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**RISK SHARING IN THE EUROPEAN UNION:  
THE ROLE OF THE EU BUDGET**

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# Chapter 1

## Introduction

The financial and European sovereign debt crisis reignited the debate on the capacity of the *European Union* (EU) to deal with asymmetric shocks that affect its member states. As of now, 19 member states are also part of the *Economic and Monetary Union* (EMU). These countries rely on the centralised monetary policy adopted by the *European Central Bank* (ECB) to achieve price stability and macroeconomic stabilisation in the eurozone. However, the stabilisation function provided by the ECB can address common shocks effectively. Whereas, it can not address asymmetric shocks because the decisions on the monetary policy consider the entire euro area, and not single member states.

At the national level, the member states adopt their national fiscal policy and rely on it and on national automatic stabilisers to tackle the effects of idiosyncratic shocks. In 1997, the member states adopted the Stability and Growth Pact (SGP) to deal with the establishment of the EMU and the lack of a fiscal union. It aims to establish a fiscal framework that provides common fiscal rules for the member states. The member states must take into considerations the common rules when making the decisions for their national budget. Above all, the existence of the common fiscal rule is necessary to prevent uncoordinated and irresponsible fiscal policies by the member states, which, if not prevented, might lead to negative spillovers to other member states and a reduction of the effects of the monetary policy adopted by the ECB. In 2005, the member states adopted a reform to improve the SGP. One of the improvements made was the introduction of the Structural Budget Balance (SB). The SB includes an adjustment to the previous deficit/GDP ratio because it also considers the economic cycle and the "one-offs" measures — they include the adoption of investments and structural reforms to foster economic growth. Thanks to the SB, the member states have a higher degree of freedom in using their fiscal policy to help the national economy during an adverse economic scenario.

The European sovereign debt crisis highlighted the fact that an economic crisis can spread among the members of the eurozone and endanger the stability of the common currency. It also emphasised that the constraints set by the common fiscal rules lower the ability of national governments to help their economies. During the crisis, the ECB adopted an expansionary monetary policy, most notably the Quantitative Easing (QE)

that started in 2015, to reach its target of price stability<sup>1</sup>, as well as to stimulate economic growth in the member states. Despite the effort of the ECB, the uncoordinated, and for some country pro-cyclical, fiscal policy of the member states resulted in different economic performances among member states, with the member states in the south underperforming if compared to the rest of the EU. To achieve better coordination and surveillance of the national fiscal policies, especially in the eurozone, the EU enhanced the fiscal framework introduced by the SGP with the introduction of the "six-pack" in 2011 and "two-pack" in 2013. Introduced in the *six-pack*, the "European Semester" represents a necessary framework to monitor and coordinate the fiscal and economic policy of the member states. Moreover, in 2012, the member states signed the Treaty on Stability, Coordination and Governance in the Economic and Monetary Union (TSCG or "*fiscal compact*"). This Treaty requires the member states to adopt a balanced budget rule at the national level, meaning that the national budget must comply with the medium-term objective (MTO) outlined in the SGP.

The existing international risk-sharing literature extensively analyses through which channels the smoothing, or the lack thereof, of country-specific shocks to output, is obtained. In the European Union, the expectation is that the integration in the single market, as well as the introduction of the common currency, should provide a significant amount of international risk-sharing (see Kalemli-Ozcan et al. (2008)). In particular, the capital markets should contribute to the smoothing of asymmetric shocks. For example, during a negative country-specific shock, the inflows (or reduction of outflows) of income factor from (to) abroad should automatically absorb a fraction of the shock. However, a typical result of the existing literature is that the ex-ante insurance provided by the capital markets is not consistently contributing to risk-sharing. As shown by Sørensen and Yosha (1998), and more recently by Milano (2017), the fraction of smoothing provided by the capital markets in the EMU is meagre, especially if compared to its role in the USA. The results of the latter work suggest that, even after the introduction of the common currency, the members of the EMU did not successfully integrate their capital markets.

As discussed in Valiante (2016), there are still barriers that prevent the full development of the *Capital Markets Union* (CMU) in the EU. For example, the different policies of the member states in the fields of taxation and supervision contribute to the fragmentation of the capital markets. The recent improvements to the *Banking Union* (BU) should address the latter problem. Whereas, the former, is a challenging field to harmonise since it is a national competence of the member states.

As Alcidi and Thirion (2016) explain, financial integration is a necessary condition to increase the degree of international risk-sharing through the cross-border ownership of assets. The importance of financial integration led to the recent push by the *European Commission* (EC) toward the development of the CMU.

The integration process should also lead to the synchronisation of the business cycles of the member states. The seminal work of Mundell (1961), as well as the following literature on the *Optimal Currency Area* (OCA) theory, discuss the fact that, in a common currency area, the synchronisation of the business cycles would reduce the occurrence of asymmetric shocks. The common shocks would still affect the currency area, but the

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<sup>1</sup>The European Central Bank (2018) define the target for the euro area as: "inflation rates below, but close to, 2% over the medium term".

supranational monetary policy would be able to deal with them appropriately. However, Kenen (1969), and later Krugman (1993), argue that the higher integration of the economies of the member states could lead to an increase in specialisation, which would increase the occurrence of asymmetric shocks. In this scenario, in an OCA, the labour mobility<sup>2</sup> and automatic supranational stabilisers are needed to adjust to the asymmetric shocks in a way that is not costly for the affected country.

As regards the labour mobility, Farhi and Werning (2014) further analyse the effects of labour mobility in an OCA using a closed currency union model with nominal rigidities of price and wage. They show that labour mobility increases the welfare of the citizens emigrating from the regions affected by an adverse economic shock (or countries in the case of an OCA). Moreover, the emigration affects the welfare level of the citizens that remain in the depressed region. An additional aspect that influences the welfare of the citizens staying in the country is the degree of openness of the country. Under the assumption of no home-bias and production only of traded goods, the authors find that the higher the external demand shortfalls, the higher the welfare gains for citizens that stay in the depressed country following the emigration of a part of the population. Despite the positive effect of labour mobility as an adjustment mechanism to asymmetric shocks, its role is still limited in the EU if compared to the US. Barslund and Busse (2016) and Fries-Tersch et al. (2018) suggest that there are still barriers that prevent the full development of labour mobility in the EU: *(i)* differences in languages across member states; *(ii)* legal barriers; and *(iii)* administrative barriers. Both studies also point out that the level of labour mobility inside the EU increased in the years following the financial crisis, and that it is still slowly increasing. However, the labour mobility in the EU is still too limited to represent an adequate adjustment mechanism to the asymmetric shocks.

The smoothing of idiosyncratic output shocks in the EMU, given the limited labour mobility, could be achieved through transfers from the supranational level to the member state affected by the country-specific shock. For example, to stabilise the disposable national income after an adverse economic shock, the member state would receive higher transfers from the supranational level and pay lower taxes. However, the EU budget does not work as an automatic economic stabiliser. Instead, as outlined in Monti et al. (2016), the EU budget focuses on achieving redistribution between member states and fostering investments in the medium- and long-term. The programmes co-financed by the EU funds, which have a significant impact on the economic convergence of the new member states<sup>3</sup>, carry out the redistribution function. Moreover, the EU budget provides an allocation function since it is used to finance projects that are considered as "*club*" goods<sup>4</sup> for the EU — for example, the funds for migration and border management.

The expenditures to support growth are the primary source of redistribution and, on some occasions, they also contribute to stabilisation. The fraction of shocks smoothed might be low since the expenditures of the budget are pre-allocated for seven years, and

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<sup>2</sup>Mundell (1961) argues that labour mobility is one of the automatic tools that limit the effects of idiosyncratic shocks in an OCA.

<sup>3</sup>Monfort et al. (2017) provide an analysis of the effect of the funds from the EU budget on the economic growth of the member states.

<sup>4</sup>As argued in Asdrubali and Kim (2007) the classification as "*club*" goods is more appropriate than that of public goods because there is the possibility of excluding non-members from receiving benefits deriving from the common policies.

their flexibility is limited. As figure A.1 in the Appendix show,<sup>5</sup> the average share of expenditure on headlines to sustain growth is close to 86.5% of the total expenditures for the *Multiannual Financial Framework* (MFF) 2007-2013. In the next MFF, their combined share is expected to decline, and it will reach its lowest value of 62.9% in 2027. The decline derives from the possibility of achieving high levels of European added value in fields that are relevant for most member states — such as migration and border management or research and development.

Whereas, the structure used to finance the expenditure is relatively constant over time. The contributions based on the GNI are used to fill the gap between the total amount owed from a member state and the resources obtained by the member state from TOR- or VAT-based revenues. Therefore, in the years in which the other revenues are low, a member state has to provide a higher share of GNI-based contribution. Given the low flexibility of this revenue system, the budget might cause dis-smoothing of the output shocks during economic downturns. As shown in figure A.2 in the Appendix, from 2004 to 2016, the GNI-based contributions represented more than 60% of the total revenues, with a peak of 73.70% in 2013<sup>6</sup>. Commission (2018), following the suggestion of Monti et al. (2016), proposes the adoption of new traditional own resources to reduce the dependence on the GNI-based contribution. According to the forecasts of the European Commission, these new sources of revenue will contribute an average of €22 billion per year, which for the MFF 2021-2027 represent about 12% of the total revenue. Hence, the national governments would have more resources at their disposal to absorb the effects of adverse asymmetric shocks. The new resources outlined in the Commission (2018) derive from: (i) a share of the profits realised by the Common Consolidated Corporate Tax Base (CCCTB)<sup>7</sup>; (ii) a share of 20% from the revenues obtained in the auctions of the European Emissions Trading System; (iii) a national contribution of €0.80/kg computed on the amount of non-recycled plastic packaging waste in each member state.

Given the lack of an official stabilisation function of the EU budget, the Commission (2018) proposes to establish the *European Investment Stabilisation Function* (EISF) as an instrument outside of the MFF expenditure ceiling. This fund does not act automatically, and it would intervene if the resources available at the national level are not enough to deal with an asymmetric shock<sup>8</sup>. The fund aims to sustain the economy of the affected country by providing loans for financing national investments. To achieve that, the EISF will provide up to €30 billion, as well as grants to cover the interest costs. To address the presence of moral hazard, the Commission (2018) states that the access to the resources of the EISF would include strict eligibility criteria — for example, compliance with the common fiscal rules.

Juncker et al. (2015)<sup>9</sup> emphasise the necessity for a fiscal stabilisation function at the supranational level to deal with asymmetric shocks. As discussed by the authors, its introduction might avoid a contagion effect of the asymmetric shocks to the rest of the eurozone. Furceri and Zdzienicka (2013) show that the adoption of a budget that functions as automatic stabiliser would improve the risk-sharing in the EMU. However, to effectively deal with asymmetric shocks, the budget would need to have a significant

<sup>5</sup>The pre-allocated expenditures for the MFF 2021-2017 are from Commission (2018).

<sup>6</sup>In figure A.2 in the Appendix, the revenues derived from competition fines and previous year surpluses are components of the *other revenue share*.

<sup>7</sup>The Common Consolidated Corporate Tax Base still has to be implemented.

<sup>8</sup>Countries outside of the EMU might participate to the EISF if they contribute to its build-up.

<sup>9</sup>Also known as the *Five Presidents' Report*

amount of funds (according to Commission (1977) between 5% and 7% of the EU-GDP). The development of a supranational automatic stabiliser is still on hold because there is a lack of trust between the member states. The mistrust is caused by the moral hazard that could arise in the presence of a common euro area budget.

According to Juncker et al. (2015), there are four principles that a supranational stabilisation function for the euro area should satisfy. First, it should not achieve economic convergence in the member states of the EU, so it should not lead to permanent transfers in one direction only. Second, it should prevent moral hazard, an outcome that might be achieved by linking together the transfers to the compliance with the common fiscal rules, and the adoption of structural reforms to deal with national structural weaknesses. Third, it should act automatically, and it should be part of the European Union framework. Fourth, the main aim of the stabilisation function should be to improve the economic resilience of the euro area countries and the whole EMU. Beetsma et al. (2018) recently suggested a system that links the transfers received by a member state to changes in world trade. This mechanism would face low moral hazard since the changes in the relevance of a specific sector on the volume of world trade are outside the control of national governments.

Andor (2016) advocates for the introduction of a common unemployment insurance scheme, which would increase the economic resilience, as well as social cohesion, in the member states. The author argues that the unemployment rate is a suitable indicator to define the direction of the cross-country transfers because it is closely linked to the economic cycle. The insurance scheme should be established as a common fund, financed by the resources of the national unemployment schemes. Following an increase in unemployment due to a shock to a member state, the common fund would use its resources to complement the national unemployment schemes. The author emphasises the possibility that the existing national schemes would be able to raise additional funds, which can be used at the national level. The simulations realised by the existing literature for such a scheme find that it would require fundings close to 1% of EU-GDP, and that it would achieve significant stabilisation effect across the EU (the estimates range from 11% to 20%, depending on the size of the common fund). Andor (2016) also points out that this scheme would act automatically to changes in unemployment; thus, satisfying one of the principles required by a supranational stabilisation function for the euro area. The author argues that the presence of such a mechanism would ease the burden on the public saving of the member state affected by the shock, and the transfers would foster economic growth by reducing the fall in demand caused by an adverse economic scenario.

Following the recent debate on the feasibility of a common unemployment insurance scheme for the EMU, Alcidi and Thirion (2017) analyse the stabilisation effect of the federal unemployment insurance system in the US. The aim of this analysis is to draw lessons for the policymakers in the EU. The authors find that in the US, between 1995 and 2013, the unemployment benefits smoothed only 1% of the country-specific output shocks. Whereas, the national unemployment benefits of the EA-11 member states smoothed 4.6% of the shocks. However, they show that the unemployment insurance transfers in the US mainly provide stabilisation to common, and not asymmetric, shocks — the share of shocks absorbed increase from 1% to 3.1% after the inclusion of common shocks.

Alcidi and Thirion (2017) also argue that the unemployment insurance in the US is not a completely automatic stabiliser. They claim that a significant share of risk-sharing is achieved through discretionary increases of the duration and resources available to pay the unemployment benefits<sup>10</sup>. The authors also emphasise that the unemployment insurance scheme in the US is semi-decentralised. The common standards for the unemployment benefits programmes are set at the federal level. Then, the states can modify some of the characteristics of the programmes. The states also collect funds for their unemployment insurance scheme through taxes at the state level, which are the primary source of funding for the insurance schemes. According to the authors, the high relevance of the states' revenues limits the role of the schemes in providing inter-state risk sharing. Although there is a mechanism that increases the funding received from the federal level, it is triggered if certain indicators that indicate the presence of high unemployment rates are above specific threshold values. Loans from the federal level are an additional source of funds for the unemployment schemes. However, these loans entail inter-generational considerations since they must be repaid in the upcoming years.

Overall, there are aspects of the US unemployment insurance system that might be included in the design of a common unemployment insurance scheme for the EMU — for example, the conditionality between threshold levels of specific unemployment rates indicators and the fundings received at the state level. An additional aspect argued in Alcidi and Thirion (2017) is that the presence of a supranational fiscal insurance might increase the degree of risk-sharing obtained through the capital markets.

Even with financial integration, the EU might still need the introduction of a supranational automatic stabiliser to provide risk-sharing in the case of asymmetric shocks. Farhi and Werning (2017) show that, in a currency union, the presence of a fiscal union leads to efficient risk-sharing if the financial markets are either incomplete or complete. The authors also compare the effectiveness of fiscal unions to other macroeconomic stabilisation instruments available in a currency union. They find that the stabilisation provided by the fiscal union varies depending on the characteristics of the shock and the country affected. For the shock, the aspects analysed are the persistence and the degree of asymmetry. Whereas, at the country level, they look at the degree of openness of the economy, type of households, and price rigidity. Despite the positive effects that a fiscal union would have on a currency union like the EMU, the lack of political consensus among the national governments hampers its introduction. Hence, the fiscal policy is still a competence of the member states, and the national automatic stabilisers are the primary source of risk sharing.

Using a model similar to the one introduced by Farhi and Werning (2017), Pennings (2017) analyses the stabilisation effect of the *cross-region transfer multiplier* and *purchase multiplier* in a country affected by an adverse economic scenario. The latter multiplier focuses on the government purchases of home goods. Whereas, the former multiplier is composed of two components. The first is a *self-financed* component, which consists of transfers financed through national debt in the home country. The second component is the *pure cross-region transfer*, which is financed by the other countries that belong to the same currency union. According to the author, the degree of home-bias in the consumption of goods of the country affected by the output shock greatly affects the

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<sup>10</sup>According to Alcidi and Thirion (2017) the Congress of the United States adopts stimulus packages during economic downturns that affect the US as a whole, and not just output shocks that affect specific states. Hence, these measures are considered as discretionary.



stabilisation role of the cross-region transfer<sup>11</sup>. Moreover, the temporary or permanent nature of the transfer from the rest of the monetary union affects the inter-temporal considerations of the households, which decide to save part of the temporary transfer. The author finds that the cross-region transfer causes significant stabilisation in the US and low level of stabilisation in the EU. As regards the EU, the author considers a fall of 3.76% in the GDP of Ireland, which triggers a pure cross-region transfer from the monetary union equal to 30% of the fall in Ireland's GDP. Under specific values of the parameters in the model, for example, the degree of home-bias in Ireland, the transfer would lead to a fall in GDP of 3.33% instead of 3.76%. However, the results also show that almost 2/3 of this stabilisation effect can be achieved through the self-funded component, and not through a pure transfer from the rest of the EMU. Therefore, the author argues that, before the development of a supranational automatic stabiliser, the national governments of the EMU members should focus on maintaining the ability of the national fiscal policy to respond to asymmetric shocks, which was impaired during the crisis due to the common fiscal rules.

Milano (2017) also argues that the EU institutions can successfully contribute to smoothing the adverse economic shocks, even without a fiscal union. Milano (2017) and Cimadomo et al. (2017) show that the *European Financial Stability Facility* (EFSF) and *European Stability Mechanism* (ESM), through the loans to the periphery countries, smoothed a significant fraction of the country-specific shocks during the sovereign debt crisis. It is also important to point out that these institutions acted as substitutes to the national governments. In fact, in the periphery countries, the governments were constrained by the rules on deficit and public debt set by the *Stability and Growth Pact* (SGP). To respect these rules, they had to introduce austerity measures. The authors find that the outcome was dis-smoothing of the output shocks by the public saving channel, which was compensated for by the crucial role of EFSF and ESM. However, these institutions do not act automatically, and it is a significant difference if compared to a typical budget under a fiscal union. Moreover, the risk-sharing provided by the saving channel also has inter-temporal implications.

Against the backdrop of this literature, this work will analyse the degree of international risk-sharing in the member states of the European Union between 2001 and 2017. The methodology applied is based on the variance decomposition of shocks to GDP introduced in the seminal work of Asdrubali et al. (1996). Moreover, this work will further decompose the net international taxes and transfers channel to analyse the stabilisation of output growth achieved by the net transfers from the EU budget between 2001 and 2016. The analysis will consider the full sample, as well as different groups of countries and time intervals, for example, the euro area country pre- and post-financial crisis.

The main contribution of this work is to include in the analysis almost all the member states of the EU<sup>12</sup> and the data recorded in recent years (up to 2017). An additional contribution is the decomposition of the net international transfers channel to assess the smoothing of country-specific output shocks provided by the net transfers from the EU budget.

The results for the main channels of risk-sharing show that, in the EU-25, the fraction

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<sup>11</sup>Crucini and Hess (1999) suggest that a home-bias for local assets in the portfolio decisions of individual contribute to imperfect risk-sharing

<sup>12</sup>Some of the data for Croatia are not available. Hence, it is excluded from the analysis.

of unsmoothed shocks on GDP is significant (93.88% from 2001 to 2017). Moreover, the estimates confirm the findings of the existing literature, which suggest that the capital markets, except for some isolated event, do not provide smoothing of the output shocks. In fact, for the EU-25, the factor income channel absorbed just 2.69% of the shocks between 2001 and 2017 (not statistically significant). The results also show that the degree of risk-sharing in the EA-10 is significantly different for the core and periphery countries. For example, during the financial crisis, the former group smoothed 67.23% of the asymmetric shocks, while the latter just 22.21%. A further decomposition of the saving channel confirms the results of Kalemli-Ozcan et al. (2014) and Milano (2017). According to these authors, the rules set by the SGP might have limited the income smoothing provided by the national government. In fact, for the periphery countries, the public saving channel caused dis-smoothing of the shocks (-11.59%), which indicate an increase in saving during the crisis.

Overall, the estimates presented for the net transfers of the EU budget support the argument presented in Ferrer and Alcidi (2018) that, in some occasions, the budget might provide smoothing of shocks to GDP. However, it is more a consequence of isolated events, for example, for the EU-10 countries during the financial crisis (6.52% of smoothing), and not a consistent source of risk-sharing. Moreover, since the expenditure and revenue do not automatically adjust to address asymmetric shocks, the net transfers from the EU budget might also cause dis-smoothing, for example, for the periphery countries during the financial crisis (-6.99%). The fundamental limits of the EU budget are *(i)* the resources available (only 1.23% of the EU-GNI) and *(ii)* the lack of flexibility. The latter significantly hamper its ability to act as an automatic stabiliser in case of asymmetric shocks.

The rest of the paper is organised as follows. Chapter 2 will provide an overview of the results of the related literature regarding the international risk-sharing in the EU. Chapter 3 briefly introduces the theory behind international risk-sharing and the empirical methodology used to capture its effects. Then, Chapter 4 reports the result obtained from the analysis, starting from the main channels and then moving to the role of the EU budget. Chapter 5 concludes the analysis through a summary of the main findings.

## Chapter 2

# Empirical results of the related literature on risk-sharing in the EU

Over the years, many scholars analysed the degree of international risk-sharing in the EU, often as a comparison to the USA. Sørensen and Yosha (1998) use the variance decomposition of shocks to GDP introduced in Asdrubali et al. (1996), to analyse eight countries of the EU. They find that, for the time intervals from 1966 to 1980 and 1981 to 1990, the amount of shocks to GDP smoothed is 43% and 22%, respectively. The saving channel (international credit markets) is the primary source of smoothing. According to the authors, the international transfers channel, which includes the transfers from the EU budget, provides smoothing only from 1981 to 1990 (5%). On the other hand, the factor income contribution to stabilisation was close to zero. This result highlights the lack of integration of the capital markets in the EU from 1966 to 1990, especially if compared to the risk-sharing obtained in the US by the same channel between 1981 and 1990 (48%).

Using a broader data set, Balli and Sørensen (2007) look at risk-sharing in the EMU and EU member states from 1970 to 2003. The results show that the degree of risk-sharing is different between the two groups of countries, 32% for the EU and 39% for the EMU. The main contributor to smoothing is still the saving channel through the procyclical savings of the national governments. However, for both groups of countries, the authors find a decrease in the smoothing provided by the government saving channel in the sub-period from 1999 to 2003. They suggest that the Maastricht criteria might be the cause of the decline. Another significant result of the analysis is that the factor income channel provides positive risk-sharing to both the EMU and EU from 1999 to 2003 — 11% for the EMU and 6% for the EU. The authors explain that these estimates are a consequence of *(i)* the introduction of the common currency and *(ii)* the progress made toward the integration of the capital markets.

Asdrubali and Kim (2007), apply a structural VAR model to a data set including all the EU countries from 1976 to 2001. Their analysis focuses on the role of the EU budget, for which they find that the expenditures have a small stabilisation function after a shock to the GNP of a member state — they stabilise 1.5% in the year of the

impact of the shock and 2.6% over the two-year horizon. Whereas, the redistribution functions of the EU budget act in the long-term by redistributing 3% of the country-specific GNP changes. According to the authors, the transfers from the agricultural

Table 2.1: Literature review

	Alcidi and Thirion (2016)						Milano (2017)		
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)
	2008-2009			2010-2014			2007-2014		
	EMU	Core	Periphery	EMU	Core	Periphery	EMU	Core	Periphery
Factors income	4 (10)	26** (10)	-2 (10)	3 (5)	-6 (12)	3 (5)	2 (4)	11 <sup>†</sup> (6)	-1 (7)
Capital depreciation	1 (4)	-5 (5)	2 (4)	-11** (2)	-13** (5)	-11** (2)	-12** (2)	-20** (2)	-9** (2)
International transfers	-3 (3)	0 (3)	-3 (3)	1 (2)	-7 (7)	1 (2)	0 (1)	-2 <sup>†</sup> (1)	1 (3)
Saving	42** (15)	61** (19)	38** (14)	17* (8)	72** (23)	12 <sup>†</sup> (7)	39** (8)	79** (12)	31** (11)
Unsmoothed	56** (11)	18 (14)	65** (11)	91** (6)	54** (15)	94** (6)	69** (6)	26** (7)	77** (9)
Countries	11	6	5	11	6	5	11	7	4

The lists of countries used in these studies are available in the Data Appendix.

Significance levels: † : 10% \* : 5% \*\* : 1%

funds are the main contributors to the redistribution and stabilisation function. The authors also find that there are vast differences between different sub-periods. For example, from 1984 to 1993, the results point to a destabilising and counter-redistributive role of some of the funds included in the smart and inclusive growth headline.

Table 2.1 reports some of the results found by Milano (2017) and Alcidi and Thirion (2016). The former uses data from 1970 to 2014, while the latter from 1990 to 2014. Both works look at 11 countries of EMU, with the difference that Milano (2017) includes Italy in the group of core countries. According to Alcidi and Thirion (2016), the factor income channel provided significant smoothing of the shocks only for the core countries during the financial crisis (26%, column (II)) and does not consistently contribute to risk-sharing over the entire time interval<sup>1</sup>. The only statistically significant estimate for the net transfers channel suggests a dis-smoothing of the shocks of -2% for the core countries between 2007 and 2014. Milano (2017) also analyse the degree of risk-sharing in the USA. Her results show that, in the USA, the factors income and tax-transfers channel smoothed 44% of the shocks from 2007 to 2014 (22% for each channel). She suggests that the lower amount of risk sharing achieved in the EMU by these channels is a consequence of the fragmented capital markets and the lack of automatic stabilisers at the supranational level.

As regards the saving channel, both Milano (2017) and Alcidi and Thirion (2016) find that in all the groups of countries and sub-periods considered the saving channel is the primary source of smoothing of output shocks. However, there is a massive difference

<sup>1</sup>Milano (2017) does not split the time interval, but it is likely that the significant result of 11% in column (VIII) of table 2.1 is a consequence of the risk-sharing achieved during the financial crisis.

between the fraction of shocks absorbed by the savings of the national governments in the core and periphery countries. According to Milano (2017), for the former group of countries, the government saving provided 73% of consumption smoothing. Whereas, for the peripheral countries, the national governments dis-smoothed 63% of the shocks. Kalemli-Ozcan et al. (2014), as well as Milano (2017), argue that the decline in the fraction of shocks smoothed by the government saving is a consequence of the austerity measures adopted in the periphery countries to respect the deficit and debt rules set out by the SGP. Whereas, as discussed in Milano (2017) and Cimadomo et al. (2017), the loans from the EFSF and ESM provided significant smoothing of the shocks, substituting for the dis-smoothing achieved by the national governments of the periphery countries. According to the latter work, during the sovereign debt crisis, the euro area managed to smooth 65% of output shocks, an increase from the result of the pre-crisis sub-period (40%).

## Chapter 3

# Methodology and Data

### 3.1: International risk-sharing and consumption smoothing

The seminal work of Sørensen and Yosha (1998) presents a theoretical model to define international risk-sharing. The model assumes specific identical characteristics across the representative consumers of each country, for example, the degree of risk aversion and initial endowments. The model presented in Sørensen and Yosha (1998) consider a risk averse representative consumer for each country. The consumers derive utility from consumption and maximises the expected utility. Within each country, consumers are assumed to be identical ex-ante<sup>1</sup> and ex-post<sup>2</sup>. Thus, the derivation focuses on risk sharing between countries, ignoring risk sharing within countries. Assuming that the asset markets are complete, after the maximisation problem, the consumption for the representative consumer of country  $i$  in the state of nature  $t$  will be:

$$c_t^i = k^i c_t^w \quad (3.1)$$

where  $i$  denotes the country;  $t$  indicates the state of nature;  $k^i$  is a country specific constant that reflects country  $i$ 's "power" in the risk sharing arrangement;  $c_t^w$  is the world consumption. Assuming that  $u(c) = \log c$ , the terms in the RHS of equation (1.1) are equal to:

$$c_t^w = \frac{\sum_{i=1}^{28} n^i GDP_t^i}{\sum_{i=1}^{28} n^i} \quad (3.2)$$

$$k^i = (1 - \delta) \sum_{t=0}^{\infty} \delta^t \mathbb{E} \left( \frac{GDP_t^i}{c_t^w} \right) \quad (3.3)$$

where  $\mathbb{E}$  denotes the expectation in period 0. Thus, the share of country  $i$ 's consumption in world consumption is the discounted expected share of its future output in world consumption.

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<sup>1</sup>They have the same utility function and the same stochastic endowment

<sup>2</sup>All consumers are subject to the same realisation of uncertainty

As explained in Sørensen and Yosha (1998), equation (3.1) implies that risk is fully shared among countries if the consumption of a country comoves with world consumption, but does not comove with country-specific shocks. Moreover, the authors prove that, if the asset markets are complete, international risk-sharing implies perfect consumption smoothing. That is, the representative consumer faces a stable inter-temporal consumption path. The work of Baxter and Crucini (1995) shows that, under incomplete asset markets, the consumption smoothing condition can be satisfied even if the international risk-sharing condition is not.

Sørensen and Yosha (1998) also derive the equation for full risk-sharing (equation 3.1) in the presence of idiosyncratic taste shock,  $\theta_t^i$ <sup>3</sup>, in the utility function:

$$c_t^i = \theta_t^i k^i c_t^w \quad (3.4)$$

in this case, the consumption of country  $i$  still comoves, as in equation (3.1), with aggregate shocks that affect world consumption. Additionally, it also comoves with idiosyncratic taste shocks, captured by the new term  $\theta_t^i$ .

According to the international risk-sharing theory, the consumers in country  $i$  can insure their income through the ownership of assets linked to the output of the remaining  $-i$  countries. In the National Accounts, the "net primary income from the rest of the world" captures the inflows (or outflows) of international factor income. As explained in Sørensen and Yosha (1998), if the net flows of factor income entirely smooth the shocks to GDP, the consumers in country  $i$  will satisfy the following condition:

$$c_t^i = GNI_t^i \quad (3.5)$$

hence, equation (3.1) can be written as:

$$GNI_t^i = k^i c_t^w \quad (3.6)$$

the next section introduces the other channels that contribute to smoothing output shocks if the net international income factor flows do not provide full risk-sharing.

## 3.2: Empirical approach to risk-sharing

The seminal work of Asdrubali et al. (1996) introduced an empirical approach to estimate the degree of risk-sharing. Their approach uses the definitions of the primary national aggregates, which are defined in the National Accounts, to establish the role of different channels in smoothing output shocks. As customary in the existing related literature, the first step is the introduction of the following GDP identity:

$$GDP^i = \frac{GDP^i}{GNI^i} \frac{GNI^i}{NI^i} \frac{NI^i}{DNI^i} \frac{DNI^i}{C^i} C^i \quad (3.7)$$

where the subscript  $t$  is not reported because the decomposition holds for any period  $t$ . As in Milano (2017),  $C^i$  denotes the total consumption — private plus government consumption. A shock on GDP entirely affects the consumption level if it is not, at least

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<sup>3</sup>It is normalised so that  $\sum_{i=1}^n \frac{1}{\theta_t^i} = 1$ , where  $n$  is the number of countries.

partially, absorbed by one of the intermediate components in equation (3.5). Whereas, full stabilisation takes place if consumption remains unchanged following the output shock. That might happen if one or multiple intermediate components absorb the shock and their cumulative effect sum up to the total effect of the shock.

The relevant national accounting identities considered to define equation (3.5) are<sup>4</sup>:

$$\begin{aligned} GNI &= GDP + \text{net international factor income flows} \\ NI &= GNI - \text{capital depreciation} \\ DNI &= NI + \text{net international taxes and transfers} \\ C &= DNI - \text{total net saving} \end{aligned}$$

according to the first identity, the capital markets, through the net factor income flows from the rest of the world, provide full stabilisation if there is a shock on GDP but the GNI remains unchanged. Instead, if the capital markets do not provide smoothing, the GNI varies. At this point, if the NI is constant while the GNI changes, the capital depreciation provides income smoothing. The same reasoning applies to the remaining channels. In the end, if the consumption varies, the shock has not been smoothed entirely and, if the consumption varies more than the GDP, the channels contributed to amplify the shock rather than smoothing it. Furceri and Zdzienicka (2013) explain that the capital depreciation channel should provide dis-smoothing due to the way in which it is computed. The existing literature confirms this role of the capital depreciation channel.

As explained in Asdrubali et al. (1996) and Méritz and Zumer (1999), to obtain the cross-sectional variance decomposition of shocks to GDP, take the logs and differences on both sides of equation (3.5). Then, multiply both sides by  $\Delta \log GDP^i$  and subtract the means of all the different terms to get:

$$\begin{aligned} \text{var}\{\Delta \log GDP^i\} &= \text{cov}\{\Delta \log GDP^i - \Delta \log GNI^i, \Delta \log GDP^i\} \\ &\quad + \text{cov}\{\Delta \log GNI^i - \Delta \log NI^i, \Delta \log GDP^i\} \\ &\quad + \text{cov}\{\Delta \log NI^i - \Delta \log DNI^i, \Delta \log GDP^i\} \\ &\quad + \text{cov}\{\Delta \log DNI^i - \Delta \log C^i, \Delta \log GDP^i\} \\ &\quad + \text{cov}\{\Delta \log C^i, \Delta \log GDP^i\} \end{aligned} \tag{3.8}$$

then, divide both sides of equation (3.6) by  $\text{var}\{\Delta \log GDP^i\}$  to find:

$$1 = \beta_f + \beta_d + \beta_\tau + \beta_s + \beta_u \tag{3.9}$$

where each beta is the estimate of the slope in the cross-sectional regression realised

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<sup>4</sup>The definition of the variables follows the Eurostat (2014).



using the OLS. The list of coefficients is as follow:

$$\begin{aligned}\beta_f &= \frac{\text{cov}\{\Delta \log GDP^i - \Delta \log GNI^i, \Delta \log GDP^i\}}{\text{var}\{\Delta \log GDP^i\}} \\ \beta_d &= \frac{\text{cov}\{\Delta \log GNI^i - \Delta \log NI^i, \Delta \log GDP^i\}}{\text{var}\{\Delta \log GDP^i\}} \\ \beta_\tau &= \frac{\text{cov}\{\Delta \log NI^i - \Delta \log DNI^i, \Delta \log GDP^i\}}{\text{var}\{\Delta \log GDP^i\}} \\ \beta_s &= \frac{\text{cov}\{\Delta \log DNI^i - \Delta \log C^i, \Delta \log GDP^i\}}{\text{var}\{\Delta \log GDP^i\}} \\ \beta_u &= \frac{\text{cov}\{\Delta \log C^i, \Delta \log GDP^i\}}{\text{var}\{\Delta \log GDP^i\}}\end{aligned}$$

if there is not full international risk-sharing, the covariance between the consumption in country  $i$  and its output will be positive, meaning  $\beta_u > 0$ . Therefore, idiosyncratic shocks to the GDP of country  $i$  will cause a variation of the same sign on the country-specific consumption. In this case, as argued in Sørensen and Yosha (1998),  $\beta_u > 0$  is the unsmoothed share of the output shock, which would imply a deviation from the optimal consumption level under full international risk-sharing. As explained in Furceri and Zdzienicka (2013), the coefficients  $\beta_f$ ,  $\beta_d$ ,  $\beta_\tau$ , and  $\beta_s$ , represent, respectively, the fraction of shocks absorbed by the net factor income flows, capital depreciation, net international transfers, and saving. If the capital markets provide full stabilisation,  $\beta_f=1$  and, if the remaining channels do not provide dis-smoothing,  $\beta_u = 0$ . Overall, from equation (3.7) follows that if  $\beta_f + \beta_d + \beta_\tau + \beta_s = 1$ , then  $\beta_u = 0$ . Therefore, there will be a full smoothing of the output shock as long as the sum of all the betas is equal to 1, with  $\beta_u = 0$ . There are no constraints on the values or signs of the betas. As pointed out by Furceri and Zdzienicka (2013), the betas could be negative, which indicate dis-smoothing, or bigger than one if they amplify the shock.

As in Sørensen and Yosha (1998) and Furceri and Zdzienicka (2013), the baseline results presented in the next chapter are obtained from the following panel regressions:

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

where the  $\nu_{\{f;d;\tau;s;u\},t}$  are time fixed effects. All the equations utilise differenced data at an annual frequency.

Including dummy variables in the previous regressions allow to take into account different groups of countries, as well as to consider different sub-periods such as the pre- and post-financial crisis<sup>5</sup>. The following is an example of the regressions used to assess

<sup>5</sup>As suggested in Kalemli-Ozcan et al. (2014) and Alcidi and Thirion (2016), both works introduce dummy variables to differentiate between the time intervals and groups of countries — PIIGS and non-PIIGS countries.

the risk-sharing obtained by the EU-15<sup>6</sup> before, during, and after the financial crisis:

$$\begin{aligned}
\Delta \log GDP_t^i - \Delta \log GNI_t^i &= \nu_{f,t} + \beta_f^{EU15-pre} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2001-2007} \\
&\quad + \beta_f^{EU15-crisis} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2008-2009} \\
&\quad + \beta_f^{EU15-post} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2010-2017} + \epsilon_{f,t}^i \\
\Delta \log GNI_t^i - \Delta \log NI_t^i &= \nu_{d,t} + \beta_d^{EU15-pre} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2001-2007} \\
&\quad + \beta_d^{EU15-crisis} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2008-2009} \\
&\quad + \beta_d^{EU15-post} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2010-2017} + \epsilon_{d,t}^i \\
\Delta \log NI_t^i - \Delta \log DNI_t^i &= \nu_{\tau,t} + \beta_{\tau}^{EU15-pre} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2001-2007} \\
&\quad + \beta_{\tau}^{EU15-crisis} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2008-2009} \\
&\quad + \beta_{\tau}^{EU15-post} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2010-2017} + \epsilon_{\tau,t}^i \\
\Delta \log DNI_t^i - \Delta \log C_t^i &= \nu_{s,t} + \beta_s^{EU15-pre} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2001-2007} \\
&\quad + \beta_s^{EU15-crisis} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2008-2009} \\
&\quad + \beta_s^{EU15-post} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2010-2017} + \epsilon_{s,t}^i \\
\Delta \log C_t^i &= \nu_{u,t} + \beta_u^{EU15-pre} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2001-2007} \\
&\quad + \beta_u^{EU15-crisis} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2008-2009} \\
&\quad + \beta_u^{EU15-post} \Delta \log GDP_t^i \cdot D_{EU15} \cdot D_{2010-2017} + \epsilon_{u,t}^i
\end{aligned}$$

where  $D_{EU15}$  is unity if the country is part of the EU-15 and zero otherwise; and  $D_{2001-2007}$  has value one if  $2001 \leq t \leq 2007$  and zero for  $t > 2007$ . The same reasoning applies to the remaining time dummies, but for different time intervals. The analysis will also include other dummy variables to consider, for example, the core and periphery countries of the EA-11.

Following the existing literature, the saving channel is divided into the private and public sector. By doing this, it is possible to estimate the smoothing of output shocks provided by the private sector on the credit markets and by the government through its national budget. Furceri and Zdzienicka (2013) propose the following regressions to estimate the role of these two sectors in smoothing GDP shocks:

$$\begin{aligned}
\Delta \log DNI_t^i - \Delta \log (DNI_t^i + G_t^i) &= \nu_{p,t} + \beta_p \Delta \log GDP_t^i + \epsilon_{p,t}^i \\
\Delta \log (DNI_t^i + G_t^i) - \Delta \log C_t^i &= \nu_{g,t} + \beta_g \Delta \log GDP_t^i + \epsilon_{g,t}^i
\end{aligned}$$

where  $G_t^i$  is the final consumption expenditure of the general government of country  $i$  at time  $t$ . The sum of the final consumption expenditure by the public and private sector, respectively,  $G_t^i$  and  $P_t^i$ , is the total final consumption in the economy of country  $i$ ,  $C_t^i = G_t^i + P_t^i$ .

The shock is entirely smoothed by the private saving channel if  $\beta_p = 1$  while  $\beta_u = 0$ . Whereas,  $\beta_g$  is the share of the shock smoothed by the public saving. As explained in Furceri and Zdzienicka (2013), lending and borrowing on the credit markets have intertemporal implications on the adjustment of consumption. Moreover, they point out that the nature of the shock has significant consequences on the possibility of having access to the credit markets for consumption smoothing. As suggested by Furceri and

<sup>6</sup>The Data Appendix include lists describing the groups of countries used in the analysis.

Zdzienicka (2013), there might be a decrease in the willingness of the lenders to provide resources to a country under a persistent shock; thus limiting the smoothing provided by the credit markets.

Alcidi and Thirion (2017) discuss a methodology to assess the effects of the components that are part of the saving channel. Using the same methodology for the net international taxes and transfers channel yields:

$$\frac{NI_i}{NI_i + \text{Net international transfers}} = \frac{NI_i}{(NI_i + BT_i)} \frac{(NI_i + BT_i)}{DNI_i} \quad (3.10)$$

where the left-hand side is derived from the ratio  $\frac{NI_i}{DNI_i}$ , which is part of equation (3.5), and the national accounting identity for the  $DNI_i$ ;  $BT_i$  takes the values of the net transfers from the EU budget. The following equations estimate the smoothing of output shocks provided by two components of the net transfers channel:

$$\begin{aligned} \Delta \log NI_t^i - \Delta \log (NI_t^i + BT_t^i) &= \nu_{EU,t} + \beta_{EU} \Delta \log GDP_t^i + \epsilon_{EU,t}^i \\ \Delta \log (NI_t^i + BT_t^i) - \Delta \log DNI_t^i &= \nu_{RoW,t} + \beta_{RoW} \Delta \log GDP_t^i + \epsilon_{RoW,t}^i \end{aligned}$$

where  $\beta_{RoW}$  is the fraction of output shocks absorbed by the net transfers from the rest of world (other than the transfers from the EU budget). Whereas,  $\beta_{EU}$  captures the degree of risk-sharing provided by the net transfers from the EU budget. If  $(NI_t^i + BT_t^i)$  is constant while  $NI_t^i$  varies, the shock is smoothed by countercyclical net transfers from the EU budget. For example, if  $NI_t^i$  increases, the net transfers could decrease due to a reduction in expenditure received or an increase in revenue paid.  $BT_t^i$  is positive if, at time  $t$ , country  $i$  is a net beneficiary of the transfers. This methodology does not allow to capture possible additional effects of the EU budget. For example, as discussed in Ferrer and Alcidi (2018), the resources of the EU budget also work as guarantees for loans. Hence, the EU budget might also have an indirect stabilisation function through the saving channel.

As suggested by Hepp and von Hagen (2013) and Alcidi and Thirion (2017), the errors are assumed to follow an AR (1) process. The coefficients are estimated using OLS with Driscoll-Kraay<sup>7</sup> corrected standard errors. This type of standards errors correct for heteroskedasticity, autocorrelation, and possible contemporaneous correlation across panels. The test proposed by Woolridge (2010) and Drukker (2003) shows mixed results in favour of serial correlation in the dataset. The test introduced by Pesaran (2004) and Hoyos and Sarafidis (2006) suggests that there is also contemporaneous correlation. However, the introduction of the time fixed effects almost entirely solve the problem of contemporaneous correlation. There is still some weak evidence of its presence, but the Driscoll-Kraay standard errors should address it. Given the mixed evidence in favour of serial and contemporaneous correlation, the Table and Figure Appendix includes, for the main tables, estimates with standards errors robust to heteroskedasticity. As explained in Alcidi and Thirion (2017), the time fixed effects absorb the common component of the GDP shocks, leaving only the component of the country-specific shocks to the estimates of the betas.

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<sup>7</sup>Based on Driscoll and Kraay (1998)

### 3.3: Data

The dataset used for the analysis includes the data for the 28 member states of the European Union. However, Croatia is removed from the sample because it has missing DNI data from 2013 to 2017. The remaining panel is strongly balanced. The data on GDP, GNI, NI, net DNI, and C for the time interval 2000 to 2017 are from the *Annual Macroeconomic Database* (AMECO), published by the Directorate General for Economic and Financial Affairs (2018). These data are in current prices using the euro currency. The deflated values are obtained using the *All-items Harmonised Index of Consumer Prices* (HICP), which is also retrieved from the *AMECO* database. The index is computed as an annual average and the reference year is 2015. Then, the variables are transformed to per capita values using the population data from *AMECO*.

The data on the revenue and expenditure of the EU budget for the time interval 2000-2020 are obtained from the Directorate-General for Budget (2018)<sup>8</sup>. The detailed data, which break down the revenue and expenditure by country, are available for the time interval 2000 to 2016. They are deflated and transformed to real per capita values using the HICP and population data. The net positions of the countries for the transfers from the EU budget are computed as expenditure received minus revenue paid by country  $i$  in the year  $t$ . The revenue used also include the rebates and retention of the collection costs on the traditional own resources.

During the analysis, the set of countries will be divided into different groups, such as the EU-12 or EA-11. The Data Appendix summarises the member states included in the different groups used throughout the analysis.

Since the data are differenced at an annual frequency, the first year (2000) is used only to compute the growth rate for the following year. Therefore, the tables in the next section will use the year 2001 as initial year of the time intervals. The results should be interpreted with caution due to the small number of observations in the sample.

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<sup>8</sup>Directorate-General for Budget (2018) includes the Operating Budgetary Balance. However, it is not suitable to estimate the stabilisation effect of the budget due to its nature as an accounting measure.

## Chapter 4

# Empirical analysis

The first section of this chapter reports the results for the main channels of international risk-sharing. Additionally, following the methodology of Furceri and Zdzienicka (2013), the saving channel will be divided into public and private saving. The data cover the time interval ranging from 2001 to 2017, which, through the interactions with dummy variables, will be divided into sub-periods. One crucial aspect is that the country-specific shocks are the deviations from the average GDP growth of the sample. Therefore, some of the results reported in the tables are not directly comparable since they represent deviations from different aggregates. Another critical aspect to point out is that, before 2007, not all the countries in the sample were members of the EU. Notwithstanding this difference, the countries are referred to as EU members.

Instead, the second section will focus on smoothing provided by the net international taxes and transfers channel. Its components are: *(i)* the net transfers from the EU budget and *(ii)* the remaining net transfers from the rest of the world. In every sample used in this section the last year included is 2016, and not 2017.

### 4.1: Risk-sharing in the European Union and euro area

The estimates in column (I) of table 4.1 show that the EU-27 smoothed only 12.90%<sup>1</sup> of the output shocks from 2001 to 2017. The significant smoothing channels were the net international factor income and transfers with, respectively, 5.17% and 2.51%. Table A.1 in the Appendix show that these results are robust to the different standard errors. However, in table A.1, the total saving channel is also statistically significant, and it is the primary source of smoothing of the shocks (6.73%).

The significant role of the factor income channel might be a consequence of the recent development on the CMU, which should increase the cross-border ownership of the assets. The result in column (IV) should capture the recent progress made on the banking union and other measures that foster financial integration, but the coefficient (6.70%) is not significant.

The lowest degree of smoothing (3.86%) was during the financial crisis (2008-2009).

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<sup>1</sup>Amount of smoothed shocks to GDP computed as  $1 - \beta_u$ .

Table 4.1: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EU-27				EU-25 <sup>a</sup>			
	2001-2017 (I)	2001-2007 (II)	2008-2009 (III)	2010-2017 (IV)	2001-2017 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2017 (VIII)
International factor ( $\beta_f$ ) income flows	5.17 <sup>†</sup> (2.52)	1.96 (1.58)	9.05 (6.59)	6.70 (4.50)	2.69 (2.22)	0.32 (1.58)	8.01 (5.42)	1.94 (1.94)
Capital depreciation ( $\beta_d$ )	-1.51 (3.61)	-5.49** (1.19)	-1.44 (1.38)	4.00 (10.04)	-5.14** (1.10)	-5.84** (1.26)	-2.02 (1.28)	-6.77** (1.89)
Net international taxes ( $\beta_r$ ) and transfers	2.51** (0.66)	3.46** (1.10)	2.97** (0.56)	0.84 (0.79)	2.70** (0.63)	3.42** (1.03)	3.07** (0.19)	1.15 (1.15)
Total saving ( $\beta_s$ )	6.73 (4.63)	5.65 (3.62)	-6.72 (11.85)	18.42** (5.16)	5.87 (4.27)	6.86 <sup>†</sup> (3.72)	-7.36 (8.37)	16.17* (5.92)
Private saving ( $\beta_p$ )	0.95 (1.43)	2.30 (1.45)	-2.08 (3.73)	1.36 (0.89)	0.76 (1.38)	2.55 <sup>†</sup> (1.34)	-2.11 (3.07)	0.28 (0.93)
Public saving ( $\beta_g$ )	5.79 (3.59)	3.35 (3.05)	-4.64 (8.12)	17.06** (4.80)	5.11 (3.34)	4.31 (3.16)	-5.25 (5.31)	15.89** (5.30)
Unsmoothed ( $\beta_u$ )	87.10** (6.29)	94.42** (3.06)	96.14** (3.32)	70.04** (13.37)	93.88** (2.16)	95.24** (2.93)	98.31** (1.49)	87.51** (3.39)
N	459	459	459	459	425	425	425	425

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation. In each column the estimates might not sum up to 100 due to rounding. All the samples do not include Croatia. The Data Appendix includes the lists of the countries in the different definitions.

Significance levels: <sup>†</sup> : 10% \* : 5% \*\* : 1%

<sup>a</sup> Luxembourg and Ireland are removed from the sample. The variables represent country-specific growth deviation from the average GDP growth in the sample, which is now the EU-25.

Whereas, despite the sovereign debt crisis, the highest fraction of shocks absorbed (29.96%) was between 2010 and 2017. In all the three sub-periods considered, the factor income channel is not significant anymore. Before and during the financial crisis, the net international transfers channel was the only source of significant shocks absorption, with 3.46% before and 2.97% during the crisis. Instead, after the crisis, this channel was not significant anymore, and the only source of risk-sharing was the saving channel, primarily through the public saving (17.06%). Table A.1 confirms the results in the columns from (II) to (IV).

A surprising effect, even if it is not statistically significant, is the large and positive coefficient of the capital depreciation channel in column (IV). As explained in Furceri and Zdzienicka (2013), this channel should not provide smoothing due to the way in which it is computed. Moreover, throughout the existing literature, the estimated coefficients for this channel are negative or slightly above zero. An analysis of the countries in the sample shows that Ireland is the cause of the anomaly. According to OECD (2016), in 2015, Ireland recorded a real GDP growth of 26.3%. This spike in GDP growth was caused by the relocation, in Ireland, of the economic activities of large multinational companies, in particular, their intellectual properties.

Column (V) to (VIII) report the estimates after the exclusion of Ireland and Luxembourg<sup>2</sup>. Now, in all the time intervals, the factor income channel does not provide significant smoothing of output shocks, suggesting that the previous results were driven

<sup>2</sup>These two countries will be excluded from most of the samples considered in the rest of the analysis. The existing literature often excludes Luxembourg from the samples due to the role of its financial sector and the fact that it is an outlier, especially for per capita variables (for example in Alcidi and Thirion (2016) and Cimadomo et al. (2017)). Whereas, Ireland, is an outlier due to the abnormal increase, in 2015, of its GDP growth.

Table 4.2: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EU-13				EU-12			
	2001-2017 (I)	2001-2007 (II)	2008-2009 (III)	2010-2017 (IV)	2001-2017 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2017 (VIII)
International factor ( $\beta_f$ ) income flows	-3.67 (3.20)	-13.30 (8.83)	-6.24 (5.69)	1.71 (2.96)	3.85 (2.71)	-0.02 (1.91)	10.98** (3.48)	2.14 (3.14)
Capital depreciation ( $\beta_d$ )	-4.58* (1.74)	-4.39 (3.37)	-0.33 (1.25)	-6.83** (2.17)	-5.24** (1.08)	-5.80** (1.28)	-2.38 (1.52)	-6.73** (1.79)
Net international taxes ( $\beta_\tau$ ) and transfers	0.72 (0.50)	1.52 (1.70)	0.74 (0.65)	0.54 (0.75)	3.07** (0.63)	3.37** (1.04)	3.55** (0.22)	1.64 (1.59)
Saving ( $\beta_s$ )	15.99** (4.98)	22.81 (15.14)	17.49** (5.27)	10.75 (7.39)	4.02 (5.07)	7.26 (4.51)	-12.55* (5.73)	20.57* (7.58)
Private saving ( $\beta_p$ )	1.15 (1.31)	-0.62 (2.98)	2.92* (1.31)	0.09 (1.73)	0.69 (1.72)	2.47† (1.25)	-3.16 (2.78)	0.43 (1.41)
Public saving ( $\beta_g$ )	14.84** (4.07)	23.43 (13.49)	14.57** (3.96)	10.66† (5.94)	3.34 (3.74)	4.79 (3.98)	-9.39** (2.95)	20.14** (6.75)
Unsmoothed ( $\beta_u$ )	91.54** (2.98)	93.36** (5.02)	88.34** (2.31)	93.83** (3.12)	94.30** (2.54)	95.19** (3.03)	100.39** (0.96)	82.37** (5.75)
N	425	425	425	425	425	425	425	425

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation. In each column the estimates might not sum up to 100 due to rounding. Luxembourg and Ireland are removed from the sample. Therefore, the country-specific shocks represent deviation from the average GDP growth in the sample, which is now the EU-25. The Appendix contains the list of countries included in EU-13 and EU-12.

Significance levels: † : 10% \* : 5% \*\* : 1%

by the abnormal behaviour of the two outliers (Ireland and Luxembourg). Instead, the smoothing by the transfers channel is still positive and significant. Moreover, the role of the saving channel after the financial crisis is confirmed and, now, it also has a significant effect before the financial crisis (6.86%). Between 2001 and 2007, the borrowing and lending in the credit markets by the private sector absorbed 2.55% of the shocks. The removal of the anomaly in the capital depreciation channel dramatically impacts the fraction of unsmoothed output shocks. As before, the period following the financial crisis has the lowest share of unsmoothed shocks (87.51%), but it is higher than before (70.04%). The main difference is that the capital depreciation channel provided significant dis-smoothing of the shocks (-6.77%) instead of smoothing them. During the financial crisis, only 1.69% of the asymmetric shocks was absorbed.

Using dummy variables, the EU-25 is divided into EU-13, often defined as "old member states", and EU-12, known as "new member states"<sup>3</sup>. The results in table 4.2 show that, before and during the crisis, the fraction of unsmoothed shocks was higher in the EU-12 than the EU-13. Whereas, from 2010 to 2017, the EU-12 absorbed a higher fraction of shocks than the EU-13, 17.63% and 6.17%, respectively.

During the financial crisis, in the EU-12, the effects on consumption of the output shocks were amplified ( $\beta_u > 1$ ). Whereas, the EU-13 smoothed 11.66% of the output shocks. The primary source of risk-sharing was the saving channel (17.49%). In particular, there was a contribution of the private sector in the credit markets (2.92%), while the public saving channel provided the remaining share (14.57%). One possible

<sup>3</sup>It refers to the countries that joined the EU in the 2004 or 2007 enlargement: Cyprus, Malta, Czech Republic, Hungary, Poland, Latvia, Lithuania, Estonia, Slovakia, Slovenia, Bulgaria and Romania.

explanation is that, during the financial crisis, national automatic stabilisers smoothed the effects of the shocks. On the contrary, for the EU-12, the public saving provided significant dis-smoothing (-9.39%). It might be a consequence of austerity measures adopted to respect the constraints set by the common fiscal rules. The dis-smoothing provided by the saving channel opposed the positive smoothing of the capital markets. In fact, during the financial crisis, the capital markets absorbed 10.98% of the output shocks. This significant result does not indicate that the EU-12 have access to integrated capital markets because it appears to be an isolated event.

As regards the EU-13, before the sovereign debt crisis, the factor income flows channel provided dis-smoothing, although it is not statistically significant. According to the arguments presented in Kalemli-Ozcan et al. (2014), this might be a consequence of the interest payments owed to the foreign holders of the sovereign debt. For all the time intervals, the capital depreciation provided dis-smoothing. As Milano (2017) show, the public savings of the periphery countries of the EMU<sup>4</sup> were profoundly affected by the European sovereign debt crisis. This aspect is captured by the estimate of the public saving channel in column (IV) of table 4.2, and it might explain why the fraction of shocks absorbed (10.66%) is lower for the EU-13 than for the EU-12 (20.14%)

Tables 4.3 reports the results for the samples of the EA-10<sup>5</sup> and EU-12 groups of countries. The estimates in column (I) suggest that the EA-10 countries absorbed only 15.74% of the output shocks. The channel that absorbed a significant fraction of the shocks was the saving channel, mainly through procyclical public saving (18.22%). The significant result for the factor income channel (7.35%) suggests that the capital markets might absorb asymmetric shocks, at least for the countries that share the common currency and that are supposed to be well integrated into the single market. In fact, for the EU-12, which are less integrated with the single market, the factor income channel does not have a significant result (column V).

For the EA-10, across the sub-periods, the difference in the fractions of shocks that were reflected on consumption is striking. During the financial crisis, 60.66% of the shocks was smoothed, as opposed to only 4.85% in the post-financial crisis. These results are caused by an increase in the dis-smoothing of the capital depreciation channel, paired with a decrease in the fraction of shocks smoothed by the factor income and saving channel. The former, smoothed as much as 33.46% of the output shocks during the crisis, while the estimate for the post-crisis is just 3.06% (not significant). Whereas, the saving channel smoothed 35.45% of the shocks during the financial crisis. The private sector used lending and borrowing in the credit markets, which also has inter-temporal consequences. As regards the national governments, they smoothed the shocks (29.43%) through the national automatic stabilisers and measures to sustain the national economy. Instead, after the financial crisis, the smoothing provided by the public saving decreased to 14.81%; this decrease should be driven by the periphery countries. The private saving switched from smoothing the shocks during the financial crisis (6.02%) to dis-smoothing them (-3.31%, not significant) during the sovereign debt crisis. As suggested in Milano (2017), the dis-smoothing might result from an accumulation of savings by the households sector during the crisis, most likely as precautionary measures for the

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<sup>4</sup>The periphery countries of the EMU included in the EU-13 are: Italy, Greece, Portugal, and Spain.

<sup>5</sup>The countries included in the EU-13 but not in the EA-10 are: the United Kingdom, Denmark and Sweden.



Table 4.3: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EA-10 <sup>a</sup>				EU-12 <sup>b</sup>			
	2001-2017 (I)	2001-2007 (II)	2008-2009 (III)	2010-2017 (IV)	2001-2017 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2017 (VIII)
International factor ( $\beta_f$ ) income flows	7.35 <sup>†</sup> (3.71)	10.47* (4.61)	33.46** (2.02)	3.06 (3.62)	2.44 (4.27)	-4.04 (1.58)	17.96** (5.42)	1.29 (1.94)
Capital depreciation ( $\beta_d$ )	-8.28** (2.21)	-1.67 (3.10)	-8.35** (1.48)	-10.44** (1.55)	-4.84* (1.83)	-5.79** (1.94)	0.61 (1.95)	-9.15** (2.31)
Net international taxes ( $\beta_r$ ) and transfers	0.62 (1.45)	0.47 (0.56)	0.11 (3.07)	0.74 (2.13)	3.47** (1.11)	4.01* (1.62)	4.50** (0.43)	0.50 (2.25)
Saving ( $\beta_s$ )	16.05 <sup>†</sup> (8.88)	22.49* (10.63)	35.45** (10.92)	11.50 (11.42)	4.33 (6.71)	6.42 (6.10)	-20.26** (5.07)	30.39** (6.82)
Private saving ( $\beta_p$ )	-2.17 (2.69)	-1.83 (3.19)	6.02** (1.20)	-3.31 (3.65)	0.74 (1.68)	1.53 (1.80)	-2.04 (3.74)	2.02 (1.24)
Public saving ( $\beta_g$ )	18.22* (6.67)	24.32* (9.99)	29.43** (9.72)	14.81 <sup>†</sup> (8.27)	3.60 (5.64)	4.89 (5.38)	-18.22** (1.32)	28.37** (7.15)
Unsmoothed ( $\beta_u$ )	84.26** (8.00)	68.25** (7.92)	39.34** (10.32)	95.15** (5.07)	94.60** (2.43)	99.41** (3.08)	97.18** (1.44)	76.97** (4.99)
N	170	170	170	170	204	204	204	204

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation. In each column the estimates might not sum up to 100 due to rounding.

Significance levels: <sup>†</sup> : 10% \* : 5% \*\* : 1%

<sup>a</sup> The country-specific shocks are deviation from the average EA-10 growth. The euro area countries considered are: Germany, France, the Netherlands, Belgium, Austria, Finland, Italy, Spain, Portugal and Greece.

<sup>b</sup> The country-specific shocks are deviation from the average EU-12 growth. The countries that joined the EU in the 2004 or 2007 enlargement: Cyprus, Malta, Czech Republic, Hungary, Poland, Latvia, Lithuania, Estonia, Slovakia, Slovenia, Bulgaria and Romania.

uncertainty in the future economic growth. The estimates in column (V) suggest that, from 2001 to 2017, the fraction of shocks absorbed in the EU-12 is much lower than in the EA-10 sample (5.40% for the EU-12 and 15.74% for the EA-10). For the EU-12, the factor income and saving channel provide positive smoothing, but they are not significant. Whereas, the net transfers channel is positive and significant (3.47%); this result might suggest a stabilisation role of the net transfers from the EU budget.

The estimates for the pre-financial crisis, column (VI), suggest that almost the entire variation of the country-specific GDP growth was reflected on consumption. The smoothing provided by the net transfers and saving channel, although only the former has a significant estimate (4.01), was almost entirely balanced by the dis-smoothing of the net factor income (not statistically significant) and capital depreciation channel. During the financial crisis, 97.18% of the output shocks was left unsmoothed. The public and private saving provided dis-smoothing, but only the effect of the former is statistically significant (-18.22%). As before, a possible explanation of the dis-smoothing by the public saving is that the member states had to respect the rules set by the *Stability and Growth Pact*. There is a surprisingly significant risk-sharing from the factor income channel (17.96%). However, it might be the consequence of an isolated event and not the signal of integrated capital markets.

In fact, in the post-financial crisis, the coefficient for the factor income channel is much lower (1.29%) and not statistically significant. The shocks absorption provided by the net transfers from abroad is close to zero and not significant. Whereas, the saving channel, is back to its procyclical behaviour. It provides a significant smoothing of 30.39%, of which the main contributor is the public saving channel (28.37%). Overall, mainly

driven by the smoothing of the output shocks by the saving channel, the unsmoothed fraction of shocks decreased to 76.97% (from 97.18% during the financial crisis).

As customary in the literature, the analysis will consider the core and periphery countries of the EMU (see Alcidi and Thirion (2017); Milano (2017)). In table 4.4, column (I) and (II) show that there is a striking difference in the fraction of output shocks absorbed between 2001 and 2017 in the EA-10. The core countries fared much better than the periphery countries with a fraction of, respectively, 42.35% and 8.21% of shocks smoothed. The saving channel had a significant role in smoothing the shocks for the core countries (48.46%), through the private (4.01%) and public (44.44%) sector. In contrast, for the periphery countries, the saving channel was not significant. Although the public saving channel had significant smoothing (10.79%), the private sector acted oppositely by dis-smoothing -3.92% of the shocks (not significant). The differences in the estimates for the saving channel are the leading cause of the gap between the fraction of unsmoothed shocks in the core and periphery countries.

The estimates for the pre-financial crisis period confirm that the saving channel had a significant role in smoothing output shocks for the core countries (47.14%), primarily through the public saving (44.55%). Whereas, for the periphery countries, the magnitude of the result is much lower (8.80% for the saving channel) and not significant. It might suggest that, during the years of economic growth, the core countries accumulated savings to prepare for possible economic downturns. On the other hand, the factor income channel provided some significant smoothing (16.25%) for the periphery countries, while it was close to zero and not statistically significant for the core countries. As suggested by Kalemli-Ozcan et al. (2014), during the years of economic growth, the outflows of dividends to shareholders located abroad caused the significant risk-sharing in the periphery countries. The capital depreciation channel provided dis-smoothing (-5.53%) for the core countries and smoothing for the periphery countries (0.47%), but both estimates are not significant. The results show that the net transfers channel followed the same behaviour.

The estimates for the financial crisis time interval suggest that the saving channel of the periphery countries provided dis-smoothing (-8.96%) due to countercyclical saving by the public sector (-11.59%). As proposed by Kalemli-Ozcan et al. (2014), a possible explanation is that the national governments did not create enough buffers during the years of economic growth. Hence, their savings were not enough to absorb the effect of the financial crisis and they had to increase their savings during the economic downturn to respect the rules set by the SGP. However, as shown in table A.2 in the Appendix, this result is not robust. On the other hand, for the core countries, the saving channel had a significant smoothing effect (43.02%). It is a consequence of shocks absorption by both components of the saving channel (6.60% by the private and 36.43% by the public sector)<sup>6</sup>. It suggests that the core countries were able to create sufficient saving buffers in the pre-financial crisis. Surprisingly, the net factor income channel provided significant and positive risk-sharing for both groups of countries (33.01% for the core and 36.06% for the periphery). However, as discussed in Alcidi and Thirion (2016), the smoothing obtained by the core countries was caused by Nokia, which shared its losses across countries because numerous shareholders are not located in Finland. It is possible that a similar event is the cause of the positive result for the periphery countries.

<sup>6</sup>In this case, column (IV) of table A.2 in the Appendix shows that the significance of the public saving channel is robust while the estimate for the private saving channel is not.

Table 4.4: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EA-10: 2001-2017 <sup>a</sup>		EA-10: Core <sup>b</sup>			EA-10: Periphery <sup>c</sup>		
	Core (I)	Periphery (II)	2001-2007 (III)	2008-2009 (IV)	2010-2017 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2017 (VIII)
International factor ( $\beta_f$ ) income flows	5.65 (6.83)	7.84 <sup>†</sup> (3.82)	0.05 (7.05)	33.01** (3.42)	1.42 (5.27)	16.25** (2.94)	36.06** (8.53)	3.23 (4.12)
Capital depreciation ( $\beta_d$ )	-9.93** (2.83)	-7.82** (2.27)	-5.53 (3.92)	-9.17** (1.02)	-9.75* (3.92)	0.47 (2.86)	-3.53** (0.23)	-10.51** (1.40)
Net international taxes ( $\beta_\tau$ ) and transfers	-1.82 (1.75)	1.32 (1.72)	-1.85** (0.55)	0.36 (2.94)	-5.34* (2.41)	1.76 (1.18)	-1.36 (2.62)	1.39 (2.20)
Saving ( $\beta_s$ )	48.46** (7.97)	6.87 (7.69)	47.14** (13.37)	43.02** (6.48)	50.18** (14.42)	8.80 (11.17)	-8.96* (4.06)	7.37 (10.16)
Private saving ( $\beta_p$ )	4.01* (1.85)	-3.92 (2.92)	2.59 (2.98)	6.60** (1.16)	6.08 (5.16)	-4.29 (4.41)	2.63 (1.67)	-4.31 (3.73)
Public saving ( $\beta_g$ )	44.44** (7.32)	10.79 <sup>†</sup> (5.15)	44.55** (13.44)	36.43** (5.32)	44.11** (12.18)	13.09 (8.06)	-11.59** (2.39)	11.69 (6.84)
Unsmoothed ( $\beta_u$ )	57.65** (8.39)	91.79** (6.01)	60.19** (9.25)	32.77** (4.98)	63.49** (8.21)	72.72** (9.62)	77.79** (7.31)	98.52** (3.80)
N	170	170	170	170	170	170	170	170

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation. In each column the estimates might not sum up to 100 due to rounding. In all the columns, the country-specific shocks are deviation from the average EA-10 growth.

Significance levels: † : 10% \* : 5% \*\* : 1%

<sup>a</sup> The euro area countries considered are: Germany, France, the Netherlands, Belgium, Austria, Finland, Italy, Spain, Portugal and Greece.

<sup>b</sup> The core countries are: Germany, France, the Netherlands, Belgium, Austria and Finland.

<sup>c</sup> The periphery countries are: Italy, Spain, Portugal and Greece.

Overall, despite the positive role of the factor income, the fraction of unsmoothed output shocks in the periphery countries was high (77.79%). Whereas, in the core countries, only 32.77% of the shocks was left unsmoothed.

From 2010-2017, the fraction of unsmoothed shocks increased in both groups of countries (98.52% in the periphery and 63.49% in the core countries). During the sovereign debt crisis, the inability of the periphery countries to deal with asymmetric shocks created a debate on whether some of the periphery countries would have been better off out of the common currency. Since they could not rely on national monetary policy, the lack of a supranational transfer system and labour mobility made the adjustment to the asymmetric shocks costly. Especially since there is a low degree of risk-sharing in capital markets. The result for the factor income channel in column (V) and (VIII) support the theory that the significant risk-sharing provided by this channel during the financial crisis was an isolated event and not the result of integrated capital markets. The capital depreciation channel dis-smoothed about -10.00% of the output shocks in both groups of countries. Whereas, the net transfers channel provided dis-smoothing only in the core countries (-5.34% and significant) and smoothing in the periphery (1.39% but not significant). Again, the contribution of the saving channel is the main difference in the risk-sharing obtained. It smoothed 50.18% of the shocks in the core countries and 7.37% in the periphery (not statistically significant). As explained in Milano (2017), during the sovereign debt crisis, the national governments and the households of the periphery countries provided dis-smoothing through the saving channel. However, the author finds that the loans guaranteed by the European Institutions, EFSF and ESM, compensate for the dis-smoothing by the national governments. Hence, the estimate for the public saving channel has a positive sign (column VIII) because it captures both effects.

Table 4.5: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EA-11: 2001-2014 <sup>a</sup>		EA-11: Core <sup>b</sup>			EA-11: Periphery <sup>c</sup>		
	Core (I)	Periphery (II)	2001-2007 (III)	2008-2009 (IV)	2010-2014 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2014 (VIII)
International factor ( $\beta_f$ ) income flows	6.73 (8.20)	4.59 (4.67)	1.64 (6.42)	24.02 <sup>†</sup> (11.46)	-5.75 (8.65)	17.50** (4.96)	-2.64 (7.63)	2.35 (5.63)
Capital depreciation ( $\beta_d$ )	-9.38* (3.48)	-3.84 (3.40)	-4.83 (3.49)	-5.56 <sup>†</sup> (2.73)	-11.15* (5.32)	4.17 (2.50)	1.37 (3.34)	-9.15** (1.91)
Net international taxes ( $\beta_\tau$ ) and transfers	-1.55 (1.99)	0.57 (1.63)	-1.04 (0.91)	-0.46 (1.97)	-7.05 <sup>†</sup> (3.46)	3.13 (1.78)	-4.01** (0.52)	1.36 (2.05)
Saving ( $\beta_s$ )	56.58** (8.74)	17.63 <sup>†</sup> (9.19)	51.51* (19.04)	65.41** (5.35)	64.68** (11.66)	3.87 (13.84)	43.02** (6.48)	14.45 (10.73)
Private saving ( $\beta_p$ )	5.52* (2.03)	-0.56 (3.51)	3.25 (3.94)	10.78** (1.33)	9.12 (8.43)	-6.46 (4.76)	12.58** (1.19)	-2.71 (3.19)
Public saving ( $\beta_g$ )	51.06** (7.91)	18.19** (5.94)	48.26* (16.72)	54.63** (4.02)	55.56** (9.48)	10.33 (9.41)	30.44** (5.29)	17.16* (7.91)
Unsmoothed ( $\beta_u$ )	47.61** (10.47)	81.05** (8.58)	52.72** (12.98)	16.60* (6.88)	59.27** (6.10)	71.32** (7.65)	62.27** (16.93)	91.00** (6.18)
N	154	154	154	154	154	154	154	154

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation. In each column the estimates might not sum up to 100 due to rounding. In all the columns, the country-specific shocks are deviations from the average EA-11 growth.

Significance levels: <sup>†</sup> : 10% \* : 5% \*\* : 1%

<sup>a</sup> The euro area countries considered are: Germany, France, the Netherlands, Belgium, Austria, Finland, Italy, Spain, Portugal, Greece and Ireland.

<sup>b</sup> The core countries are: Germany, France, the Netherlands, Belgium, Austria and Finland.

<sup>c</sup> The periphery countries are: Italy, Spain, Portugal, Greece and Ireland.

Table A.3 in the Appendix divide the 2010-2017 time interval into two sub-periods, from 2010 to 2014 and 2015 to 2017. The results for the core countries have the same signs but different magnitudes if compared to column (V) of table 4.4; the only sign variation is from smoothing to dis-smoothing for the factor income channel between 2010 and 2014. Instead, for the periphery countries, there are relevant differences between the two sub-periods. Between 2010 and 2014, the effect of the output shocks on the consumption was amplified. As suggested by Milano (2017) as a result of the sovereign debt crisis, the private sector accumulated precautionary saving (-5.88%, but not significant). Instead, in the following sub-period, the private saving channel absorbed 8.77% of the shocks. Additionally, the public saving channel smoothed 19.95% of the shocks. This result might suggest that the national governments increased their saving during the recent positive economic phase. Overall, between 2015 to 2017, just 78.79% of shocks was left unsmoothed.

Table 4.5 repeat the regressions for the EA-11<sup>7</sup>. As regards the core countries, the differences are the dis-smoothing provided by the net transfers channel during the financial crisis (-0.46% instead of 0.36% in table 4.4) and the factor income channel post-financial crisis (-5.75% as opposed to 1.42%). However, both estimates are still not statistically significant.

For the periphery countries, there is a massive difference in the estimates of the financial crisis sub-period. The net factor income channel provided dis-smoothing (-2.64%, but not significant). Whereas, in table 4.4, it absorbed a significant 36.06% of

<sup>7</sup>Ireland is included in the periphery countries. The last year of the sample is 2014 instead of 2017 to avoid the anomaly in the GDP growth of Ireland.

Table 4.6: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EU-10 <sup>a</sup>				EU-2 <sup>b</sup>			
	2001-2003 (I)	2004-2007 (II)	2008-2009 (III)	2010-2017 (IV)	2001-2006 (V)	2007 (VI)	2008-2009 (VII)	2010-2017 (VIII)
International factor ( $\beta_f$ ) income flows	3.39 (2.42)	-10.30** (3.10)	18.87** (2.96)	1.06 (4.38)	-6.75** (1.66)	-9.20** (1.59)	12.57** (1.57)	2.25 (5.01)
Capital depreciation ( $\beta_d$ )	-6.81 <sup>†</sup> (3.70)	-4.09 <sup>†</sup> (2.12)	1.26 (2.04)	-10.67** (2.57)	-5.38* (2.21)	-7.39** (1.08)	-3.24** (2.45)	-2.65 (2.05)
Net international taxes ( $\beta_\tau$ ) and transfers	3.01 (2.51)	5.28** (1.48)	4.20** (0.18)	-0.41 (2.71)	3.34 (3.17)	6.61** (0.76)	6.27* (2.35)	4.38 (3.39)
Saving ( $\beta_s$ )	0.70 (5.31)	15.56 (11.55)	-20.69** (4.42)	36.20** (9.08)	5.00 (6.40)	9.53 (5.91)	-17.70 <sup>†</sup> (9.97)	5.56 (5.87)
Private saving ( $\beta_p$ )	1.68 (1.89)	2.16* (0.95)	-2.38 (4.11)	3.05** (0.89)	0.11 (3.49)	3.44** (0.48)	-0.02 (2.37)	-2.37 (4.32)
Public saving ( $\beta_g$ )	-0.98 (4.51)	13.40 (11.31)	-18.31** (0.30)	33.15** (9.43)	4.89 (4.39)	6.09 (5.79)	-17.68* (7.60)	7.93 (5.34)
Unsmoothed ( $\beta_u$ )	99.70** (2.70)	93.55** (6.25)	96.36** (0.41)	73.81** (6.41)	103.78** (3.77)	100.45** (3.20)	102.10** (11.45)	90.46** (5.79)
N	204	204	204	204	204	204	204	204

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation. In each column the estimates might not sum up to 100 due to rounding. In all the columns, the country-specific shocks are deviation from the average EU-12 growth.

Significance levels: <sup>†</sup> : 10% \* : 5% \*\* : 1%

<sup>a</sup> The countries that joined the EU in the 2004 enlargement: Cyprus, Malta, Czech Republic, Hungary, Poland, Latvia, Lithuania, Estonia, Slovakia and Slovenia.

<sup>b</sup> The countries that joined the EU in the 2007 enlargement: Bulgaria and Romania.

the shocks. The change in the estimate of the factor income channel is balanced by an increase in the smoothing by the saving channel. The latter absorbed 43.02% of the shocks, as opposed to the dis-smoothing of -8.96% in table 4.4. The same holds for the role of the public saving, which absorbed 30.44% instead of dis-smoothing -11.59% of the shocks. The massive difference in the estimates might suggest that, in Ireland, the public saving were the primary source of smoothing of the shocks. However, a further breakdown is needed to assess whether it was the outcome of loans from the EU institutions or the use of national automatic stabilisers. The role of the private saving channel is now significant and positive (12.58%).

For both groups of countries the fraction of unsmoothed output shocks is lower in each time interval if compared to the results in table 4.4 and, during the financial crisis, it is as low as 16.60% for the core countries. Overall, the results of table 4.5 are consistent with the existing related literature (see Alcidi and Thirion (2016)).

Moving to the new member states, table 4.6 considers the ten countries that joined the EU in 2004 and the two countries of the 2007 enlargement. For the EU-10, before their accession to the EU, almost all the shocks were reflected on consumption (99.70%). Whereas, for the EU-2, the shocks were amplified (103.78%). The dis-smoothing provided by the capital depreciation channel is common to both groups of countries. The only difference is that, for the EU-2, the income factor channel was significant and provided dis-smoothing (-6.75%).

After their accession to the EU, but before the financial crisis, the factor income channel dis-smoothed a significant -10.30% and -9.20% for the EU-10 and EU-2, respectively. A possible explanation is that, during years of relative economic growth, there were in-

flows of factor income from abroad. The saving channel absorbed a higher fraction of the shocks than before the EU membership, but the estimates are not significant. Whereas, the smoothing from the net transfers channel was statistically significant (5.28% in the EU-10 and 6.61% in the EU-2).

During the financial crisis, only 3.64% of the output shocks was absorbed in the EU-10 while the effects of the shocks were amplified in the EU-2 (102.10%). The significant smoothing channels were the factor income and the net transfers from the EU. The former might be a consequence of a reduction in the interest payments to foreign shareholders during a recession (relative to the average EU-12 GDP growth). Whereas, the smoothing by the net transfers might be a consequence of the inflow of funds from the EU budget. The saving channel dis-smoothed -20.69% of the shocks in the EU-10 and -17.70% in the EU-2. In both cases, the dis-smoothing derives from the countercyclical saving of the private and public sector. As regards the latter, it might be a consequence of austerity measures.

For both groups of countries, the results of the post-financial crisis suggest procyclical public saving. For the EU-10 the public saving channel smoothed 33.15% of the shocks, together with the private saving channel the total share was 36.20%. Whereas for the EU-2, the saving channel absorbed 5.56% of the shocks, but it is not statistically significant. The factor income channel is again providing risk-sharing, but it is not significant. It confirms that the risk-sharing provided by this channel during the crisis was an isolated event. Overall, in the last period, in the EU-10 and EU-2, the fractions of shocks left unsmoothed were 73.81% and 90.46%, respectively. In both cases, these results represent improvements from the large fraction of unsmoothed shocks in the previous sub-period.

## 4.2: The role of the EU budget

Table A.4 in the Appendix shows that in the EU-25, during the financial crisis, the fraction of unsmoothed shocks was 98.31%. As in table 4.1, the transfers channel is the only significant source of smoothing of the shocks (3.07%), mainly through the EU budget (5.54%). It suggests that, despite the lack of a clear stabilisation function of the EU budget, the net transfers helped the member states in smoothing the asymmetric shocks. Column (V) and (VI) suggest that the net transfers channel provided risk-sharing to the EU-12 (3.06%), which include most of the net beneficiaries of the EU budget. However, the estimates for the net transfers from the EU budget are not statistically significant.

Table 4.7 reports the estimates for the net transfer channel in the EU-13 and EU-12 for different sub-periods. The EU budget provided risk-sharing in all the sub-period considered and for both groups of countries. However, the estimates are statistically significant only for the EU-12 before the sovereign debt crisis. During the financial crisis, the transfers from the EU budget smoothed a significant 6.76% of the shocks for the EU-12. A possible explanation is that the positive net transfers from the budget compensated for the decrease in NI caused by the financial crisis. There is also a positive and significant smoothing by the EU budget in the EU-13 group during the sovereign

Table 4.7: Shocks to GDP smoothed by the international transfers channel, percentage points (Pooled OLS)

	EU-13			EU-12		
	2001-2007 (I)	2008-2009 (II)	2010-2016 (III)	2001-2007 (IV)	2008-2009 (V)	2010-2016 (VI)
Unsmoothed ( $\beta_u$ )	93.36** (5.03)	88.34** (2.31)	93.95** (3.30)	95.19** (3.04)	100.39** (0.96)	79.03** (4.45)
Net international taxes ( $\beta_\tau$ ) and transfers	1.52 (1.70)	0.74 (0.65)	0.65 (0.78)	3.37** (1.05)	3.55** (0.22)	1.31 (1.73)
Net transfers from ( $\beta_{EU}$ ) the EU budget	2.67 (1.71)	-0.32 (1.08)	2.66* (1.19)	-0.38 (0.58)	6.76** (1.95)	1.77 (2.25)
Other net transfers from ( $\beta_{RoW}$ ) the rest of the world	-1.15 (2.65)	1.06* (0.43)	-2.01 (1.17)	3.75** (0.74)	-3.21 (2.17)	-0.45 (1.82)
N	400	400	400	400	400	400

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation for the residuals. In each column the estimates for the EU budget and the rest of the world transfers might not sum up to the net international taxes and transfers coefficient due to rounding. The Data Appendix includes the lists of the countries considered in each sample. Significance levels: † : 10% \* : 5% \*\* : 1%

debt crisis (2.66%). This result might be driven by the countries that were profoundly affected by the recent migratory crisis. In fact, while they had a negative GDP growth relative to the average, there was an increase in funds from the EU budget to help them in coping with the inflow of asylum seekers and economic migrants. Dis-smoothing from the net transfer from the rest of the world balanced the smoothing provided in these occasions by the net transfers from the EU budget (-3.21% for the EU-12 and -2.01% for the EU-13). The other transfers from the rest of the world provided significant risk-sharing in the EU-12 before the financial crisis (3.75%) and in the EU-13 during the financial crisis (1.06%).

Table 4.8 focuses on the EA-10 sample. Across all the columns, the fractions of unsmoothed shocks confirm the heterogeneous level of risk-sharing that were highlighted in table 4.4. According to the estimates in column (I) and (II), the net transfers from the EU budget smoothed 5.33% of the shocks in the periphery countries. Instead, the other net transfers from the rest of the world provided significant dis-smoothing for both groups of countries (-5.59% for the core and -3.92% for the periphery). A possible explanation is that the EA-10 countries are net contributors to international organisations and agreements. Since these type of contributions might not adjust to the business cycle, they might contribute to dis-smoothing the shocks. Overall the transfers channel, due to the opposite effect of its components, provided dis-smoothing for the core countries (-2.21%) and smoothing for the periphery countries (1.41%). However, both estimates are not statistically significant.

In the core countries, the EU budget smoothed 3.90% of the shocks during the financial crisis. It might be a consequence of the positive relative growth of the core countries during the crisis, which was balanced by a high amount of contribution to the EU budget for the benefits received. The other net transfers from the rest of the world increasingly dis-smoothed the shocks in the three sub-periods, but the results are not statistically significant.

Table 4.8: Shocks to GDP smoothed by the international transfers channel, percentage points (Pooled OLS)

	EA-10: 2001-2016 <sup>a</sup>		EA-10: Core <sup>b</sup>			EA-10: Periphery <sup>c</sup>		
	Core (I)	Periphery (II)	2001-2007 (III)	2008-2009 (IV)	2010-2016 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2016 (VIII)
Unsmoothed ( $\beta_u$ )	57.68** (8.64)	91.97** (6.01)	60.19** (9.28)	32.77** (5.00)	63.50** (9.39)	72.72** (9.65)	77.79** (7.33)	98.82** (3.74)
Net international taxes ( $\beta_\tau$ ) and transfers	-2.21 (1.90)	1.41 (1.73)	-1.85** (0.55)	0.36 (2.95)	-7.53** (2.21)	1.76 (1.19)	-1.36 (2.62)	1.57 (2.15)
Net transfers from ( $\beta_{EU}$ ) the EU budget	3.37 (2.31)	5.33** (1.68)	1.11 (1.98)	3.90** (0.69)	-2.75 (2.79)	2.43 (3.16)	-6.99** (0.26)	7.12** (1.25)
Other net transfers from ( $\beta_{RoW}$ ) the rest of the world	-5.59** (1.36)	-3.92* (1.73)	-2.96 (2.28)	-3.53 (2.27)	-4.77 (3.15)	-0.66 (3.71)	5.63 <sup>†</sup> (2.88)	-5.55** (1.44)
N	160	160	160	160	160	160	160	160

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation for the residuals. In each column the estimates for the EU budget and rest of the world transfers might not sum up to the net international taxes and transfers coefficient due to rounding. In all the columns, the country-specific shocks are deviation from the average EA-10 growth.

Significance levels: <sup>†</sup> : 10% \* : 5% \*\* : 1%

<sup>a</sup> The euro area countries considered are: Germany, France, the Netherlands, Belgium, Austria, Finland, Italy, Spain, Portugal and Greece.

<sup>b</sup> The core countries are: Germany, France, the Netherlands, Belgium, Austria and Finland.

<sup>c</sup> The periphery countries are: Italy, Spain, Portugal and Greece.

For the periphery countries, the net transfers from the EU budget smoothed the shocks between 2001 and 2007 (2.43%) and from 2010 to 2016 (7.12%), but only the latter is statistically significant. It suggests that the transfers received from the EU budget to cope with the migration crisis might have contributed to smooth the shocks during a phase of negative economic growth if compared to the core countries. Instead, during the crisis, the net transfer from the EU budget dis-smoothed a significant -6.99% of the shocks. A possible explanation is that the expenditures were pre-allocated to the new member states to foster their economic convergence. Therefore, when the financial crisis hit the periphery countries, they had to maintain their contributions to the EU budget while receiving a relatively low level of expenditure. The other net transfers from the rest of the world had the opposite effect. They provided significant risk-sharing (5.63%) during the financial crisis but dis-smoothed (-5.55%) the shocks in the following sub-period. It is possible that the periphery countries reduced or suspended their payments to international organisations or agreements during the financial crisis. That would also explain the dis-smoothing in the following period if the contributions were postponed but realised during the sovereign debt crisis.

Considering the newer member states, the estimates in table 4.9 shows that the only occasion in which the EU budget significantly absorbed the shocks was during the financial crisis for the EU-10. In fact, in that sub-period, the EU budget smoothed 6.52% of the output shocks. It might be a consequence of the inflows of structural funds during a period of negative economic growth if compared to the average. The pre-accession funds received from the EU budget contributed, in the EU-2 countries, to absorb the shocks (0.92%, but not statistically significant). Whereas, for the EU-10, they had a dis-smoothing effect of -1.38%, but it is not statistically significant. A possible explanation is that the EU-10 were in a relatively positive phase while they received the pre-accession funds, which were not balanced by contributions to the EU budget.

After the financial crisis, the smoothing of 1.68% of the shocks in the EU-10 is not significant, while the dis-smoothing of -8.69% for the EU-2 is statistically significant. A possible explanation for the latter estimate is that, during the financial crisis, the EU-10



Table 4.9: Shocks to GDP smoothed by the international transfers channel, percentage points (Pooled OLS)

	EU-10 <sup>a</sup>				EU-2 <sup>b</sup>			
	2001-2003 (I)	2004-2007 (II)	2008-2009 (III)	2010-2016 (IV)	2001-2006 (V)	2007 (VI)	2008-2009 (VII)	2010-2016 (VIII)
Unsmoothed ( $\beta_u$ )	99.70** (2.71)	93.55** (6.27)	96.36** (0.41)	73.96** (6.72)	103.78** (3.78)	100.45** (3.21)	102.10** (11.48)	84.04** (4.18)
Net international taxes ( $\beta_\tau$ ) and transfers	3.01 (2.52)	5.28** (1.49)	4.20** (0.18)	-0.68 (2.84)	3.34 (3.18)	6.61** (0.76)	6.27* (2.36)	3.85 (4.25)
Net transfers from ( $\beta_{EU}$ ) the EU budget	-1.38 (1.23)	-0.43 (2.54)	6.52* (2.74)	1.68 (3.03)	0.92 (1.08)	1.71 (1.30)	-1.01 (3.01)	-8.69** (4.93)
Other net transfers from ( $\beta_{RoW}$ ) the rest of the world	4.40** (1.36)	5.71** (1.83)	-2.31 (2.93)	-2.36 (3.80)	2.43 (3.51)	4.90** (0.94)	7.28 (5.37)	12.54 <sup>†</sup> (6.15)
N	192	192	192	192	192	192	192	192

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation for the residuals. In each column the estimates for the EU budget and rest of the world transfers might not sum up to the net international taxes and transfers coefficient due to rounding. In all the columns, the country-specific shocks are deviation from the average EU-12 growth.

Significance levels: † : 10% \* : 5% \*\* : 1%

<sup>a</sup> The countries that joined the EU in the 2004 enlargement: Cyprus, Malta, Czech Republic, Hungary, Poland, Latvia, Lithuania, Estonia, Slovakia and Slovenia.

<sup>b</sup> The countries that joined the EU in the 2007 enlargement: Bulgaria and Romania.

countries received a significant amount of funds, which were primarily used to realise public investments. The investments sustained the economic growth over the short- and long-term; thus affecting the GDP growth between 2010-2016. Due to the economic growth of the other countries, there was a relative negative economic growth of the EU-2 (if compared to the EU-12 average). Since the expenditures were pre-allocated, there was not an increase in transfers to the EU-2 to balance the relatively low growth. As a consequence, the country-specific asymmetric shocks to the EU-2 were not smoothed by the net transfers of the EU budget. However, as table A.5 in the Appendix show, this result is not robust.

For the EU-2 countries, the other net transfers from the rest of the world absorbed the output shocks in all the sub-periods considered. The risk-sharing of these transfers increased over time and is statistically significant in 2007 (4.90%) and between 2010 and 2016 (12.54%). In the latter sub-period, this channel compensated for the dis-smoothing provided by the net transfers from the EU budget. On the other hand, for the EU-10, the net transfer from the rest of the world absorbed the shocks in the sub-periods before the financial crisis. Whereas, during the financial and sovereign debt crisis, this channel contributed to the dis-smoothing of the output shocks, -2.31% in 2008-2009 and -2.36% from 2010 to 2016. However, both estimates are not statistically significant. Overall, for both groups of countries, the net transfers channel smoothed the shocks, except for the EU-10 during the sovereign debt crisis where it provided dis-smoothing.

## Chapter 5

# Conclusions

This work shows, using the methodology introduced by Asdrubali et al. (1996) to a dataset that includes 27 member states of the EU from 2001 to 2017, that the level of international risk-sharing in the European Union is still low and heterogeneous across the member states.

The results suggest that, for the EU-25, 93.88% of the country-specific shocks were left unsmoothed from 2001 to 2017. One of the causes of the low level of international risk-sharing is the presence of fragmented capital markets in the EU, which lead to a low level of ex-ante insurance from output shocks. Moreover, the net transfers channel was not able to compensate for the lack of risk-sharing by the factor income channel. In fact, the analysis on the components of the net transfers channel confirms that the net transfers from the EU budget do not consistently absorb the shocks. Although in some occasions, they contribute to smoothing significant shares of the output shocks, for example for the EU-10 during the financial crisis (6.52%), they also provide dis-smoothing. It is a consequence of the lack of flexibility of the revenue and expenditure system of the EU budget, which does not automatically adjust to deal with asymmetric shocks.

Given the low degree of risk-sharing obtained through the net international factor income and transfers channel, the saving channel, primarily through the public saving, is the main source of smoothing of the output shocks for the member states. However, as the results of the analysis suggest, and as discussed by Kalemli-Ozcan et al. (2014) and Milano (2017), the common fiscal rules constrained the capacity of the public saving channel to absorb the output shocks, and, in the case of the financial and sovereign debt crisis, led to significant dis-smoothing of the shocks.

Therefore, since the saving channel might be constrained, the member states need to increase the smoothing of output shocks provided by the net international factor income and transfers channel. As regards the former, the development of the Capital Market Union (CMU) is necessary to increase the degree of financial integration in the member states of the European Union. Whereas, for the latter, as suggested by Furceri and Zdzienicka (2013), there should be a reform of the EU budget to increase its flexibility and the resources at its disposal. Otherwise, the European Union should create other supranational automatic stabilisers capable of dealing with the asymmetric shocks that affect the member states.

# Appendix A

## Table and Figure Appendix

Figure A.1: Budget expenditures from 2000 to 2027

Source: Author's computation, data from the DG Budget and Commission (2018)

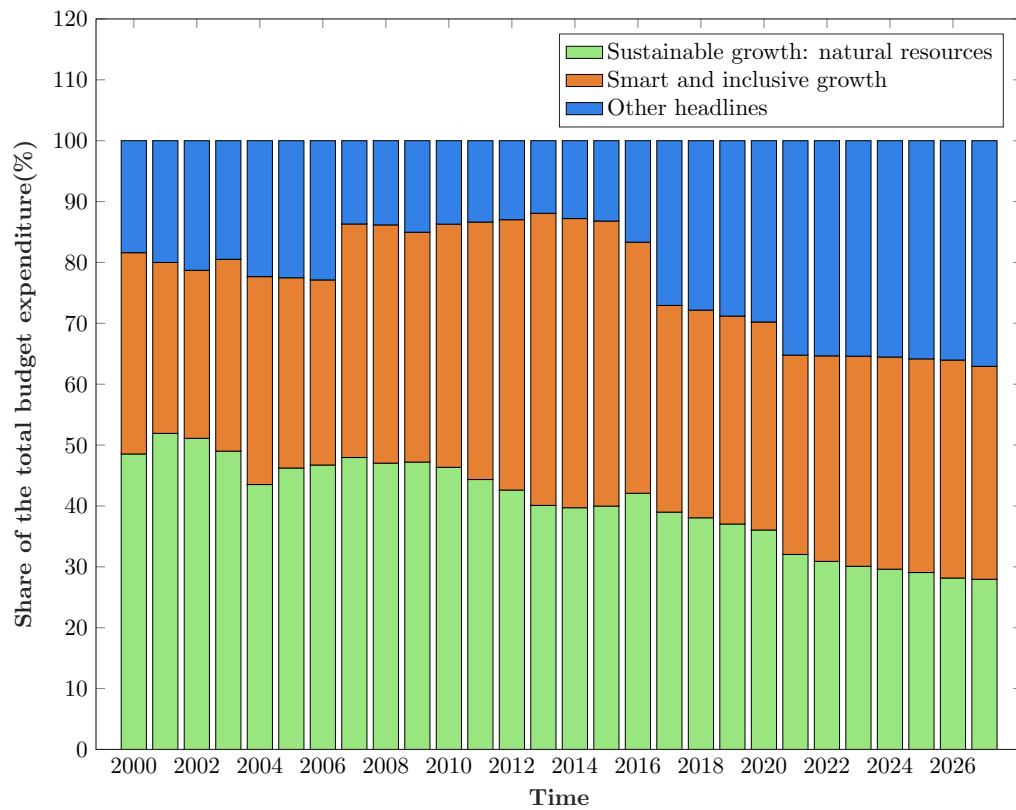


Figure A.2: Budget revenue from 2000 to 2016

Source: Author's computation, data from the DG Budget

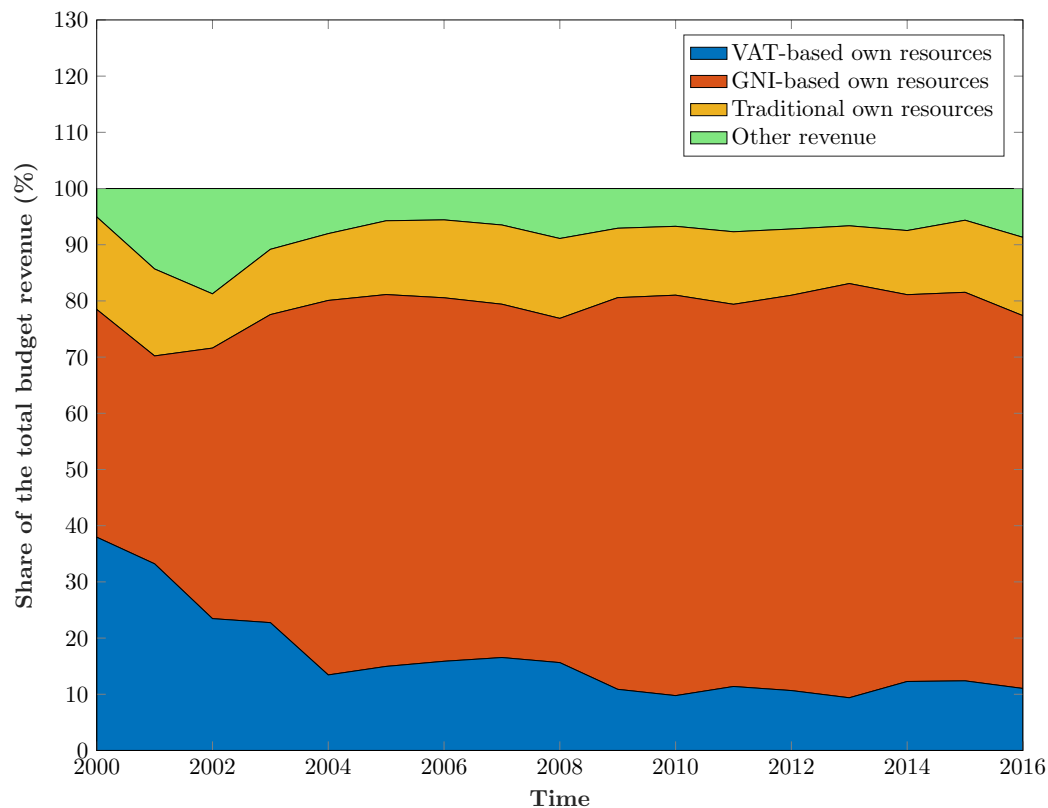


Table A.1: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EU-27				EU-25 <sup>a</sup>			
	2001-2017 (I)	2001-2007 (II)	2008-2009 (III)	2010-2017 (IV)	2001-2017 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2017 (VIII)
International factor ( $\beta_f$ ) income flows	5.36* (2.49)	2.33 (1.84)	9.05 (6.78)	6.70 (4.68)	2.83 (2.01)	0.58 (1.63)	8.01 (6.36)	1.94 (2.26)
Capital depreciation ( $\beta_d$ )	-1.47 (3.24)	-5.49** (1.47)	-1.44 (2.27)	4.00 (8.82)	-5.11** (1.01)	-5.78** (1.51)	-2.02 (2.30)	-6.77** (1.16)
Net international taxes ( $\beta_\tau$ ) and transfers	2.51** (0.72)	3.48** (1.35)	2.97** (0.99)	0.84 (0.88)	2.72** (0.77)	3.46* (1.39)	3.07** (0.92)	1.15 (1.08)
Total saving ( $\beta_s$ )	6.73 <sup>†</sup> (3.82)	5.61 (4.15)	-6.72 (11.13)	18.42** (3.94)	5.80 (3.73)	6.73 (4.24)	-7.36 (9.86)	16.17** (4.61)
Private saving ( $\beta_p$ )	1.01 (1.24)	2.45 (1.61)	-2.08 (3.73)	1.36 (1.12)	0.78 (1.26)	2.62 (1.61)	-2.11 (3.59)	0.28 (1.24)
Public saving ( $\beta_g$ )	5.73* (2.90)	3.16 (3.45)	-4.64 (7.96)	17.06** (3.38)	5.02 <sup>†</sup> (2.86)	4.10 (3.55)	-5.25 (6.92)	15.89** (3.90)
Unsmoothed ( $\beta_u$ )	86.87** (5.57)	94.07** (2.94)	96.14** (5.51)	70.04** (13.25)	93.76** (2.08)	95.02** (2.81)	98.31** (5.10)	87.51** (3.05)
N	459	459	459	459	425	425	425	425

Standard errors robust to heteroskedasticity reported in parenthesis. In each column the estimates might not sum up to 100 due to rounding. All the samples do not include Croatia. The Data Appendix includes the lists of the countries in the different definitions.

Significance levels: <sup>†</sup> : 10% \* : 5% \*\* : 1%

<sup>a</sup> Luxembourg and Ireland are removed from the sample. Therefore, the variables represent country-specific growth deviation from the average GDP growth in the sample, which is now the EU-25.

Table A.2: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EA-10: 2001-2017 <sup>a</sup>		EA-10: Core <sup>b</sup>			EA-10: Periphery <sup>c</sup>		
	Core (I)	Periphery (II)	2001-2007 (III)	2008-2009 (IV)	2010-2017 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2017 (VIII)
International factor ( $\beta_f$ ) income flows	4.45 (5.78)	7.07 (5.00)	-4.00 (9.77)	33.01* (15.30)	1.42 (8.09)	12.48* (5.87)	36.06† (19.67)	3.23 (5.78)
Capital depreciation ( $\beta_d$ )	-11.48** (1.60)	-8.81** (1.24)	-10.06** (2.73)	-9.17** (2.97)	-9.75** (3.41)	-3.73† (1.90)	-3.53 (3.69)	-10.51** (1.25)
Net international taxes ( $\beta_\tau$ ) and transfers	-1.69 (1.58)	1.40 (1.38)	-1.27 (2.12)	0.36 (4.08)	-5.34† (2.79)	2.31 (2.27)	-1.36 (4.01)	1.39 (1.69)
Saving ( $\beta_s$ )	52.07** (8.43)	9.19 (6.62)	61.41** (13.97)	43.02† (23.71)	50.18** (13.60)	22.05* (10.99)	-8.96 (27.94)	7.37 (8.25)
Private saving ( $\beta_p$ )	5.05* (2.55)	-3.25 (2.23)	6.49 (4.57)	6.60 (5.37)	6.08 (4.46)	-0.68 (3.97)	2.63 (8.81)	-4.31 (2.84)
Public saving ( $\beta_g$ )	47.01** (7.22)	12.45* (5.33)	54.92** (12.30)	36.43† (20.43)	44.11** (10.75)	22.73** (8.53)	-11.59 (25.89)	11.69† (6.57)
Unsmoothed ( $\beta_u$ )	56.65** (6.91)	91.15** (4.06)	53.92** (10.38)	32.77** (11.04)	63.49** (8.24)	66.89** (9.14)	77.79** (15.12)	98.52** (2.65)
N	170	170	170	170	170	170	170	170

Standard errors robust to heteroskedasticity reported in parenthesis. In each column the estimates might not sum up to 100 due to rounding. In all the columns, the country-specific shocks are deviation from the average EA-10 growth.

Significance levels: † : 10% \* : 5% \*\* : 1%

<sup>a</sup> The euro area countries considered are: Germany, France, the Netherlands, Belgium, Austria, Finland, Italy, Spain, Portugal and Greece.

<sup>b</sup> The core countries are: Germany, France, the Netherlands, Belgium, Austria and Finland.

<sup>c</sup> The periphery countries are: Italy, Spain, Portugal and Greece.

Table A.3: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EA-10: Core <sup>a</sup>				EA-10: Periphery <sup>b</sup>			
	2001-2007 (I)	2008-2009 (II)	2010-2014 (III)	2015-2017 (IV)	2001-2007 (V)	2008-2009 (VI)	2010-2014 (VII)	2015-2017 (VIII)
International factor ( $\beta_f$ ) income flows	0.05 (7.10)	33.01** (3.44)	-0.27 (8.07)	0.77 (10.05)	16.25** (2.96)	36.06** (8.59)	3.76 (4.67)	-0.60 (2.61)
Capital depreciation ( $\beta_d$ )	-5.53 (3.95)	-9.17** (1.02)	-11.25* (4.54)	-10.88 (5.63)	0.47 (2.88)	-3.53** (0.23)	-10.97** (1.18)	-3.92 (2.64)
Net international taxes ( $\beta_\tau$ ) and transfers	-1.85** (0.55)	0.36 (2.96)	-7.83* (3.50)	-5.12 (5.14)	1.76 (1.19)	-1.36 (2.63)	2.05 (2.53)	-2.97** (0.74)
Saving ( $\beta_s$ )	47.14** (13.46)	43.02** (6.52)	64.46** (12.32)	45.39** (14.86)	8.80 (11.24)	-8.96* (4.09)	3.91 (10.05)	28.72** (7.39)
Private saving ( $\beta_p$ )	2.59 (3.00)	6.60** (1.17)	9.46 (6.26)	12.34* (5.50)	-4.29 (4.44)	2.63 (1.68)	-5.88 (3.95)	8.77** (2.94)
Public saving ( $\beta_g$ )	44.55** (13.53)	36.43** (5.35)	54.99** (12.49)	33.05** (9.51)	13.09 (8.11)	-11.59** (2.41)	9.78 (6.52)	19.95** (4.48)
Unsmoothed ( $\beta_u$ )	60.19** (9.32)	32.77** (5.02)	54.89** (10.44)	60.04** (6.67)	72.72** (9.69)	77.79** (7.36)	101.25** (2.77)	78.79** (3.75)
N	170	170	170	170	170	170	170	170

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation. In each column the estimates might not sum up to 100 due to rounding. In all the columns, the country-specific shocks are deviation from the average EA-10 growth.

Significance levels: † : 10% \* : 5% \*\* : 1%

<sup>a</sup> The core countries are: Germany, France, the Netherlands, Belgium, Austria and Finland.

<sup>b</sup> The periphery countries are: Italy, Spain, Portugal and Greece.

Table A.4: Shocks to GDP smoothed by the international transfers channel, percentage points (Pooled OLS)

	EU-25				EU-13	EU-12
	2001-2016 (I)	2001-2007 (II)	2008-2009 (III)	2010-2016 (IV)	2001-2016 (V)	2001-2016 (VI)
Unsmoothed ( $\beta_u$ )	93.68** (2.22)	95.24** (2.94)	98.31** (1.49)	86.14** (2.96)	91.47** (3.07)	94.09** (2.62)
Net international taxes ( $\beta_\tau$ ) and transfers	2.70** (0.65)	3.42** (1.03)	3.07** (0.19)	1.00 (0.98)	0.77 (0.51)	3.06** (0.64)
Net transfers from ( $\beta_{EU}$ ) the EU budget	1.76 (1.40)	-0.46 (0.58)	5.54* (2.44)	2.19 (1.46)	1.33 (1.09)	1.84 (1.72)
Other net transfers from ( $\beta_{RoW}$ ) the rest of the world	0.94 (1.61)	3.87** (0.70)	-2.47 (2.25)	-1.19 (1.47)	-0.56 (1.19)	1.22 (1.84)
N	400	400	400	400	400	400

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation for the residuals. In each column the estimates for the EU budget and rest of the world transfers might not sum up to the net international taxes and transfers coefficient due to rounding. The Data Appendix includes the lists of the countries considered in each sample. Significance levels: † : 10% \* : 5% \*\* : 1%

Table A.5: Shocks to GDP smoothed by the international transfers channel, percentage points (Pooled OLS)

	EU-10 <sup>a</sup>				EU-2 <sup>b</sup>			
	2001-2003 (I)	2004-2007 (II)	2008-2009 (III)	2010-2016 (IV)	2001-2006 (V)	2007 (VI)	2008-2009 (VII)	2010-2016 (VIII)
Unsmoothed ( $\beta_u$ )	97.90** (6.36)	93.71** (6.45)	96.36** (9.47)	73.96** (6.86)	104.31** (4.75)	100.54** (6.59)	102.10** (14.48)	84.04** (10.81)
Net international taxes ( $\beta_\tau$ ) and transfers	2.78 (2.61)	5.30* (2.60)	4.20** (1.23)	-0.68 (2.25)	3.41 (3.83)	6.62** (2.08)	6.27† (3.27)	3.85 (5.62)
Net transfers from ( $\beta_{EU}$ ) the EU budget	-1.42 (1.40)	-0.43 (1.72)	6.52* (2.73)	1.68 (3.47)	0.93 (0.78)	1.71 (1.82)	-1.01 (2.30)	-8.69 (6.24)
Other net transfers from ( $\beta_{RoW}$ ) the rest of the world	4.20 (2.80)	5.73* (2.90)	-2.31 (3.41)	-2.36 (4.10)	2.48 (3.91)	4.91† (2.58)	7.28 (5.14)	12.54* (5.89)
N	192	192	192	192	192	192	192	192

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation for the residuals. In each column the estimates for the EU budget and rest of the world transfers might not sum up to the net international taxes and transfers coefficient due to rounding. In all the columns, the country-specific shocks are deviation from the average EU-12 growth.

Significance levels: † : 10% \* : 5% \*\* : 1%

<sup>a</sup> The countries that joined the EU in the 2004 enlargement: Cyprus, Malta, Czech Republic, Hungary, Poland, Latvia, Lithuania, Estonia, Slovakia and Slovenia.

<sup>b</sup> The countries that joined the EU in the 2007 enlargement: Bulgaria and Romania.

## Appendix B

# Data Appendix

The countries included in this work are:

- **EU-27:** Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.
- **EU-25:** Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.
- **EU-13:** Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.
- **EU-12:** Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.
- **EU-10:** Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.
- **EU-2:** Bulgaria and Romania.
- **EA-11:** Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.
  - **Periphery:** Greece, Ireland, Italy, Portugal and Spain.
  - **Core:** Austria, Belgium, Finland, France, Germany and the Netherlands.
- **EA-10:** Austria, Belgium, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal and Spain.
  - **Periphery:** Greece, Italy, Portugal and Spain.
  - **Core:** Austria, Belgium, Finland, France, Germany and the Netherlands.

The list of countries included in table 1.1 and in the part of the related literature are:

- **Sørensen and Yosha (1998):** Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, United Kingdom.
- **Balli and Sørensen (2007):**
  - **EMU:** Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Spain, Portugal.

- **EU**: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Spain, Portugal, Sweden, United Kingdom.
- **Furceri and Zdzienicka (2013)**:
  - **EMU**: Austria, Belgium, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovak Republic, Slovenia, Spain.
- **Kalemli-Ozcan et al. (2014)**:
  - **PIIGS**: Portugal, Ireland, Italy, Greece, and Spain.
  - **Non-PIIGS**: Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands, Sweden, and the United Kingdom.
- **Alcidi and Thirion (2016)**:
  - **EMU**: Germany, the Netherlands, Belgium, Austria, Finland, France, Italy, Spain, Portugal, Greece, Ireland.
  - **Core**: Germany, the Netherlands, Belgium, Austria, Finland, France.
  - **Periphery**: Italy, Spain, Portugal, Greece, Ireland.
- **Milano (2017)**:
  - **EMU**: Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Greece, Ireland, Portugal, Spain.
  - **Core**: Austria, Belgium, Finland, France, Germany, Italy, the Netherlands.
  - **Periphery**: Greece, Ireland, Portugal, Spain.



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**RISK SHARING IN THE EUROPEAN UNION:  
THE ROLE OF THE EU BUDGET**

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**ACADEMIC YEAR 2017/2018**

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# Chapter 1

## Summary

### 1.1: Introduction

The financial and European sovereign debt crisis reignited the debate on the capacity of the *European Union* (EU) to deal with asymmetric shocks that affect its member states. For the euro area, the stabilisation function provided by the ECB can address common shocks effectively. Whereas, it can not address asymmetric shocks because the decisions on the monetary policy consider the entire euro area, and not single member states.

The existing international risk-sharing literature extensively analyses through which channels the smoothing, or the lack thereof, of country-specific shocks to output, is obtained. In the European Union, the expectation is that the integration in the single market, as well as the introduction of the common currency, should provide a significant amount of international risk-sharing (see Kalemli-Ozcan et al. (2008)). In particular, the capital markets should contribute to the smoothing of asymmetric shocks. However, a consistent result in the existing literature is that the ex-ante insurance provided by the capital markets is not consistently contributing to risk-sharing. As Alcidi and Thirion (2016) explain, financial integration is a necessary condition to increase the degree of international risk-sharing through the cross-border ownership of assets. In the European Union, as discussed in Valiante (2016), there are still barriers that prevent the full development of the *Capital Markets Union* (CMU).

The integration process should also lead to the synchronisation of the business cycles of the member states. The seminal work of Mundell (1961), as well as the following literature on the *Optimal Currency Area* (OCA) theory, discuss the fact that, in a common currency area, the synchronisation of the business cycles would reduce the occurrence of asymmetric shocks. The common shocks would still affect the currency area, but the supranational monetary policy would be able to deal with them appropriately. However, Kenen (1969), and later Krugman (1993), argue that the higher integration of the economies of the member states could lead to an increase in specialisation, which would increase the occurrence of asymmetric shocks. In this scenario, in an OCA, the labour mobility and automatic supranational stabilisers are needed to adjust to the asymmetric shocks in a way that is not costly for the affected country.

As regards the labour mobility, Farhi and Werning (2014) further analyse the effects of

labour mobility in an OCA using a closed currency union model with nominal rigidities of price and wage. They show that labour mobility increases the welfare of the citizens emigrating from the regions affected by an adverse economic shock (or countries in the case of an OCA). Moreover, the emigration affects the welfare level of the citizens that remain in the depressed region. An additional aspect that influences the welfare of the citizens staying in the country is the degree of openness of the country. Under the assumption of no home-bias and production only of traded goods, the authors find that the higher the external demand shortfalls, the higher the welfare gains for citizens that stay in the depressed country following the emigration of a part of the population. Despite the positive effect of labour mobility as an adjustment mechanism to asymmetric shocks, its role is still limited in the EU if compared to the US. Fries-Tersch et al. (2018) suggest that there are still barriers that prevent the full development of labour mobility in the EU: (i) differences in languages across member states; (ii) legal barriers; and (iii) administrative barriers. As a consequence of these barriers, the labour mobility in the EU is still too limited to represent an adequate adjustment mechanism to the asymmetric shocks.

The smoothing of idiosyncratic output shocks in the EMU, given the limited labour mobility, could be achieved through transfers from the supranational level to the member state affected by the country-specific shock. For example, to stabilise the disposable national income after an adverse economic shock, the member state would receive higher transfers from the supranational level and pay lower taxes. However, the EU budget does not work as an automatic economic stabiliser due to its low flexibility in the expenditure and revenue system.

Juncker et al. (2015)<sup>1</sup> emphasise the necessity for a fiscal stabilisation function at the supranational level to deal with asymmetric shocks. As discussed by the authors, its introduction might avoid a contagion effect of the asymmetric shocks to the rest of the eurozone. Furceri and Zdzienicka (2013) show that the adoption of a budget that functions as automatic stabiliser would improve the risk-sharing in the EMU. However, the development of a supranational automatic stabiliser is still on hold because there is a lack of trust between the member states. The mistrust is caused by the moral hazard that could arise in the presence of a common euro area budget.

According to Juncker et al. (2015), there are four principles that a supranational stabilisation function for the euro area should satisfy. First, it should not achieve economic convergence in the member states of the EU, so it should not lead to permanent transfers in one direction only. Second, it should prevent moral hazard, an outcome that might be achieved by linking together the transfers to the compliance with the common fiscal rules, and the adoption of structural reforms to deal with national structural weaknesses. Third, it should act automatically, and it should be part of the European Union framework. Fourth, the main aim of the stabilisation function should be to improve the economic resilience of the euro area countries and the whole EMU.

Beetsma et al. (2018) recently suggested a system that links the transfers received by a member state to changes in world trade. This mechanism would face low moral hazard since the changes in the relevance of a specific sector on the volume of world trade are outside the control of national governments.

Andor (2016) advocates for the introduction of a common unemployment insurance

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<sup>1</sup>Also known as the *Five Presidents' Report*



scheme, which would increase the economic resilience, as well as social cohesion, in the member states. The author argues that the unemployment rate is a suitable indicator to define the direction of the cross-country transfers because it is closely linked to the economic cycle. The insurance scheme should be established as a common fund, financed by the resources of the national unemployment schemes. Following an increase in unemployment due to a shock to a member state, the common fund would use its resources to complement the national unemployment schemes. The author emphasises the possibility that the existing national schemes would be able to raise additional funds, which can be used at the national level. The simulations realised by the existing literature for such a scheme find that it would require fundings close to 1% of EU-GDP, and that it would achieve significant stabilisation effect across the EU (the estimates range from 11% to 20%, depending on the size of the common fund). Andor (2016) also points out that this scheme would act automatically to changes in unemployment; thus, satisfying one of the principles required by a supranational stabilisation function for the euro area. The author argues that the presence of such a mechanism would ease the burden on the public saving of the member state affected by the shock, and the transfers would foster economic growth by reducing the fall in demand caused by an adverse economic scenario.

Following the recent debate on the feasibility of a common unemployment insurance scheme for the EMU, Alcidi and Thirion (2017) analyse the stabilisation effect of the federal unemployment insurance system in the US. The aim of this analysis is to draw lessons for the policymakers in the EU. The authors find that in the US, between 1995 and 2013, the unemployment benefits smoothed only 1% of the country-specific output shocks. Whereas, the national unemployment benefits of the EA-11 member states smoothed 4.6% of the shocks. However, they show that the unemployment insurance transfers in the US mainly provide stabilisation to common, and not asymmetric, shocks — the share of shocks absorbed increase from 1% to 3.1% after the inclusion of common shocks.

Alcidi and Thirion (2017) also argue that the unemployment insurance in the US is not a completely automatic stabiliser. They claim that a significant share of risk-sharing is achieved through discretionary increases in the duration and resources available to pay the unemployment benefits<sup>2</sup>. The states also collect funds for their unemployment insurance scheme through taxes at the state level, which are the primary source of funding for the insurance schemes. According to the authors, the high relevance of the states' revenues limits the role of the schemes in providing inter-state risk sharing. Although there is a mechanism that increases the funding received from the federal level, it is triggered if certain indicators that indicate the presence of high unemployment rates are above specific threshold values. Loans from the federal level are an additional source of funds for the unemployment schemes. However, these loans entail inter-generational considerations since they must be repaid in the upcoming years.

Overall, there are aspects of the US unemployment insurance system that might be included in the design of a common unemployment insurance scheme for the EMU — for example, the conditionality between threshold levels of specific unemployment rates indicators and the fundings received at the state level. An additional aspect argued in

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<sup>2</sup>According to Alcidi and Thirion (2017) the Congress of the United States adopts stimulus packages during economic downturns that affect the US as a whole, and not just output shocks that affect specific states. Hence, these measures are considered as discretionary.

Alcidi and Thirion (2017) is that the presence of a supranational fiscal insurance might increase the degree of risk-sharing obtained through the capital markets.

Even with financial integration, the EU might still need the introduction of a supranational automatic stabiliser to provide risk-sharing in the case of asymmetric shocks. Farhi and Werning (2017) show that, in a currency union, the presence of a fiscal union leads to efficient risk-sharing if the financial markets are either incomplete or complete. The authors also compare the effectiveness of fiscal unions to other macroeconomic stabilisation instruments available in a currency union. They find that the stabilisation provided by the fiscal union varies depending on the characteristics of the shock and the country affected.

Milano (2017) also argues that the EU institutions can successfully contribute to smoothing the adverse economic shocks, even without a fiscal union. Milano (2017) and Cimadomo et al. (2017) show that the *European Financial Stability Facility* (EFSF) and *European Stability Mechanism* (ESM), through the loans to the periphery countries, smoothed a significant fraction of the country-specific shocks during the sovereign debt crisis. It is also important to point out that these institutions acted as substitutes to the national governments. In fact, in the periphery countries, the governments were constrained by the rules on deficit and public debt set by the *Stability and Growth Pact* (SGP). To respect these rules, they had to introduce austerity measures. The authors find that the outcome was dis-smoothing of the output shocks by the public saving channel, which was compensated for by the crucial role of EFSF and ESM. However, these institutions do not act automatically, and it is a significant difference if compared to a typical budget under a fiscal union. Moreover, the risk-sharing provided by the saving channel also has inter-temporal implications.

Against the backdrop of this literature, this work will analyse the degree of international risk-sharing in the member states of the European Union between 2001 and 2017. Moreover, the net international taxes and transfers channel is decomposed to analyse the stabilisation of output growth achieved by the net transfers from the EU budget between 2001 and 2016. The analysis will consider the full sample, as well as different groups of countries and time intervals, for example, the euro area country pre- and post-financial crisis.

The main contribution of this work is to include in the analysis almost all the member states of the EU and the data recorded in recent years (up to 2017). An additional contribution is the decomposition of the net international transfers channel to assess the smoothing of country-specific output shocks provided by the net transfers from the EU budget.

## 1.2: Empirical results of the related literature on risk-sharing in the EU

Over the years, many scholars analysed the degree of international risk-sharing in the EU, often as a comparison to the USA. This section will look at some of the recent results proposed by the literature in this field.

Table 1.1 reports some of the results found by Alcidi and Thirion (2016) and

Table 1.1: Literature review

	Alcidi and Thirion (2016)						Milano (2017)		
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)
	2008-2009			2010-2014			2007-2014		
	EMU <sup>a</sup>	Core <sup>b</sup>	Periphery <sup>c</sup>	EMU <sup>a</sup>	Core <sup>b</sup>	Periphery <sup>c</sup>	EMU <sup>a</sup>	Core <sup>d</sup>	Periphery <sup>e</sup>
Factors income	4 (10)	26** (10)	-2 (10)	3 (5)	-6 (12)	3 (5)	2 (4)	11 <sup>†</sup> (6)	-1 (7)
Capital depreciation	1 (4)	-5 (5)	2 (4)	-11** (2)	-13** (5)	-11** (2)	-12** (2)	-20** (2)	-9** (2)
International transfers	-3 (3)	0 (3)	-3 (3)	1 (2)	-7 (7)	1 (2)	0 (1)	-2 <sup>†</sup> (1)	1 (3)
Saving	42** (15)	61** (19)	38** (14)	17* (8)	72** (23)	12 <sup>†</sup> (7)	39** (8)	79** (12)	31** (11)
Unsmoothed	56** (11)	18 (14)	65** (11)	91** (6)	54** (15)	94** (6)	69** (6)	26** (7)	77** (9)
Countries	11	6	5	11	6	5	11	7	4

<sup>a</sup>EMU: Germany, the Netherlands, Belgium, Austria, Finland, France, Italy, Spain, Portugal, Greece, Ireland.

<sup>b</sup>Core in Alcidi and Thirion (2016): Germany, the Netherlands, Belgium, Austria, Finland, France.

<sup>c</sup>Periphery in Alcidi and Thirion (2016): Italy, Spain, Portugal, Greece, Ireland.

<sup>d</sup>Core in Milano (2017): Germany, the Netherlands, Belgium, Austria, Finland, France, Italy.

<sup>e</sup>Periphery in Milano (2017): Spain, Portugal, Greece, Ireland.

Significance levels: † : 10% \* : 5% \*\* : 1%

Milano (2017). The former uses data from 1970 to 2014, while the latter from 1990 to 2014. Both works look at 11 countries of EMU. According to Alcidi and Thirion (2016), the factor income channel provided significant smoothing of the shocks only for the core countries during the financial crisis (26%, column (II)) and does not consistently contribute to risk-sharing over the entire time interval<sup>3</sup>. The only statistically significant estimate for the net transfers channel suggests a dis-smoothing of the shocks of -2% for the core countries between 2007 and 2014. Milano (2017) also analyse the degree of risk-sharing in the USA. Her results show that, in the USA, the factors income and tax-transfers channel smoothed 44% of the shocks from 2007 to 2014 (22% for each channel). She suggests that the lower amount of risk sharing achieved in the EMU by these channels is a consequence of the fragmented capital markets and the lack of automatic stabilisers at the supranational level.

As regards the saving channel, both Milano (2017) and Alcidi and Thirion (2016) find that in all the groups of countries and sub-periods considered the saving channel is the primary source of smoothing of output shocks. However, there is a massive difference between the fraction of shocks absorbed by the savings of the national governments in the core and periphery countries. According to Milano (2017), for the former group of countries, the government saving provided 73% of consumption smoothing. Whereas, for the peripheral countries, the national governments dis-smoothed 63% of the shocks. Kalemli-Ozcan et al. (2014), as well as Milano (2017), argue that the decline in the fraction of shocks smoothed by the government saving is a consequence of the austerity measures adopted in the periphery countries to respect the deficit and debt rules set out by the SGP. Whereas, as discussed in Milano (2017) and Cimadomo et al. (2017), the loans from the EFSF and ESM provided significant smoothing of the shocks, substituting for the dis-smoothing achieved by the national governments of the periphery countries.

<sup>3</sup>Milano (2017) does not split the time interval, but it is likely that the significant result of 11% in column (VIII) of table 1.1 is a consequence of the risk-sharing achieved during the financial crisis.

According to the latter work, during the sovereign debt crisis, the euro area managed to smooth 65% of output shocks, an increase from the result of the pre-crisis sub-period (40%).

### 1.3: Empirical approach to risk-sharing

The methodology used in this analysis is based on the seminal work of Asdrubali et al. (1996), which introduced a cross-sectional variance decomposition of shocks to GDP. As in Sørensen and Yosha (1998) and Furceri and Zdzienicka (2013), the estimates for the smoothing channels are obtained using the following panel regressions:

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

where the  $\nu_{\{f;d;\tau;s;u\},t}$  are time fixed effects. All the equations utilise differenced data at an annual frequency.

If there is not full international risk-sharing, the covariance between the consumption in country  $i$  and its output will be positive, meaning  $\beta_u > 0$ . Therefore, idiosyncratic shocks to the GDP of country  $i$  will cause a variation of the same sign on the country-specific consumption. As explained in Furceri and Zdzienicka (2013), the coefficients  $\beta_f$ ,  $\beta_d$ ,  $\beta_{\tau}$ , and  $\beta_s$ , represent, respectively, the fraction of shocks absorbed by the net factor income flows, capital depreciation, net international transfers, and saving. There will be full smoothing of the output shock as long as the sum of all the betas is equal to 1, with  $\beta_u = 0$ .

Following the existing literature, the saving channel is divided into private and public sector. Furceri and Zdzienicka (2013) propose the following regressions to estimate the role of these two sectors in smoothing GDP shocks:

$$\begin{aligned}\Delta \log DNI_t^i - \Delta \log (DNI_t^i + G_t^i) &= \nu_{p,t} + \beta_p \Delta \log GDP_t^i + \epsilon_{p,t}^i \\ \Delta \log (DNI_t^i + G_t^i) - \Delta \log C_t^i &= \nu_{g,t} + \beta_g \Delta \log GDP_t^i + \epsilon_{g,t}^i\end{aligned}$$

where  $G_t^i$  is the final consumption expenditure of the general government of country  $i$  at time  $t$ . The sum of the final consumption expenditure by the public and private sector, respectively,  $G_t^i$  and  $P_t^i$ , is the total final consumption in the economy of country  $i$ ,  $C_t^i = G_t^i + P_t^i$ . If  $\beta_p = 1$  while  $\beta_u = 0$ , the shock is entirely smoothed by the private saving channel. Whereas,  $\beta_g$  is the share of the shock smoothed by the public saving.

Using the same methodology adopted by Alcidi and Thirion (2017), the net international taxes and transfers channel is decomposed in the following way:

$$\frac{NI_i}{NI_i + \text{Net international transfers}} = \frac{NI_i}{(NI_i + BT_i)} \frac{(NI_i + BT_i)}{DNI_i} \quad (1.1)$$

$BT_i$  takes the values of the net transfers from the EU budget. The following equations estimate the smoothing of output shocks provided by two components of the net transfers

channel:

$$\begin{aligned}\Delta \log NI_t^i - \Delta \log (NI_t^i + BT_t^i) &= \nu_{EU,t} + \beta_{EU} \Delta \log GDP_t^i + \epsilon_{EU,t}^i \\ \Delta \log (NI_t^i + BT_t^i) - \Delta \log DNI_t^i &= \nu_{RoW,t} + \beta_{RoW} \Delta \log GDP_t^i + \epsilon_{RoW,t}^i\end{aligned}$$

where  $\beta_{RoW}$  is the fraction of output shocks absorbed by the net transfers from the rest of world (other than the transfers from the EU budget). Whereas,  $\beta_{EU}$  captures the degree of risk-sharing provided by the net transfers from the EU budget. If  $(NI_t^i + BT_t^i)$  is constant while  $NI_t^i$  varies, the shock is smoothed by countercyclical net transfers from the EU budget. This methodology does not allow to capture possible additional effects of the EU budget. For example, as discussed in Ferrer and Alcidi (2018), the resources of the EU budget also work as guarantees for loans. Hence, the EU budget might also have an indirect stabilisation function through the saving channel.

The coefficients are estimated using OLS with Driscoll-Kraay<sup>4</sup> corrected standard errors. This type of standards errors correct for heteroskedasticity, autocorrelation, and possible contemporaneous correlation across panels. As suggested by Hepp and von Hagen (2013) and Alcidi and Thirion (2017), the errors are assumed to follow an AR (1) process. As a robustness check, some of the main tables are estimated using standards errors robust to heteroskedasticity.

## 1.4: Data

The dataset used for the analysis includes the data for the 28 member states of the European Union. However, Croatia is removed from the sample because it has missing DNI data from 2013 to 2017. The remaining panel is strongly balanced. However, Ireland and Luxembourg are removed for almost all the analysis since they are outliers and, in the case of Ireland, it registered a spike in the real GDP growth for 2015, which would bias the results. The data on GDP, GNI, NI, net DNI, C, HICP and population for the time interval 2000 to 2017 are from the *Annual Macroeconomic Database* (AMECO), published by the Directorate General for Economic and Financial Affairs (2018). The variables are deflated using the HICP and transformed to per capita values using the population data.

The detailed data, which break down the revenue and expenditure by country, are obtained from Directorate-General for Budget (2018) for the time interval 2000 to 2016. They are also deflated and transformed to real per capita values. The net positions of the countries for the transfers from the EU budget are computed as expenditure received minus revenue paid by country  $i$  in the year  $t$ .

## 1.5: Empirical analysis: Risk-sharing in the European Union and euro area

This section reports the results for the main channels of international risk-sharing. Additionally, following the methodology of Furceri and Zdzienicka (2013), the saving

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<sup>4</sup>Which are based on Driscoll and Kraay (1998)

Table 1.2: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EU-27				EU-25 <sup>a</sup>			
	2001-2017 (I)	2001-2007 (II)	2008-2009 (III)	2010-2017 (IV)	2001-2017 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2017 (VIII)
International factor ( $\beta_f$ ) income flows	5.17 <sup>†</sup> (2.52)	1.96 (1.58)	9.05 (6.59)	6.70 (4.50)	2.69 (2.22)	0.32 (1.58)	8.01 (5.42)	1.94 (1.94)
Capital depreciation ( $\beta_d$ )	-1.51 (3.61)	-5.49** (1.19)	-1.44 (1.38)	4.00 (10.04)	-5.14** (1.10)	-5.84** (1.26)	-2.02 (1.28)	-6.77** (1.89)
Net international taxes ( $\beta_r$ ) and transfers	2.51** (0.66)	3.46** (1.10)	2.97** (0.56)	0.84 (0.79)	2.70** (0.63)	3.42** (1.03)	3.07** (0.19)	1.15 (1.15)
Total saving ( $\beta_s$ )	6.73 (4.63)	5.65 (3.62)	-6.72 (11.85)	18.42** (5.16)	5.87 (4.27)	6.86 <sup>†</sup> (3.72)	-7.36 (8.37)	16.17* (5.92)
Private saving ( $\beta_p$ )	0.95 (1.43)	2.30 (1.45)	-2.08 (3.73)	1.36 (0.89)	0.76 (1.38)	2.55 <sup>†</sup> (1.34)	-2.11 (3.07)	0.28 (0.93)
Public saving ( $\beta_g$ )	5.79 (3.59)	3.35 (3.05)	-4.64 (8.12)	17.06** (4.80)	5.11 (3.34)	4.31 (3.16)	-5.25 (5.31)	15.89** (5.30)
Unsmoothed ( $\beta_u$ )	87.10** (6.29)	94.42** (3.06)	96.14** (3.32)	70.04** (13.37)	93.88** (2.16)	95.24** (2.93)	98.31** (1.49)	87.51** (3.39)
N	459	459	459	459	425	425	425	425

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation. In each column the estimates might not sum up to 100 due to rounding. All the samples do not include Croatia.

Significance levels: <sup>†</sup> : 10% \* : 5% \*\* : 1%

<sup>a</sup> Luxembourg and Ireland are removed from the sample. The variables represent country-specific growth deviation from the average GDP growth in the sample, which is now the EU-25.

channel will be divided into public and private saving. The data cover the time interval ranging from 2001 to 2017, which, through the interactions with dummy variables, will be divided into sub-periods. One crucial aspect is that the country-specific shocks are the deviations from the average GDP growth of the sample. Therefore, some of the results reported in the tables are not directly comparable since they represent deviations from different aggregates. Another critical aspect to point out is that, before 2007, not all the countries in the sample were members of the EU. Notwithstanding this difference, the countries are referred to as EU members.

The estimates in column (I) of table 1.2 show that the EU-27 smoothed only 12.90%<sup>5</sup> of the output shocks from 2001 to 2017. The significant smoothing channels were the net international factor income and transfers with, respectively, 5.17% and 2.51%. The robustness checks to the different standard errors find that the total saving channel is also statistically significant, and it is the primary source of smoothing of the shocks (6.73%).

The significant role of the factor income channel might be a consequence of the recent development on the CMU, which should increase the cross-border ownership of the assets. The result in column (IV) should capture the recent progress made on the banking union and other measures that foster financial integration, but the coefficient (6.70%) is not significant.

The lowest degree of smoothing (3.86%) was during the financial crisis (2008-2009). Whereas, despite the sovereign debt crisis, the highest fraction of shocks absorbed (29.96%) was between 2010 and 2017. In all the three sub-periods considered, the factor income channel is not significant anymore. Before and during the financial crisis, the

<sup>5</sup>Amount of smoothed shocks to GDP computed as  $1 - \beta_u$ .

net international transfers channel was the only source of significant shocks absorption, with 3.46% before and 2.97% during the crisis. Instead, after the crisis, this channel was not significant anymore, and the only source of risk-sharing was the saving channel, primarily through the public saving (17.06%).

A surprising effect, even if it is not statistically significant, is the large and positive coefficient of the capital depreciation channel in column (IV). As explained in Furceri and Zdzienicka (2013), this channel should not provide smoothing due to the way in which it is computed. Moreover, throughout the existing literature, the estimated coefficients for this channel are negative or slightly above zero. An analysis of the countries in the sample shows that Ireland is the cause of the anomaly. According to OECD (2016), in 2015, Ireland recorded a real GDP growth of 26.3%. This spike in GDP growth was caused by the relocation, in Ireland, of the economic activities of large multinational companies, in particular, their intellectual properties.

Column (V) to (VIII) report the estimates after the exclusion of Ireland and Luxembourg<sup>6</sup>. Now, in all the time intervals, the factor income channel does not provide significant smoothing of output shocks, suggesting that the previous results were driven by the abnormal behaviour of the two outliers (Ireland and Luxembourg). Instead, the smoothing by the transfers channel is still positive and significant. Moreover, the role of the saving channel after the financial crisis is confirmed and, now, it also has a significant effect before the financial crisis (6.86%). Between 2001 and 2007, the borrowing and lending in the credit markets by the private sector absorbed 2.55% of the shocks. The removal of the anomaly in the capital depreciation channel dramatically impacts the fraction of unsmoothed output shocks. As before, the period following the financial crisis has the lowest share of unsmoothed shocks (87.51%), but it is higher than before (70.04%). The main difference is that the capital depreciation channel provided significant dis-smoothing of the shocks (-6.77%) instead of smoothing them. During the financial crisis, only 1.69% of the asymmetric shocks was absorbed.

As customary in the literature, the analysis will consider the core and periphery countries of the EMU (see Alcidi and Thirion (2017); Milano (2017)). In table 1.3, column (I) and (II) show that there is a striking difference in the fraction of output shocks absorbed between 2001 and 2017 in the EA-10. The core countries fared much better than the periphery countries with a fraction of, respectively, 42.35% and 8.21% of shocks smoothed. The saving channel had a significant role in smoothing the shocks for the core countries (48.46%), through the private (4.01%) and public (44.44%) sector. In contrast, for the periphery countries, the saving channel was not significant. Although the public saving channel had significant smoothing (10.79%), the private sector acted oppositely by dis-smoothing -3.92% of the shocks (not significant). The differences in the estimates for the saving channel are the leading cause of the gap between the fraction of unsmoothed shocks in the core and periphery countries.

The estimates for the pre-financial crisis period confirm that the saving channel had a significant role in smoothing output shocks for the core countries (47.14%), primarily through the public saving (44.55%). Whereas, for the periphery countries, the

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<sup>6</sup>These two countries will be excluded from most of the samples considered in the rest of the analysis. The existing literature often excludes Luxembourg from the samples due to the role of its financial sector and the fact that it is an outlier, especially for per capita variables (for example in Alcidi and Thirion (2016) and Cimadomo et al. (2017)). Whereas, Ireland, is an outlier due to the abnormal increase, in 2015, of its GDP growth.

Table 1.3: Shocks to GDP smoothed by each channel, percentage points (Pooled OLS)

	EA-10: 2001-2017 <sup>a</sup>		EA-10: Core <sup>b</sup>			EA-10: Periphery <sup>c</sup>		
	Core (I)	Periphery (II)	2001-2007 (III)	2008-2009 (IV)	2010-2017 (V)	2001-2007 (VI)	2008-2009 (VII)	2010-2017 (VIII)
International factor ( $\beta_f$ ) income flows	5.65 (6.83)	7.84 <sup>†</sup> (3.82)	0.05 (7.05)	33.01** (3.42)	1.42 (5.27)	16.25** (2.94)	36.06** (8.53)	3.23 (4.12)
Capital depreciation ( $\beta_d$ )	-9.93** (2.83)	-7.82** (2.27)	-5.53 (3.92)	-9.17** (1.02)	-9.75* (3.92)	0.47 (2.86)	-3.53** (0.23)	-10.51** (1.40)
Net international taxes ( $\beta_\tau$ ) and transfers	-1.82 (1.75)	1.32 (1.72)	-1.85** (0.55)	0.36 (2.94)	-5.34* (2.41)	1.76 (1.18)	-1.36 (2.62)	1.39 (2.20)
Saving ( $\beta_s$ )	48.46** (7.97)	6.87 (7.69)	47.14** (13.37)	43.02** (6.48)	50.18** (14.42)	8.80 (11.17)	-8.96* (4.06)	7.37 (10.16)
Private saving ( $\beta_p$ )	4.01* (1.85)	-3.92 (2.92)	2.59 (2.98)	6.60** (1.16)	6.08 (5.16)	-4.29 (4.41)	2.63 (1.67)	-4.31 (3.73)
Public saving ( $\beta_g$ )	44.44** (7.32)	10.79 <sup>†</sup> (5.15)	44.55** (13.44)	36.43** (5.32)	44.11** (12.18)	13.09 (8.06)	-11.59** (2.39)	11.69 (6.84)
Unsmoothed ( $\beta_u$ )	57.65** (8.39)	91.79** (6.01)	60.19** (9.25)	32.77** (4.98)	63.49** (8.21)	72.72** (9.62)	77.79** (7.31)	98.52** (3.80)
N	170	170	170	170	170	170	170	170

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation. In each column the estimates might not sum up to 100 due to rounding. In all the columns, the country-specific shocks are deviation from the average EA-10 growth.

Significance levels: † : 10% \* : 5% \*\* : 1%

<sup>a</sup> The euro area countries considered are: Germany, France, the Netherlands, Belgium, Austria, Finland, Italy, Spain, Portugal and Greece.

<sup>b</sup> The core countries are: Germany, France, the Netherlands, Belgium, Austria and Finland.

<sup>c</sup> The periphery countries are: Italy, Spain, Portugal and Greece.

magnitude of the result is much lower (8.80% for the saving channel) and not significant. It might suggest that, during the years of economic growth, the core countries accumulated savings to prepare for possible economic downturns. On the other hand, the factor income channel provided some significant smoothing (16.25%) for the periphery countries, while it was close to zero and not statistically significant for the core countries. As suggested by Kalemli-Ozcan et al. (2014), during the years of economic growth, the outflows of dividends to shareholders located abroad caused the significant risk-sharing in the periphery countries. The capital depreciation channel provided dis-smoothing (-5.53%) for the core countries and smoothing for the periphery countries (0.47%), but both estimates are not significant. The results show that the net transfers channel followed the same behaviour.

The estimates for the financial crisis time interval suggest that the saving channel of the periphery countries provided dis-smoothing (-8.96%) due to countercyclical saving by the public sector (-11.59%). As proposed by Kalemli-Ozcan et al. (2014), a possible explanation is that the national governments did not create enough buffers during the years of economic growth. Hence, their savings were not enough to absorb the effect of the financial crisis and they had to increase their savings during the economic downturn to respect the rules set by the SGP. However, this result is not robust to different specifications of the standard errors. On the other hand, for the core countries, the saving channel had a significant smoothing effect (43.02%). It is a consequence of shocks absorption by both components of the saving channel (6.60% by the private and 36.43% by the public sector)<sup>7</sup>. It suggests that the core countries were able to create sufficient

<sup>7</sup>In this case, robustness checks show that the significance of the public saving channel is robust while the estimate for the private saving channel is not.



saving buffers in the pre-financial crisis. Surprisingly, the net factor income channel provided significant and positive risk-sharing for both groups of countries (33.01% for the core and 36.06% for the periphery). However, as discussed in Alcidi and Thirion (2016), the smoothing obtained by the core countries was caused by Nokia, which shared its losses across countries because numerous shareholders are not located in Finland. It is possible that a similar event is the cause of the positive result for the periphery countries. Overall, despite the positive role of the factor income, the fraction of unsmoothed output shocks in the periphery countries was high (77.79%). Whereas, in the core countries, only 32.77% of the shocks was left unsmoothed.

From 2010-2017, the fraction of unsmoothed shocks increased in both groups of countries (98.52% in the periphery and 63.49% in the core countries). During the sovereign debt crisis, the inability of the periphery countries to deal with asymmetric shocks created a debate on whether some of the periphery countries would have been better off out of the common currency. Since they could not rely on national monetary policy, the lack of a supranational transfer system and labour mobility made the adjustment to the asymmetric shocks costly. Especially since there is a low degree of risk-sharing in capital markets. The result for the factor income channel in column (V) and (VIII) support the theory that the significant risk-sharing provided by this channel during the financial crisis was an isolated event and not the result of integrated capital markets. The capital depreciation channel dis-smoothed about -10.00% of the output shocks in both groups of countries. Whereas, the net transfers channel provided dis-smoothing only in the core countries (-5.34% and significant) and smoothing in the periphery (1.39% but not significant). Again, the contribution of the saving channel is the main difference in the risk-sharing obtained. It smoothed 50.18% of the shocks in the core countries and 7.37% in the periphery (not statistically significant). As explained in Milano (2017), during the sovereign debt crisis, the national governments and the households of the periphery countries provided dis-smoothing through the saving channel. However, the author finds that the loans guaranteed by the European Institutions, EFSF and ESM, compensate for the dis-smoothing by the national governments. Hence, the estimate for the public saving channel has a positive sign (column VIII) because it captures both effects.

Table 1.4 reports the estimates for the net transfer channel in the EU-13 and EU-12 for different sub-periods. The EU budget provided risk-sharing in all the sub-period considered and for both groups of countries. However, the estimates are statistically significant only for the EU-12 before the sovereign debt crisis. During the financial crisis, the transfers from the EU budget smoothed a significant 6.76% of the shocks for the EU-12. A possible explanation is that the positive net transfers from the budget compensated for the decrease in NI caused by the financial crisis. There is also a positive and significant smoothing by the EU budget in the EU-13 group during the sovereign debt crisis (2.66%). This result might be driven by the countries that were profoundly affected by the recent migratory crisis. In fact, while they had a negative GDP growth relative to the average, there was an increase in funds from the EU budget to help them in coping with the inflow of asylum seekers and economic migrants. Dis-smoothing from the net transfer from the rest of the world balanced the smoothing provided in these occasions by the net transfers from the EU budget (-3.21% for the EU-12 and -2.01% for the EU-13). The other transfers from the rest of the world provided significant risk-sharing in the EU-12 before the financial crisis (3.75%) and in the EU-13 during the financial crisis (1.06%).

Table 1.4: Shocks to GDP smoothed by the international transfers channel, percentage points (Pooled OLS)

	EU-13			EU-12		
	2001-2007 (I)	2008-2009 (II)	2010-2016 (III)	2001-2007 (IV)	2008-2009 (V)	2010-2016 (VI)
Unsmoothed ( $\beta_u$ )	93.36** (5.03)	88.34** (2.31)	93.95** (3.30)	95.19** (3.04)	100.39** (0.96)	79.03** (4.45)
Net international taxes ( $\beta_\tau$ ) and transfers	1.52 (1.70)	0.74 (0.65)	0.65 (0.78)	3.37** (1.05)	3.55** (0.22)	1.31 (1.73)
Net transfers from ( $\beta_{EU}$ ) the EU budget	2.67 (1.71)	-0.32 (1.08)	2.66* (1.19)	-0.38 (0.58)	6.76** (1.95)	1.77 (2.25)
Other net transfers from ( $\beta_{RoW}$ ) the rest of the world	-1.15 (2.65)	1.06* (0.43)	-2.01 (1.17)	3.75** (0.74)	-3.21 (2.17)	-0.45 (1.82)
N	400	400	400	400	400	400

Driscoll-Kraay corrected standard errors reported in parenthesis, AR(1) correlation for the residuals. In each column the estimates for the EU budget and the rest of the world transfers might not sum up to the net international taxes and transfers coefficient due to rounding.

Significance levels: † : 10% \* : 5% \*\* : 1%

The analysis on the role of the EU budget for the EA-10 sample shows that, between 2001 and 2016, the net transfers from the EU budget smoothed 5.33% of the shocks in the periphery countries. Instead, the other net transfers from the rest of the world provided significant dis-smoothing for both groups of countries (-5.59% for the core and -3.92% for the periphery). A possible explanation is that the EA-10 countries are net contributors to international organisations and agreements. Since these type of contributions might not adjust to the business cycle, they might contribute to dis-smoothing the shocks. Overall the transfers channel, due to the opposite effect of its components, provided dis-smoothing for the core countries (-2.21%) and smoothing for the periphery countries (1.41%). However, both estimates are not statistically significant.

In the core countries, the EU budget smoothed 3.90% of the shocks during the financial crisis. It might be a consequence of the positive relative growth of the core countries during the crisis, which was balanced by a high amount of contribution to the EU budget for the benefits received. The other net transfers from the rest of the world increasingly dis-smoothed the shocks in the three sub-periods, but the results are not statistically significant.

For the periphery countries, the net transfers from the EU budget smoothed the shocks between 2001 and 2007 (2.43%) and from 2010 to 2016 (7.12%), but only the latter is statistically significant. It suggests that the transfers received from the EU budget to cope with the migration crisis might have contributed to smooth the shocks during a phase of negative economic growth if compared to the core countries. Instead, during the crisis, the net transfer from the EU budget dis-smoothed a significant -6.99% of the shocks. A possible explanation is that the expenditures were pre-allocated to the new member states to foster their economic convergence. Therefore, when the financial crisis hit the periphery countries, they had to maintain their contributions to the EU budget while receiving a relatively low level of expenditure. The other net transfers from the rest of the world had the opposite effect. They provided significant risk-sharing (5.63%)

during the financial crisis but dis-smoothed (-5.55%) the shocks in the following sub-period. It is possible that the periphery countries reduced or suspended their payments to international organisations or agreements during the financial crisis. That would also explain the dis-smoothing in the following period if the contributions were postponed but realised during the sovereign debt crisis.

Considering the newer member states, the estimates show that the only occasion in which the EU budget significantly absorbed the shocks was during the financial crisis for the EU-10. In fact, in that sub-period, the EU budget smoothed 6.52% of the output shocks. It might be a consequence of the inflows of structural funds during a period of negative economic growth if compared to the average. The pre-accession funds received from the EU budget contributed, in the EU-2 countries, to absorb the shocks (0.92%, but not statistically significant). Whereas, for the EU-10, they had a dis-smoothing effect of -1.38%, but it is not statistically significant. A possible explanation is that the EU-10 were in a relatively positive phase while they received the pre-accession funds, which were not balanced by contributions to the EU budget.

After the financial crisis, the smoothing of the shocks in the EU-10 is not significant, while the dis-smoothing of -8.69% for the EU-2 is statistically significant. A possible explanation for the latter estimate is that, during the financial crisis, the EU-10 countries received a significant amount of funds, which were primarily used to realise public investments. The investments sustained the economic growth over the short- and long-term; thus affecting the GDP growth between 2010-2016. Due to the economic growth of the other countries, there was a relative negative economic growth of the EU-2 (if compared to the EU-12 average). Since the expenditures were pre-allocated, there was not an increase in transfers to the EU-2 to balance the relatively low growth. As a consequence, the country-specific asymmetric shocks to the EU-2 were not smoothed by the net transfers of the EU budget. However, this result is not robust.

## 1.6: Conclusion

The level of international risk-sharing in the European Union is still low and heterogeneous across the member states. The results obtained in the analysis suggest that, for the EU-25, 93.88% of the country-specific shocks were left unsmoothed from 2001 to 2017. One of the causes of the low level of international risk-sharing is the presence of fragmented capital markets in the EU, which lead to a low level of ex-ante insurance from output shocks. Moreover, the net transfers channel was not able to compensate for the lack of risk-sharing by the factor income channel. In fact, the analysis on the components of the net transfers channel confirms that the net transfers from the EU budget do not consistently absorb the shocks. Although in some occasions, they contribute to smoothing significant shares of the output shocks, for example for the EU-10 during the financial crisis (6.52%), they also provide dis-smoothing. It is a consequence of the lack of flexibility of the revenue and expenditure of the EU budget, which does not automatically adjust to deal with asymmetric shocks.

Given the low degree of risk-sharing obtained through the net international factor income and transfers channel, the saving channel, primarily through the public saving, is the main source of smoothing of the output shocks for the member states. However, as the results of the analysis suggest, and as discussed in Kalemli-Ozcan et al. (2014)

and Milano (2017), the common fiscal rules constrained the capacity of the public saving channel to absorb the output shocks, and, in the case of the financial and sovereign debt crisis, led to significant dis-smoothing of the shocks.

Therefore, since the saving channel might be constrained, the member states need to increase the smoothing of output shocks provided by the net international factor income and transfers channel. As regards the former, the development of the Capital Market Union (CMU) is necessary to increase the degree of financial integration in the member states of the European Union. Whereas, for the latter, as suggested by Furceri and Zdzienicka (2013), there should be a reform of the EU budget to increase its flexibility and the resources at its disposal. Otherwise, the European Union should create other supranational automatic stabilisers capable of dealing with the asymmetric shocks that affect the member states.

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