector s = 1,…,S the country specialization index is constructed as:

$$SPEC_i = \sqrt{\sqrt{(1 - SPEC_{i,1})^2} + (1 - SPEC_{i,2})^2 + \cdots + (1 - SPEC_{i,S})^2}$$

where $\mathrm{SPEC}_{i,S} = \left(\frac{VA_{i,s}}{\sum_s VA_{i,s}}\right) / \left(\frac{VA_{EA,s}}{\sum_s VA_{EA,s}}\right)$ and VA stands for value added. Sample of countries: Austria (AT), Belgium (BE), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), the Netherlands (NL) and Portugal (PT). The figure plots the average value of the index by technology classification and region over time.

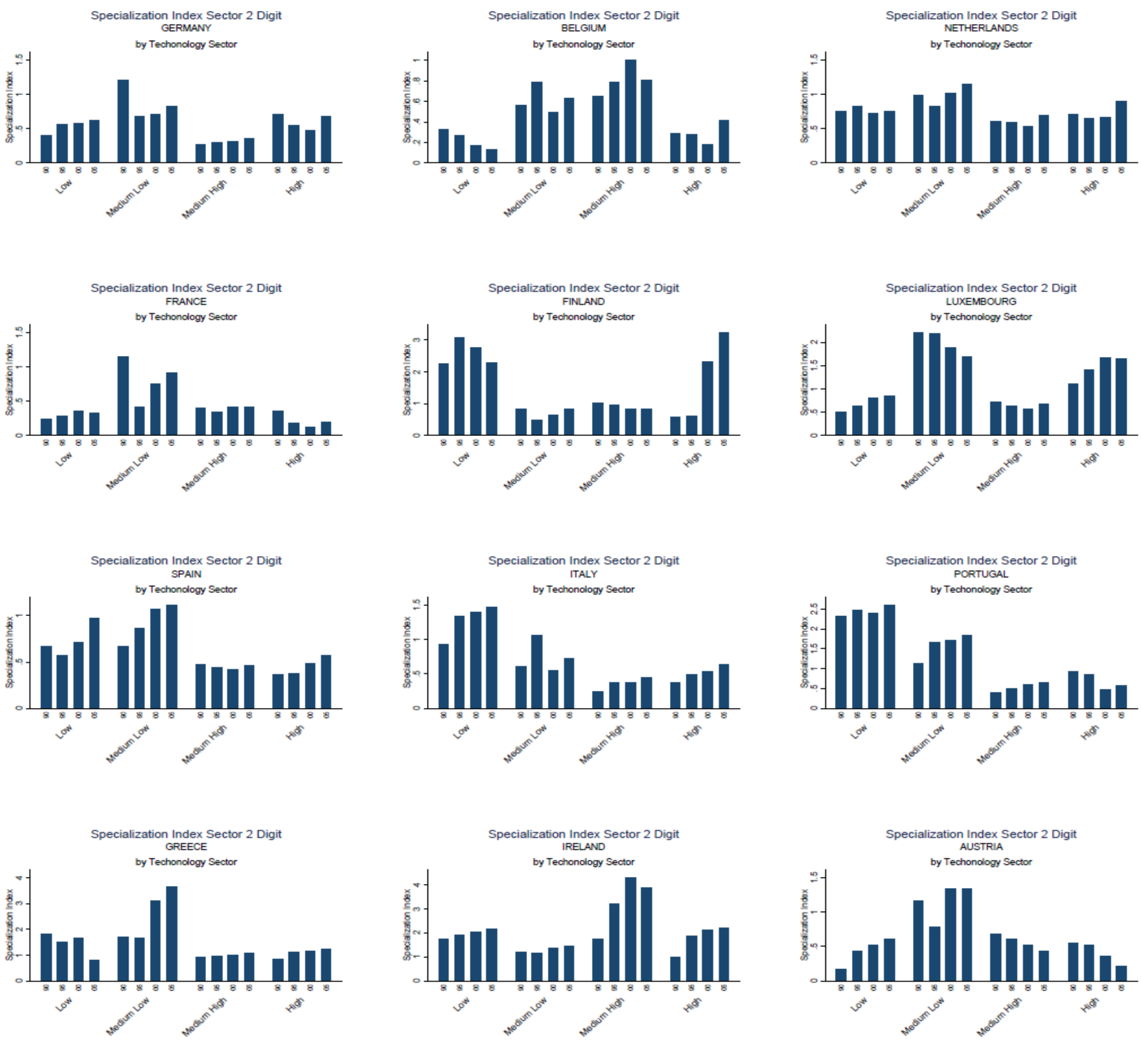


Figure B.2: Specialization Index (2-digit sector) by Sector Technology Classification. **Low Technology**: Manufacturing (15t16 “Manufacture of food products, beverages and tobacco”; 17t19 “Manufacture of textiles, textile products and leather”; 21t22 “Manufacture of pulp, paper and paper products; publishing and printing”) Non-Manufacturing (45 “Construction”). **Medium Low Technology**: Manufacturing (23 “Manufacture of coke, refined petroleum products and nuclear fuel”; 25 “Manufacture of rubber and plastic products”; 26 “Manufacture of other non-metallic mineral products”; 27t28 “Manufacture of basic metals and fabricated metal products”; 36t37 “Manufacturing n.e.c.”) Non-Manufacturing (50 “Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel”; 51 “Wholesale trade and commission trade, except of motor vehicles and motorcycles” 52 “Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods”). **Medium High Technology**: Manufacturing (24 “Manufacture of chemicals and chemical products”) Non-Manufacturing (60t63 “Transport and storage”; 70 “Real estate activities”; 71t74 “Renting and business activities”). **High Technology**: Manufacturing (30t33 “Manufacture of electrical and optical equipment”; 34t35 “Manufacture of transport equipment”) Non-Manufacturing (64 “Post and telecommunications”). *Source sector classification: OECD*

C. Specialization

C.1. Specialization Index

Let $VA_{i,s}$ denote the value added of sector *s* in country *i*, and $VA_{EA,s}$ the total value added of sector *s* in the euro area as a whole. The index is calculated as:

$$SPEC_{i,s} = \frac{\frac{VA_{i,s}}{\sum_s VA_{i,s}}}{\frac{VA_{EA,s}}{\sum_s VA_{EA,s}}}$$

The degree of specialization in a country is measured as the Euclidean distance between the country's vector of specialization and the vector corresponding to the hypothetical non-specialization case (the specialization coefficient would be equal to one). For each country *"i"* and sectors *s=1,...,S* the country specialization index is computed as:

$$SPEC_i = \sqrt{(1 - SPEC_{i,1})^2 + (1 - SPEC_{i,2})^2 + \cdots + (1 - SPEC_{i,S})^2}$$

C.2. Specialization and Productivity

The question we would like to address is whether specialization had any effect on sector productivity and if we can identify a differential effect after the implementation of the euro. In order to do so, we estimate the following specification:

$$\ln\left(\frac{VA}{EMPL}\right)_{i,s,t} = \beta_0 + \beta_1 SPEC2dig_{i,s,t} \times Euro_{i,t} + \beta_2 SPEC2dig_{i,s,t} + \delta_t + \delta_{i,s} + u_{i,s,t}$$

where $ln(VA/EMPL)_{i,s,t}$ is the log of country-sector-year productivity measured as value added per employee, $SPEC2dig_{i,s,t}$ is the specialization index of country *i*, two-digit sector *s* and time *t* (see the previous section on how this index is constructed), $Euro_{i,t}$ is a dummy variable that takes the value of one if the corresponding country introduced the euro in 1999 and thereafter, δ_t is a time dummy for years 1970 to 2006 and $\delta_{i,s}$ corresponds to country-sector fixed effects.

To explore whether there is a differential effect for Southern European countries we estimate:

$$\ln\left(\frac{VA}{EMPL}\right)_{i,s,t} = \beta_0 + \beta_1 SPEC2dig_{i,s,t} \times Euro_{i,t} \times South_i$$
$$+ \beta_2 SPEC2dig_{i,s,t} \times South_i$$
$$+ \beta_3 SPEC2dig_{i,s,t} \times Euro_{it}$$
$$+ \beta_4 South_i \times Euro_{it}$$
$$+ \beta_5 SPEC2dig_{i,s,t}$$
$$+ \delta_{i,t} + \delta_{st} + \delta_{i,s} + u_{i,s,t}$$

where all variables are defined as in equation (3) and South is a dummy that equals one in Spain, Italy, Greece, Portugal and Ireland. We expect β_1 to be negative and significant so that Southern European countries that specialized more after the introduction of the euro show lower productivity. This specification is similar to a difference-in-difference strategy so that β_1 compared to β_3 shows the incremental effect on productivity of specializing in the South after the introduction of the euro versus the effect of specialization in the North post-euro (captured by β_3). Similarly, β_1 compared to β_4 reflects the increase in productivity in Southern Europe after the introduction of the euro compared to the average effect of the introduction of the euro in the South regardless of specialization (β_4). Notice that when the specification includes country-year fixed effects, to control for alternative country level shocks, we will not be able to separately identify the effect of the euro on Southern Europe β_4.

D. Risk Sharing

D.1. Risk Sharing Basic

We follow the decomposition proposed in Sorensen and Yosha (1998) and specify year by year regressions that quantify deviations from perfect income risk sharing. Consider a group of countries and the following set of cross-sectional regressions, one for each year t:

$$\Delta logGNI_{it} - \Delta logGNI_t = \beta_0 + \beta_{k,t}(\Delta logGDP_{it} - \Delta logGDP_t) + \varepsilon_{it}$$

The coefficient $\beta_{k,t}$ measures the average co-movement of country-specific GNI growth with country-specific GDP growth in year t. Under perfect risk sharing, the left-hand side of equation (5) will be zero implying that $\beta_{k,t}$ is zero. The smaller the co-movement of idiosyncratic GNI with GDP, the more GNI is buffered against GDP fluctuations and the smaller the estimated value of $\beta_{k,t}$. Since GNI equals GDP plus net factor income from abroad, this regression measures the amount of income risk sharing provided by net factor income flows, the lower $\beta_{k,t}$, the higher is income risk sharing in year t. The estimated coefficients, $\beta_{k,t}$, measure the evolution of risk sharing over time. Often it is more instructive to look at the equivalent series (1 - $\beta_{k,t}$). This series will take the value one if risk sharing is perfect and the value zero if GNI moves one-to-one with output.

D.2. Risk Sharing and Financial Integration

To explore the effects of financial integration on income risk sharing we follow Sorensen, Wu, Yosha, and Zhu (2007) and Kose, Prasad, and Terrones (2009) and estimate the following equation:

$$\begin{aligned}\Delta logGNI_{it} - \Delta logGNI_t = \mu_i + \beta_k(\Delta logGDP_{it} - \Delta logGDP_t) \\ + \beta_2(\Delta logGDP_{it} - \Delta logGDP_t) \times FI_{it} \\ + \beta_3 FI_{it} + \delta_t + \epsilon_{it}\end{aligned}$$

where FI_{it} refers to the gross stocks of external assets plus liabilities scaled by GDP, or a subset of those when we split financial stocks differentiating among equity, foreign direct investment (FDI), debt, and private flows, the latter representing the sum of equity and FDI. We expect a negative β_2 to positively contribute to an increase in income risk sharing.

E. Financial Integration and Specialization

To test whether financial integration has contributed to greater specialization in the South, we estimate the following equation for the subsample of low and medium-low technology industries in a reduced version of the South including Spain, Portugal and Greece:

$$SPEC2dig_{i,s,t} = \mu_i + \beta_1 FI_{i,t} + \beta_2 FI_{i,t} \times Euro_{i,t} + \delta_t + \delta_{s,t} + \epsilon_{i,s,t}$$

where the variable $FI_{i,t}$ refers to the split of the gross stocks of external assets and liabilities scaled by GDP, differentiating among equity, foreign direct investment (FDI), and debt. $SPEC2dig_{i,s,t}$ is the specialization index of country *i*, two-digit sector *s* and time *t*, $Euro_{i,t}$ is a dummy variable that takes the value of one if the corresponding country introduced the euro in 1999 and thereafter, δ_t is a time dummy and $\delta_{s,t}$ corresponds to sector-year fixed effects.

F. Robustness

F.1. Granger Causality

Following Dumitrescu and Hurlin (2012) we conduct a Granger non-causality test in heterogeneous panels based on our productivity and specialization model. In particular, we specify the following model with two lags for each country:

$$\ln\left(\frac{VA}{EMPL}\right)_{s,t} = \beta_0 + \gamma_1 \ln\left(\frac{VA}{EMPL}\right)_{s,t-1} + \gamma_2 \ln\left(\frac{VA}{EMPL}\right)_{s,t-2} + \beta_1 SPEC2dig_{s,t-1} \times Euro_t + \beta_2 SPEC2dig_{s,t-1} + +\beta_3 SPEC2dig_{s,t-2} \times Euro_t + \beta_4 SPEC2dig_{s,t-2} + \delta_s + u_{s,t}$$

Dumitrescu and Hurlin (2012) show that under certain assumptions, the standardized average statistic $\tilde{Z}_N^{Hnc}$ converges in distribution:

$$\tilde{Z}_N^{Hnc} = \sqrt{\frac{N}{2 \times K} \times \frac{(T-2K-5)}{(T-K-3)}} \times \left[\frac{(T-2K-3)}{(T-2K-1)} W_{N,T}^{Hnc} - K\right] \xrightarrow{d} N(0,1)$$

These are the corresponding $\tilde{Z}_N^{Hnc}$ statistics for each country:

Country	$\tilde{Z}_N^{Hnc}$
Austria	3.7
Belgium	14.3
Germany	13.3
Spain	3.8
Finland	4.7
Greece	7.7
Ireland	8.6
Italy	9.4
Netherlands	4.2
Portugal	8.8

Therefore, in each country we can reject the null. Thus, we cannot reject the hypothesis that in at least one sector per country there is a Granger causality relationship between specialization and productivity.

Similarly we conduct a Granger causality test in heterogeneous panels exploring the relationship between risk sharing and financial integration. For each country we run the model in column (6) of Table 3 based on a two-period lag specification and, while results should be interpreted with caution due to the low number of observations, we find that $\tilde{Z}_N^{Hnc}$**= 13.80573**, and therefore cannot reject the hypothesis that at least in one of the countries under analysis there is a Granger causality relationship between risk sharing and financial integration when we differentiate according to the type of capital inflows. The Granger causality test of models specified in columns (4) and (5) of Table A.4. show that we can reject the hypothesis that at least in one of the countries under analysis there is a Granger causality relationship between risk sharing and financial integration. The associated z-statistics for columns (4) and (5) are: $\tilde{Z}_N^{Hnc}$**= -.1571459 and** $\tilde{Z}_N^{Hnc}$**= .976069,** respectively.

References

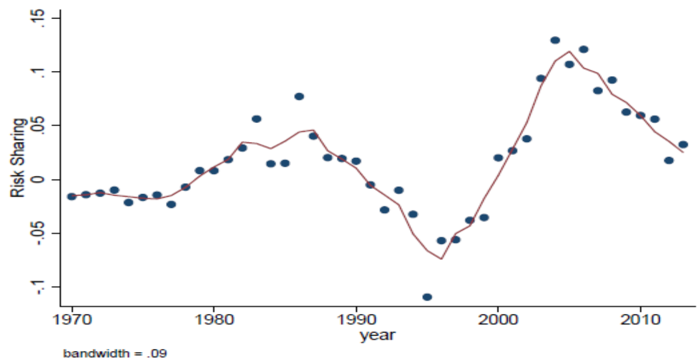
Dumitrescu, Elena-Ivona & Hurlin, Christophe, 2012. "Testing for Granger non-causality in heterogeneous panels," *Economic Modelling*, Elsevier, vol. 29(4), pages 1450-1460.

F.2. Risk Sharing Estimation Technique

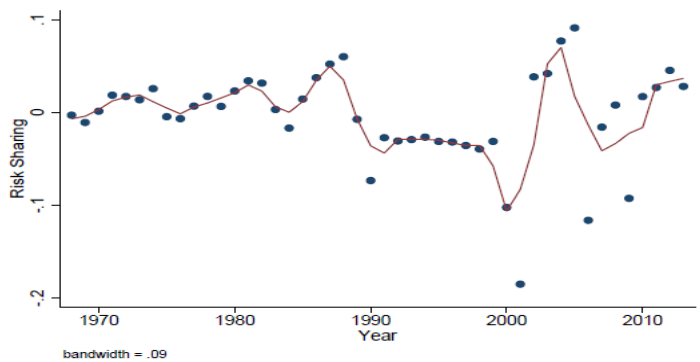
Following Kose, Prasad, and Terrones (2009) we explore the robustness of these results to alternative estimation techniques using 9-year rolling windows to smooth the risk-sharing coefficients. First, cross-section regressions are estimated for each year over the period 1960-2013. Specifically, we compute:

$$(1-\beta_t) = \frac{1}{9}\sum_{s=0}^{8}(1-\beta_{t-8+s}) \qquad t = 1969, \dots, 2004$$

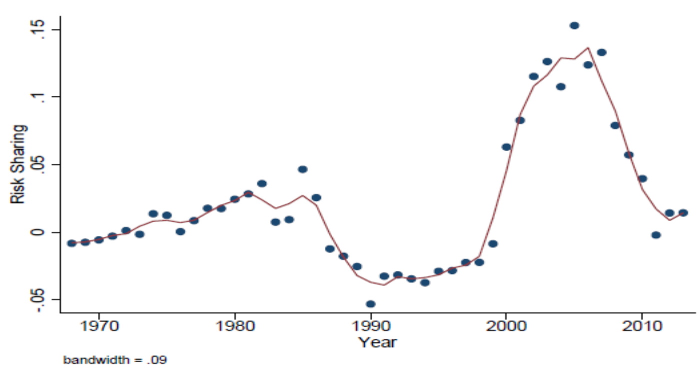
Panel A in Figure B.3 in the appendix shows the basic results, with an increase in income risk sharing from mid-90s to mid-2000s and a decrease thereafter. Second, Panel B in Figure B.3 in the appendix shows the results from time series estimation. We run the regression for each country and then compute the median β over the country sample for each period. In other words, we estimate (1-$\beta_t = median_i(1-\beta_{it})$) where β_{it} is estimated from a regression for each "I" over "t-8 to t" and t = 1969,…, 2004. Third, Panel C in Figure B.3 in the appendix plots the coefficient from estimating the panel version of the same equation estimated over nine-year rolling panels. Specifically, (1-β_t) is obtained from panel regressions "t-8 to t" where t = 1969,…,2004. Panel A, B and C are greatly consistent and suggest an increase in income risk sharing from the mid-late 90s. However, there seems to be a trend reversal from the mid-2000s that ends in similar levels of risk sharing to those observe during the 70s and 80s. Considering that the 9-year smoothing window shifts the average forward, the results are consistent with Figure 3, showing an increase in risk-sharing during the 90s and a decline during the 2000s.



(a) Cross-Section



(b) Time Series



(c) Panel

Figure B.3: Risk Sharing by Estimation Technique. Sample of countries: Austria (AT), Belgium (BE), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), the Netherlands (NL) and Portugal (PT). See the text for a description of how panels (a), (b) and (c) are estimated. A mean LOWESS smoothing "locally weighted scatterplot smoothing" with a bandwidth of 0.09 and no weights is applied to the three panels.

F.3. Structural Break

a) Risk Sharing Structural Break

We take the smoothed series plotted in Figure 3 – panel (a) during the period 1961-2013 and regress the series on a time trend and a constant, with robust standard errors to unknown forms of heteroskedasticity. Then we conduct a Wald test for a structural break in year 1999. The null hypothesis (Ho): No structural break

chi2(2) = 16.1361

Prob > chi2 = 0.0003

We can reject the null hypothesis that there is no structural break in 1999 in the risk sharing series.

b) Specialization Structural Break

We take the specialization series plotted in Figure 1 – panel (a) during the period 1970-2006 and regress the series on a time trend and a constant, with robust standard errors to unknown forms of heteroskedasticity. Then we conduct a Wald test for a structural break in year 1999. The null hypothesis (Ho): No structural break

chi2(2) = 67.3943

Prob > chi2 = 0.0000

We can reject the null hypothesis that there is no structural break in 1999 in the risk sharing series.

In addition, we test for a structural break in the specialization series for each country. Based on the results in the following table we can reject the null hypothesis that there is no structural break in 1999 in the specialization series in all countries under analysis.

	AT	BE	DE	ES	FI	FR	IE	IT	GR	NL	PT
chi2(2)	15.093	12.836	15.718	29.990	49.753	70.032	20.091	14.796	59.042	180.17	6.5439
Prob > chi2	0.0005	0.0016	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0379