

I. Cross-border risk sharing after asymmetric shocks: evidence from the euro area and the United States

This section presents empirical evidence on the shock absorption capacity of the different channels of cross-border risk sharing in the euro area. The surge in economic divergence since the crisis has turned attention to the available cross-border mechanisms to smooth consumption in the face of asymmetric shocks. The main channels considered are: private risk sharing, through access to cross-border capital and credit markets and other cross-border factor income such as labour compensation; and public risk sharing, through cross-border fiscal transfers (public stabilisation through domestic means is not considered). This section shows that Economic and Monetary Union has likely facilitated cross-border shock absorption through private risk sharing, even taking into account the impact of the crisis on the financial sector. However, a direct comparison with the shock absorption capacity across US states shows that the size of the asymmetric shock that remains unsmoothed in the euro area is very high. The difference is mainly due to much less developed capital and labour market cross-border channels in the euro area. Therefore, enhancing private risk sharing among the euro area Member States, especially through capital markets, remains a policy priority. ⁽¹⁾

I.1. Introduction

One of the most important characteristics of a well-functioning economic and monetary union is the capacity to absorb asymmetric (i.e. country-specific) shocks. The challenges specific to the euro area were clear from the beginning. ⁽²⁾

After a period of relatively high synchronisation in the run-up to and in the first years of Economic and Monetary Union (EMU), the surge in cyclical and structural differences during the economic and financial crisis has turned attention to the mechanisms available to smooth consumption in the face of asymmetric shocks. These include possible policy measures to improve cross-border risk sharing among Member States.

The Five Presidents' Report issued in June 2015 pays particular attention to enhancing the shock absorption capacity of the euro area, both through better integrated financial and capital markets (*private risk sharing*) and through a mechanism

of fiscal stabilisation among euro area Member States (*public risk sharing*). ⁽³⁾

Currently, a high level of economic divergence among euro area Member States is still present. ⁽⁴⁾ By 2015, the divergent economic performance since the crisis resulted in an eight percentage point growth gap between the best and the worst performing Member State, while the gap between the highest and lowest unemployment rate in the euro area reached 20 percentage points. ⁽⁵⁾ In such an environment, even a small localised shock can have large effects if cross-border risk sharing among Member States is weak.

Therefore, the goal of this section is to present empirical evidence on the current degree of cross-border risk sharing in the euro area in the event of an asymmetric shock. The section starts with a brief review of the existing channels of cross-border risk sharing and presents some stylised facts on consumption smoothing following asymmetric

⁽¹⁾ This section was prepared by Plamen Nikolov.

⁽²⁾ See 'EMU@10 The first ten years: a resounding success' in *Quarterly Report on the Euro Area*, Vol. 7, No 2 (2008) for a historical overview of the challenges in the functioning of the EMU and the design of the appropriate policy responses as seen by its early proponents and the policy-makers of the time. Common shocks could also have asymmetric effects across countries. A good example of an asymmetric effect of common shocks is presented in Box 6 of the report, which explains the differentiated response to a fall in US private demand in Germany, Italy and Ireland by referring to the differences in their trade openness and the structure of their exports.

⁽³⁾ 'Completing Europe's Economic and Monetary Union', Report by Jean-Claude Juncker in close cooperation with Donald Tusk, Jeroen Dijsselbloem, Mario Draghi and Martin Schulz, 2015.

⁽⁴⁾ For a presentation of asymmetries across euro area Member States see Ruscher, E. (2015), 'An overview of market-based adjustment in the euro area in the light of the crisis' in *Quarterly Report on the Euro Area*, Vol. 14, No 4 (2015).

⁽⁵⁾ In 2015 the fastest growing economy in the euro area was Ireland, at 7.8 %, while the worst performance was in Greece at -0.2 %. The highest unemployment was in Greece at almost 25 % of civilian labour force, while the lowest in Germany at 4.6 %. To be fair, US states also experience divergent growth performance. In 2014 real state domestic product in Alaska shrank by -1.4 % while in North Dakota it increased by 7 %. However, labour market divergence between US states is much more subdued, with a difference of only 4.1 pps. between the worst performer (Illinois) and the best performer (South Dakota).

output shocks. Next, the section presents quantitative results. Specifically, it employs an econometric approach to quantify the relative amount of smoothing of asymmetric output shocks that is due to three distinct cross-border channels: net factor income, fiscal support and savings. The section contrasts private and public risk sharing results obtained by this method in the euro area and the United States and shows that private risk sharing works better in the latter. The section concludes with policy implications for the efforts needed to increase the shock absorption capacity of the euro area through cross-border risk sharing.

I.2. Mechanisms of cross-border risk sharing

Cross-border risk sharing is linked to integration between countries: first and foremost economic and financial, but also political and institutional at least to some extent. Therefore it is important to examine the channels through which this type of risk sharing operates and the minimum degree of integration that makes it efficient. This needs to be done in order to anticipate necessary changes in policy.

The channels of operation of cross-border risk sharing can be divided into two broad categories: *private* and *public*.

The *private channels* of cross-border risk sharing work through access to foreign financial markets, including through foreign capital markets and cross-border loans and deposits, as well as through labour compensation generated across borders.

The cross-border provision of financial services by financial institutions and markets is one of the main ways that private risk sharing operates. Residents of a country that experiences a negative output shock could smooth their consumption through property income streams generated by financial assets held in another jurisdiction, which is shielded from the shock. This is the capital market channel of risk sharing.

Alternatively, residents of a country that sees a negative output shock can secure consumption levels by drawing down savings accumulated during better times or by borrowing. This can also be done indirectly, for example when public borrowing is used to compensate for the loss of tax revenues after asymmetric shocks in order to sustain government expenditure levels and in turn smooth household consumption. This is what is

called the credit market or savings channel of risk sharing. The savings channel does not necessarily involve a cross-border element, but integration helps deepening of financial markets, thus ensuring cost-cutting and efficiency. ⁽⁶⁾

The operation of both the capital and the credit market channels is greatly facilitated by integrated financial markets and competition among financial institutions. This requires the adoption of a legal framework (among which insolvency laws and accounting standards) for competitive cross-border financial intermediation, the creation of an efficient financial infrastructure and the required institutional safeguards to ensure stable financial systems.

Another private channel of risk sharing that operates through streams of cross-border factor income is the cross-border labour compensation channel. Residents of a country that experiences a negative shock to output could smooth their consumption with labour income generated in another jurisdiction that does not experience the shock. Such workers are called commuter workers. ⁽⁷⁾ This channel requires free movement of labour as well as the prerequisites for a high degree of labour mobility, among which are investment in human capital, flexibility in compensation and hours worked, portability of social security rights, and facilitated firm entry and exit.

The public channels of cross-border risk sharing involve some form of fiscal redistribution between those countries that experience a negative output shock and those which do not. For example, the fiscal redistribution can be in the form of cross-border subsidies, social protection, including a common unemployment scheme, or cross-border financing of public investment, such as transport corridors.

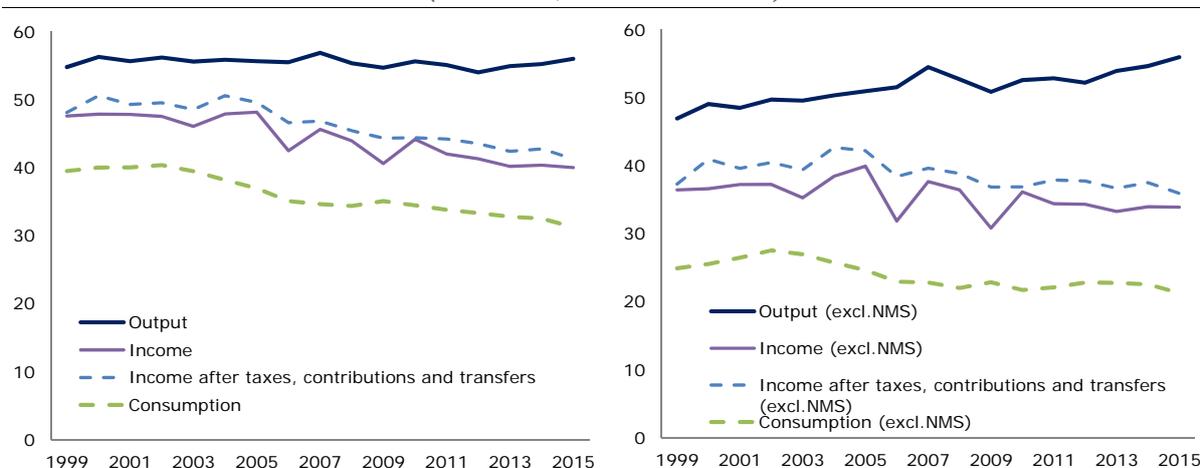
The public channels require a great deal of solidarity among the partners and naturally involve

⁽⁶⁾ In the case of risk sharing measured by balancing items for the total economy a fixed level of household and government consumption after an output shock can only be achieved by borrowing or lending abroad.

⁽⁷⁾ This channel is different from, although closely related to, risk sharing through remittances sent to the home country by workers residing abroad. The difference comes from the fact that remittances are sent by residents of an immigration country to residents of a country of origin and thus are measured differently in the national accounts.

Graph I.1: Cross-country dispersion of output, income and consumption in the euro area (1)(2)

(1999-2015, Index: EA-19=100)



(1) Standard deviation of real per-capita terms, output is measured by GDP, income by gross national income (GNI) and income after taxes, contributions and subsidies by gross disposable income (GDI).
 (2) New Member States (NMS) of the euro area are those that joined after 2004.

Source: AMECO

a higher degree of political and institutional integration between them, including a system of common decision-making that ensures democratic legitimacy and accountability.

The initial EMU design did not envisage a substantial role for cross-border public risk sharing through common EMU fiscal support. The EU budget remains quite small in comparison to the sum of the Member States' national budgets and is mainly designed to support real convergence rather than smooth shocks across countries. ⁽⁸⁾

I.3. Methods to measure cross-border risk sharing

Empirical facts on cross-border risk sharing among Member States support the view that the EMU likely helped the process of smoothing cross-border output shocks, mainly through private channels. Graph I.1 shows the cross-country dispersion of output, income, ⁽⁹⁾ income after taxes and consumption in the euro area since the start of the EMU.

The dispersion of output among Member States has remained quite stable since the launch of the euro despite a minor increase in the boom years before the crisis and a minor drop after the crisis hit. Both income (including after-tax income) and consumption show a lower degree of dispersion among the Member States than output. ⁽¹⁰⁾ This suggests that asymmetric shocks to output are being smoothed among countries as part of the general income and consumption convergence process in the euro area.

Moreover, the years after the introduction of the euro as a common currency seem to coincide with a visible, even though slight, reduction in the cross-country dispersion of income and consumption. The trend is also visible when the sample excludes new Member States (right-hand panel). This suggests that the creation of the EMU has resulted in better convergence and possibly better cross-border risk sharing among Member States. ⁽¹¹⁾

⁽⁸⁾ The amount of cross-border risk sharing in the EU through common public channels, such as spending through the multiannual financial framework (MFF), remains much lower than in federal states. The EU budget accounts for 1 % of the EU's combined GDP, while in the US it reaches 25 % of GDP.

⁽⁹⁾ Income is derived from GDP, adjusted for net factor income vis-à-vis rest of the world, plus net taxes and subsidies on products and imports. See also Box II.1.

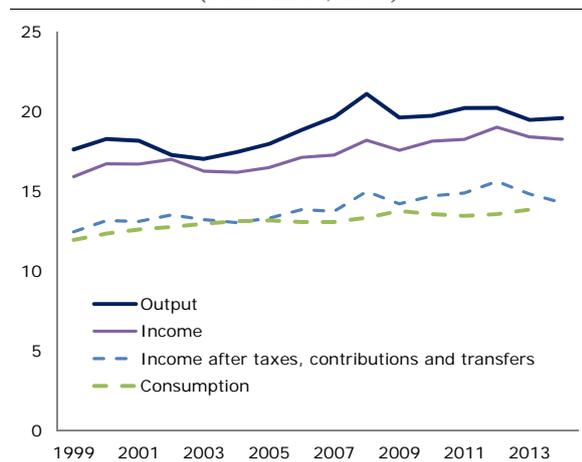
⁽¹⁰⁾ Measured by the standard deviation in real per capita terms. This remains valid even when the sample excludes the countries that joined the euro area after 2004. See right-hand panel of Graph II.1.

⁽¹¹⁾ The fact that after-tax-income shows slightly more dispersion than pre-tax-income is hardly surprising given that fiscal policy in the euro area is decided at national level. If there is a common system of risk sharing through cross-border transfers to smooth income and governments can borrow, decentralised fiscal policy can also dampen variations in after tax income.

Looking at the same graph for the US reveals that the disparity of output, income and consumption among the 50 US states is much lower than between the euro area Member States. The crisis has affected divergence in the US as well, with a sharp increase in the cross-state standard deviation of output and income in 2008 (Graph I.2).

Another difference with the euro area is the smoothing role of taxes, contributions and transfers, with gross disposable state income having a much lower dispersion than unadjusted income in the US compared to the euro area. This is to be expected given the larger size of the US federal budget.

Graph I.2: **Cross-state dispersion of output, income and consumption in the 50 US states (1)**
(1999-2014, in %)



(1) Standard deviation of real per-capita terms, output is measured by gross state product (GSP), income by gross state personal and non-personal income and income after taxes, contributions and subsidies by gross disposable state income.

Source: US Bureau of Economic Analysis (BEA), US Office of Management and Budget (OMB), US Bureau of Labour Statistics (BLS), US Census Bureau, DG ECFIN calculations.

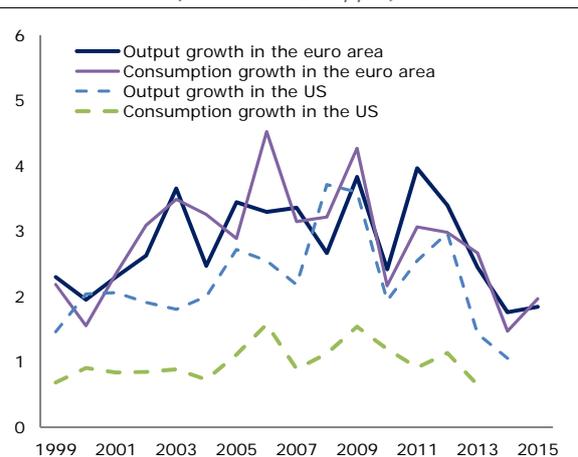
A more concrete representation of the process of cross-border risk sharing within a single year can be obtained by looking at the dispersion of output and consumption growth among euro area Member States and US states, shown on Graph I.3. The vertical difference between the dispersions of output and consumption gives the amount of a change in output that is not picked up by the change in consumption over the course of the year and thus appears to be smoothed. This is in contrast to dispersion of output, income and consumption in levels presented above, which contains in itself convergence irrespective of

shocks as well as smoothing of past shocks that takes more than one year.

The graph shows that there were periods before the crisis when annual consumption growth within the euro area differed more than the growth in output. Conversely between 2010 and 2013 the dispersion of consumption growth was clearly below the dispersion of output growth suggesting smoothing in the course of each of these years.

The contrast with the US is visible here as well. Both output and consumption growths among the US states vary less than among euro area Member States and in the US the variability of consumption growth is consistently lower than the variability of output growth, suggesting a more consistent risk sharing process.

Graph I.3: **Cross-border dispersion of output and consumption growth in the euro area and the 50 US states (1)**
(1999-2015, in pps.)



(1) Standard deviation of growth in real per-capita terms.

Source: AMECO, US Bureau of Economic Analysis (BEA), US Office of Management and Budget (OMB), US Bureau of Labour Statistics (BLS), US Census Bureau, DG ECFIN calculations.

Labour mobility

Looking at the specific channels of cross-border risk sharing, Graph I.4 attempts to illustrate the role of cross-border labour income with data from Eurostat's Labour Force Survey.⁽¹²⁾ The graph

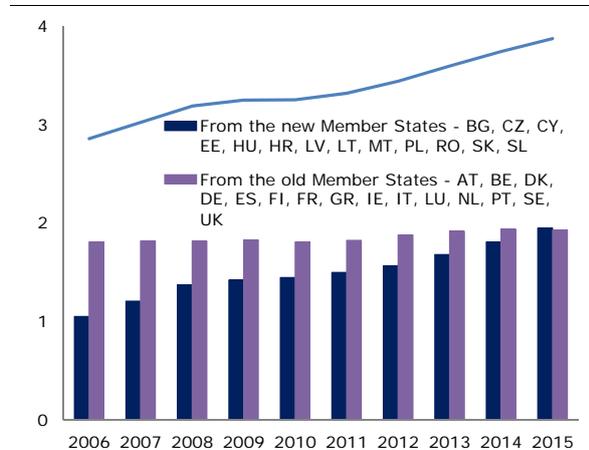
(12) The EU labour force survey is a large sample survey among private households in Europe and an important source for European statistics about the situation and trends in the EU labour market.

Visit <http://ec.europa.eu/eurostat/web/microdata/european-union-labour-force-survey> for more information.

provides statistics on employment by citizenship and thus on the number of euro area workers who work in another Member State. A caveat needs to be made here. Employment by citizenship only approximates the number of cross-border commuter workers. In the very narrow sense, risk sharing through labour mobility is performed by commuter workers whose number fluctuates almost simultaneously with a shock in output, while cross-border employment, as presented in the graph, also contains a structural pattern. ⁽¹³⁾

The share of euro area labour force that has an EU citizenship different from that of the reporting country has been increasing since the start of the survey. There was a minor slowdown during the crisis, but by 2015 the share of euro area workers who are citizens of another EU country had reached almost 4%. Most of the increase since the beginning of the survey in 2006 can be attributed to workers from the new Member States. By 2015 their number had surpassed the number of workers from the EU-15.

Graph I.4: **Cross-border employment in the euro area (1)(2)**
(2006-2015, y-o-y % change)



(1) Employment by citizenship other than of the reporting country, 15-64 year old, % of total employment
(2) New Member States of the EU are those that joined after 2004.

Source: Eurostat

There is quite a disparity among Member States regarding the share of cross-border labour. This means that cross-border risk sharing through this channel is not homogeneous across Member States as some countries likely benefit more from this

⁽¹³⁾ Data on commuter workers that move in response to shocks are unavailable in the Labour Force Survey.

form of risk sharing than the rest. In 2015 the share of workers that are citizens of another EU country varies between more than 10% in Ireland and Cyprus to as low as 0.6% in Portugal and below or close to 2% in France, Finland, the Netherlands, Malta and Greece. Luxembourg, with its small size and high expatriate population, is a clear outlier. Workers from the new Member States are a clear majority of EU workers in Ireland, Austria, Spain and Italy. This diversity among Member States suggests that the pattern of cross-border risk sharing through this channel is quite different depending on the country concerned.

There is still quite a lot to be done to increase the impact of cross-border labour mobility on risk sharing among euro area Member States. The line on Graph I.4 clearly shows a pattern similar to the demand cycle during the crisis. This means that the aggregate number of cross-border workers within the euro area is pro-cyclical. This may help adjustment, for example when cross-border workers return to their countries of origin after a negative shock in the host country. ⁽¹⁴⁾ Yet at this stage, given the lack of precise information on the number of cross-border commuters in the euro area, it is difficult to arrive at more precise conclusions on the role of risk sharing through labour compensation in the various Member States.

Financial integration

The rapid financial integration in the years between the EMU's creation and the start of the global financial crisis undoubtedly provided conditions for better cross-border risk sharing in the euro area. The increase in the importance and size of the financial services sector in the Member States followed similar developments in the other

⁽¹⁴⁾ Putting this channel in a more comparative perspective is difficult. Annual interstate mobility in the US (a flow concept) is found to be 2.5% of working age population in 2005. This is a relatively high number compared to countries in Europe, given that in 2006 2.9% of the euro area labour force had a citizenship of another EU country (a stock concept). See Bonin, H., W. Eichhorst, C. Florman, M. Okkels Hansen, L. Skiöld, J. Stuhler, K. Tatsiramos, H. Thomasen, and K. F. Zimmermann (2008), 'Geographic mobility in the European Union: optimising its economic and social benefits', *IZA (Forschungsinstitut zur Zukunft der Arbeit), Research Report*, No 19. The crisis may have affected these estimates in a different way in the two blocs. For evidence that the crisis has reduced the importance of migration across state borders as a labour market adjustment tool in the US see Foote, A., M. Grosz and A.H. Stevens (2015), 'Locate your nearest exit: mass layoffs and local labour market response', *NBER Working Paper Series*, No 21618. One possibility is that the Great Recession was unique given the role of the US housing crisis, which impeded mobility.

advanced economies but in Europe the process was given an additional impetus by the creation of the common currency and, linked to that, the decrease in the costs of borrowing. Previous analysis in this series has shown that financial market integration has supported cross-border risk sharing. However, this was less through equity markets and rather more through borrowing and saving on credit markets. ⁽¹⁵⁾

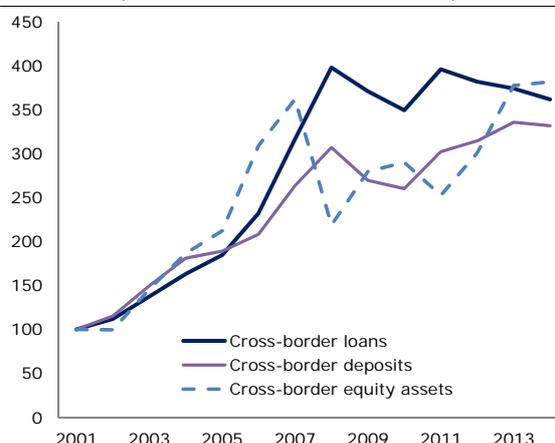
The crisis changed the perception about financial integration and the role of wholesale bank funding in a profound way. The rapid cross-border expansion up until 2007 was followed by a retrenchment of financial intermediation behind state borders. Moreover, capital misallocation during the boom years appeared as a major destabilising factor after the crisis hit, increasing the likelihood of asymmetries across Member States. ⁽¹⁶⁾

Not all cross-border financial instruments in the euro area have experienced the same deep fall since the crisis. Graph I.5 shows that in 2014 the cross-border deposits at euro area banks, excluding positions vis-à-vis other banks, stood at levels that were relatively close to those in the pre-crisis years, despite localised drops in the immediate vicinity of the sovereign-debt crisis in 2008. ⁽¹⁷⁾

Both cross-border loans and deposits expanded rapidly after the creation of the euro and, judging from their level today, the common currency plays an important role in risk sharing through cross-border provision of financial services. However, cross-border equity assets experienced a significant drop during the crisis and their recovery to pre-crisis levels has taken much longer than for cross-border deposits. It is also important to stress that

the size of the cross-border equity market is several times lower than the cross-border loan and deposit markets.

Graph I.5: **Cross-border financial instruments in the euro area(1)**
(2001-2014, Index: 2001=100)



(1) For loans and deposits, other bank counterparties are excluded.

Source: Bank for International Settlements (BIS) reporting banks, IMF Coordinated Portfolio Investment Survey (CPIS)

The euro facilitates private risk sharing through lowering transactions costs and deepening financial markets. However, as the crisis has shown, appropriate measures to create a well-functioning Banking Union are also needed. This includes in particular establishing a European Deposit Insurance Scheme (EDIS), thus building the third pillar of the Banking Union. Given the current regime of country-based deposit insurance, there are still differences in the regulatory treatment of banks. Once operational, the EDIS will work against country-specific shocks since it is likely to be fiscally neutral over time because insured risks will be spread and private contributions will be raised by a larger pool of banks. In this way the EDIS, together with a credible common backstop to the Single Resolution Fund, will create further conditions for more cross-border presence of euro area banks by ensuring consistency in regulatory treatment and by shielding the financial sector from country-specific shocks. It will therefore be another supporting factor in increasing competition in the financial sector, lowering costs and increasing cross-border risk sharing.

⁽¹⁵⁾ For an overview of increased pre-crisis financial integration and its impact on risk sharing see 'Cross-border risk sharing: has it increased in the euro area?' in *Quarterly Report on the Euro Area*, Vol. 6, No3 (2007).

⁽¹⁶⁾ For a presentation of the limits of shock absorption in the EMU since the crisis see Jevcak A. and R. Kuenzel 'Recent capital flow developments in the euro area' in *Quarterly Report on the Euro Area*, Vol. 12, No2 (2013), Loublrier A., 'Recent developments in cross-border capital flows in the euro area' in *Quarterly Report on the Euro Area*, Vol. 14, No1 (2015) and 'Financial integration and risk-sharing in a monetary union' in *Financial Integration in Europe (2016)*, ECB.

⁽¹⁷⁾ Naturally the share of large financial centres such as Ireland and Luxembourg as locations of cross-border financial positions in the euro area is disproportionately higher than their weight in the EMU population or GDP. This is another example of the Member States' uneven ability to share risk among each other through private channels.

Graph I.6: Channels of risk sharing, 50 US States, anchored-start regressions with rolling end dates (1)

(1990-2013, in % of total asymmetric shock to output)



(1) Regressions cover 1964 until the year shown on the horizontal axis. Regressions with rolling start and end dates did not give qualitatively different results.

Source: US Bureau of Economic Analysis (BEA), US Office of Management and Budget (OMB), US Bureau of Labour Statistics (BLS), US Census Bureau, DG ECFIN calculations.

I.4. Empirical results of cross-state risk sharing in the euro area and the US

Econometric results on the relative weight of the different risk sharing channels among euro area Member States and US states are given below. This sub-section updates findings of the canonical paper by Asdrubali et al. (1996) ⁽¹⁸⁾ for the US states in the years since the crisis. It next compares the US with the euro area and draws conclusions for the possible degree of risk sharing in the euro area had the latter possessed the capital and labour market characteristics of the former. The comparison also acknowledges that the US is a federal state with a

sizeable budget, while the EMU does not have common fiscal means to cope with asymmetric shocks.

Cross-border risk sharing is measured using the system of national accounts. The approach consists of sequential regressions of the balancing items in the primary and secondary distribution of income accounts and in the use of income account for the total economy (so including both the private and the public sector) in order to quantify the amount of co-movement of output, income, including after taxes, and consumption after asymmetric shocks to output. The method provides a breakdown of the relative size of the three different channels of cross-border risk sharing (net factor income, fiscal transfers, and credit markets) and the proportion of an asymmetric shock that remains unsmoothed.

⁽¹⁸⁾ Asdrubali F., B. Sorensen and O. Yosha (1996), 'Channels of interstate risk sharing: United States 1963-1990', *The Quarterly Journal of Economics*, November.

Table I.1: **Cross-border risk sharing through different channels(1)(2)**
in % of total asymmetric shock to output

	Euro area	Euro area without the New Member States	Core vs. periphery	US
Risk sharing through:	all EA MS except CY, MT, LU, LT, AT, GR	EA12 except LU, AT and GR	DE, ES, IE, NL and PT	50 states
cross-border factor income(2)	5.6	2.0	3.4	44.8
of which cross-border labour compensation	0.2	-0.2	-0.1	
cross-border fiscal transfers	0.0	1.6	2.6	8.3
credit markets	18.2	24.6	18.0	26.7
unsmoothed	75.7	61.7	63.1	17.6

(1) Time period for the euro area is between 2000q4 and 2015q4, while for the US it is between 1964 and 2013. To increase the number of observations, risk sharing in the euro area is measured at a quarterly frequency (difference compared with the same quarter in the preceding year). However, regressions with annual frequency did not produce qualitatively different results.

(2) Cross-border factor income includes property income such as income from cross-border ownership of equity, rent income and cross-border labour compensation.

Source: DG ECFIN calculations, Asdrubali et. al (1996).

See Box I.1 for a full description of the model and its estimation.

The Asdrubali et al. (1996) methodology is applied to the 50 US states and to three sets of euro area Member States: the euro area (EA) 19, except Malta, Cyprus, Luxembourg, Lithuania, Austria and Greece; EA 12 except Luxembourg, Austria and Greece; and a set of euro area core and periphery countries (Germany, Spain, Ireland, Netherlands and Portugal). The choice of euro area countries is partly based on data availability in the European System of Accounts 2010 and partly on the option to have a sample that excludes new Member States. In this way it is possible to measure legacy effects from the closer integration even before the EMU and have a sample of countries in the EA12 core and periphery, which are likely to experience more asymmetries.

The time period chosen for the US is between 1964 and a rolling end date from 1990 until 2013. For the three different sets of euro area countries the time period is between 1999 and 2015. The time periods are chosen based on data availability, while for the US it extends the period in Asdrubali et al. (1996). The difference in the two time samples does not impair comparison between the two economies because risk sharing estimates for

an economy vary little depending on the period chosen.⁽¹⁹⁾ The main differences between two economies are driven by the legal, institutional and economic structures that underpin risk sharing, not by the different time samples.

The most important result of the econometric exercise is that risk sharing among Member States is lower than across federal states in the US.⁽²⁰⁾ The overall proportion of an asymmetric shock that is not smoothed in the euro area is more than four times larger than in the US (Table I.1, last row). Naturally the gap comes from the different

⁽¹⁹⁾ This is best illustrated when comparing estimates in the original Asdrubali et al. (1996) paper and its extension here. See the small scale of the vertical axis in Graph II.4. Note also that the econometric approaches in Asdrubali et al. (1996) and the extension here are different: 2-step generalised least squares vs panel-corrected ordinary least squares. See Box II.1 for more information.

⁽²⁰⁾ The lower degree of risk sharing after asymmetric shocks in the euro area compared with the US was reported already after the first couple of years of the EMU. For an overview see for example Demyanyk Y., C. Ostergaard and B. Sorensen (2008), 'Risk sharing and portfolio allocation in EMU', *European Economy Economic Papers* 334 and Sorensen B. and O. Yosha (1998) 'International risk sharing and European monetary unification', *Journal of International Economics*, Vol. 45, pp. 211-238. On the other hand, Furceri D. and A. Zdzienicka (2013), 'The euro area crisis: need for a supranational fiscal risk sharing mechanism?', *IMF WP/13/198* point out that the crisis has hampered the ability of the euro area countries to share risk.

political and institutional setups for sharing risks in the US and the euro area, as well as the relatively big role of capital and labour markets for risk sharing in the US.

Graph I.6 shows the estimates of the amount of risk sharing through the different channels between the 50 US states following an asymmetric shock to output. The lines report the evolution of the regression estimates depending on the end date of the time series, starting with an end date in 1990. The goal is to evaluate how the different channels evolved since 1990. Table I.1 compares the three euro area samples with the US.

Cross-state risk sharing through net factor income remains the largest contributor to consumption smoothing following an asymmetric shock in the US. This channel includes risk sharing through cross-state property income such as retained earnings and income streams from cross-state ownership of shares, as well as smoothing through labour earnings by commuters across state borders. It is natural that these income streams are hampered during recessions. Graph II.4 shows two steep drops in its relative weight, which broadly correspond to the recessions in 2001 and 2008-9. ⁽²¹⁾

The estimates in Table I.1 show that there is a big difference between the role of cross-border net factor income among the euro area Member States and the US states. This comes as a result of the higher degree of labour mobility and deeper and more integrated capital markets in the US. Higher risk sharing through this channel is to be expected given the high annual interstate mobility and the high number of commuter workers across state border in the US. ⁽²²⁾ Better capital market development in the US is also well documented: see Valiante (2016) ⁽²³⁾ for evidence that Europe's capital markets are poorly functioning and underdeveloped compared to the US.

The relative share of fiscal redistribution across state borders in the US is lower than the shares of the private channels. For the full time series

between 1964 and 2013 the relative weight of fiscal support in risk sharing is around 8.5 %. Risk sharing through this channel has been at its highest level since the start of the crisis as the federal government provided support to struggling states.

The role of cross-border public risk sharing in the euro area is smaller than in the US although the difference is less striking than for the cross-border private channels. The largest role for the public channel comes up when the sample of euro area countries includes only those that benefited from official support during the crisis years. This should come as no surprise given that the euro area does not have a common fiscal capacity to absorb shocks.

The importance of credit markets for cross-border risk sharing is more similar in the euro area and the US than the other channels. This includes borrowing by both the private and the public sector. The role of public sector borrowing in risk sharing is likely smaller than the one of the private sector while stabilisation through purely domestic means is not considered here. ⁽²⁴⁾ The role of euro area credit markets in smoothing an asymmetric output shock is more similar to the one in the US in the pre-2004 euro area sample than in the other two euro area samples. This reflects a very high degree of financial deepening in the old Member States compared to those that joined recently. While encouraging at face value, this result also needs to take into account that pre-crisis cross-border financial flows in some of the old Member States turned out to be unsustainable as a result of insufficient risk management and supervision.

The overall proportion of an asymmetric shock that is not smoothed between the 50 US states is around 18 %, compared to more than 60 % among the euro area Member States. Given that the US is a federal country with a long history of fiscal redistribution and that it has well-developed capital markets with a large presence across state borders, it is to be expected that the euro area could achieve a higher degree of cross-border risk sharing once

⁽²¹⁾ Even though visually pronounced, these drops are small in absolute terms. Note the scale of the vertical axes on Graph II.4, again supporting the conclusion that the choice of a time period has a minor impact on the absolute value of the risk sharing coefficients, while keeping their relative proportion constant.

⁽²²⁾ See Bonin et al (2008), op. cit.

⁽²³⁾ Valiante, D. (2016), 'Europe's untapped capital market: rethinking integration after the great financial crisis', *CEPS Paperback*.

⁽²⁴⁾ Some authors have separated this channel into saving and borrowing on the credit markets by *private entities* (households and non-financial corporations) and *public entities* (national and local governments). See for example Furceri and Zdzienicka (2013): they find that the role of public access to credit markets for cross-border risk sharing in the euro area is several times lower than the role of private saving/borrowing. That is to be expected given the provisions of the Stability and Growth Pact and the relative sizes of the private and public sectors.

changes to its institutional setup towards more integration come into being.⁽²⁵⁾ However, shock absorption through fiscal redistribution in a fully-fledged fiscal union such as the US is not more than around 8.5 % of the asymmetric shock (as measured by the rolling end date regressions), even though it has increased since the crisis.

Therefore, a much bigger part of cross-border risk sharing in the EMU could potentially come through private channels such as integrated capital markets, once the Capital Markets Union is in place.

I.5. Conclusion

The econometric results presented in this section point to the great potential for improvement in smoothing asymmetric shocks in the euro area. When comparing the amount of an asymmetric shock that remains unsmoothed by the private and public channels of cross-border risk sharing in the euro area and the US the importance of the recent initiatives to build a Capital Markets Union stand out. The significance of factor income flows, which include labour compensation and capital income generated across state borders in the US, could serve as a model for a euro area where capital markets play an important role in cushioning asymmetric shocks across borders. Also, the creation of the Single Supervisory Mechanism and other innovations in the regulatory environment in

the euro area are likely to make risk sharing through credit markets more sustainable going forward.

Completion of the European Banking Union by establishing a European Deposit Insurance Scheme (EDIS) will also facilitate risk sharing among Member States. The EDIS is expected to increase the cross-border presence of euro area banks by ensuring consistent regulatory treatment regardless of country of operation and will offer protection against country-specific shocks. Completing the Banking Union will create conditions for more financial integration, which is expected to increase competition among banks, and thus lower intermediation costs and further increase cross-border risk sharing.

The importance of the public channel of cross-border risk sharing in the euro area, on the other hand, should be seen in contrast with its role in the US, a fully-fledged fiscal union, where fiscal redistribution among states has an important role. Even though the relative significance of this channel in the US has increased with the crisis, taxes, grants and fiscal transfers in the 50 states contribute relatively less to smoothing asymmetric shocks than the private channels. Therefore, policy efforts to achieve a higher degree of private cross-border risk sharing in the euro area, especially through capital markets and equity holdings, should remain the priority option.

⁽²⁵⁾ The level of integration will probably not be of the same magnitude since it is unlikely that the union between euro area member states will soon be politically and institutionally the same as the one between the 50 US states.

Box 1.1: Empirical methods to estimate relative weights of cross-border risk sharing channels

This box presents the econometric methodology used to estimate the relative importance of the different cross-border risk sharing channels after an asymmetric shock in the euro area and the US.

It is important to look at the balancing items in the primary and secondary distribution of income accounts and the use of income account in the European System of National Accounts 2010 (ESA 2010) in order to review the necessary variables for the estimation process. Data for Belgium for 2014 can be used as an illustration to arrive at the required several balancing items. (1) One channel of risk sharing is the difference between gross domestic product (GDP) and gross national income (GNI) – risk sharing through net international factor income. The bigger this difference and the lower its correlation over time with GDP, the more risk sharing there is through net international factor income. In order to come up with this difference — EUR 6.038 billion in this example — one has to add the net of several items. For example, there is a difference of EUR 5.715 billion between compensation of employees paid by employers in Belgium, including to workers who take their earnings abroad where they are domiciled and compensation of employees received by workers in Belgium including by workers who work in other countries but bring their earnings back to Belgium where they are domiciled. This is a net positive inflow of income from a Belgian perspective. Other items that are treated in the same way are production taxes paid (collected) by firms (governments) and subsidies on production earned (distributed) by firms (governments). Any cross-border net inflow here will be due to fewer of these taxes paid by Belgian firms abroad compared to foreign firms in Belgium and more of these subsidies earned by Belgian firms abroad compared to foreign firms in Belgium. Finally, property income, which includes interest, for example on debt securities, equity dividends, reinvested earnings and some other items, is treated in the same way. For example a net inflow occurs if Belgian citizens receive more dividends from foreign companies than foreigners from Belgian companies.

Another channel of risk sharing is through cross-border fiscal redistribution. This makes the difference between GNI and gross disposable income (GDI). Here, a net inflow in Belgium will occur if social transfers received by Belgian persons and entities from foreign sources outweigh the transfers received by foreigners in Belgium. The same will happen if income and wealth taxes paid by foreigners in Belgium are higher than income and wealth taxes paid by Belgians abroad.

Finally, the difference between GDI and consumption is gross savings through which consumption can be smoothed. Borrowings and savings are channelled through domestic and foreign financial intermediaries.

At the state level in the US, some of these balancing items are not available. Specifically, state national income and state disposable income are constructed using the method in the Appendix in Asdrubali et. al (1996). (2)

Asdrubali et. al (1996) propose a series of regressions of these balancing items to estimate the relative importance of each of the risk sharing channels. Starting from the identity: $GDP = \frac{GDP}{GNI} \cdot \frac{GNI}{GDI} \cdot \frac{GDI}{C} \cdot C$ it is easy to show that a relationship $1 = \beta_{fi} + \beta_{tr} + \beta_s + \beta_u$ exists where the beta terms are the estimates of the regression coefficients in:

$$\Delta \log GDP_t^i - \Delta \log GNI_t^i = \mu_{fi,t} + \beta_{fi} \cdot \Delta \log GDP_t^i + u_{fi,t}^i$$

$$\Delta \log GNI_t^i - \Delta \log GDI_t^i = \mu_{tr,t} + \beta_{tr} \cdot \Delta \log GDP_t^i + u_{tr,t}^i$$

$$\Delta \log GDI_t^i - \Delta \log C_t^i = \mu_{s,t} + \beta_s \cdot \Delta \log GDP_t^i + u_{s,t}^i$$

$$\Delta \log C_t^i = \mu_{u,t} + \beta_u \cdot \Delta \log GDP_t^i + u_{u,t}^i$$

The beta terms are interpreted as the relative weights of cross-border risk sharing due to net factor income, fiscal transfers, savings and borrowings on credit markets. The last beta coefficient shows the amount of an asymmetric shock that remains unsmoothed. The panel regressions include time fixed effects μ and error terms u .

(Continued on the next page)

Box (continued)

There are three sets of panels for the euro area: EA19, except Malta, Cyprus, Luxembourg, Lithuania, Austria and Greece; EA12 except Luxembourg, Austria and Greece; and a set of euro area core and periphery countries (Germany, Spain, Ireland, Netherlands and Portugal). The choice of euro area countries is partly based on data availability in the European System of Accounts 2010 and partly on the option to have a sample that excludes new Member States, to be able to measure legacy effects from the closer integration even before the EMU and to have a sample of countries in the EA12 core and periphery, which are likely to experience more asymmetries. The US sample includes the 50 US states.

The time period chosen for the US is between 1964 and a rolling end date from 1990 until 2013. For the three different sets of euro area countries the time period is between 1999 and 2015. The time periods are chosen based on data availability, while for the US it extends the period in Asdrubali et al. (1996).

The regressions are estimated with 2-step generalised least squares (GLS), correcting for heteroscedasticity and cross-sectional correlation in the case of the euro area and ordinary least squares (OLS) with panel-corrected standard errors in the case of the US. The latter method is better suited for panels with larger cross-sections while the former method is better in the opposite case. ⁽³⁾ Both estimations include a common AR1 autocorrelation structure within panels. The first differences in the quarterly euro area data are in terms of the same quarter of the preceding year. The euro area regressions also include a further breakdown of *GNI* into one corrected only for cross-border labour compensation and one for the other elements of net factor income.

Econometric results are in the table below. All estimates marked with *** are statistically significant at the 99 % confidence level. Z-statistics are in parentheses.

Table 1: Regression results

	(1)	(2)	(3)	(4)
Risk sharing through:	2-step GLS	2-step GLS	2-step GLS	PC-OLS
cross-border factor income	0.0552*** (7.22)	0.0199*** (3.16)	0.0343*** (5.68)	0.4476*** (11.98)
of which cross-border labour compensation	0.0024*** (2.81)	-0.0015*** (-4.14)	-0.0012*** (-2.82)	
cross-border fiscal transfers	-0.0007 (-0.39)	0.0156*** (8.47)	0.0257*** (7.61)	0.0832*** (8.03)
credit markets	0.1815*** (17.38)	0.2459*** (8.31)	0.1800*** (4.78)	0.2668*** (5.08)
unsmoothed	0.7574*** (378.4)	0.6171*** (25.05)	0.6312*** (18.38)	0.1760*** (5.05)
Countries	Full panel - 13 countries: BE, DE, EE, ES, FI, FR, IE, IT, LV, NL, PT, SK, SL	Old member states - 9 countries: BE, DE, ES, FI, FR, IE, IT, NL, PT	Core vs. periphery - 5 countries: DE, ES, IE, NL, PT	50 US states
Period	2000Q4-2015Q4	2000Q4-2015Q4	2000Q4-2015Q4	1964-2013
No of observations	793	549	305	2500

Source: US Bureau of Economic Analysis (BEA), US Office of Management and Budget (OMB), US Bureau of Labour Statistics (BLS), US Census Bureau Eurostat, DG ECFIN calculations.

⁽¹⁾ For more information see Box 2 in 'Cross-border risk sharing: has it increased in the euro area?' in QREA, Vol. 6, No3 (2007).

⁽²⁾ Asdrubali F., B. Sorensen and O. Yosha (1996), 'Channels of interstate risk sharing: United States 1963-1990', *The Quarterly Journal of Economics*, November.

⁽³⁾ These are standard econometric approaches in estimating cross-border risk sharing. For a short discussion on the econometrics of cross-border risk sharing see Hepp, R. and J. von Hagen (2013), 'Interstate risk sharing in Germany: 1970—2006' Oxford Economic Papers, Vol. 65, No1, pps. 1-24.