APPENDIX IV

SHARING RISKS: INWARD AND OUTWARD DIVERSIFICATION IN CROSS-BORDER CAPITAL STOCKS AND CONSUMPTION SMOOTHING[31]

1. Sharing risks: inward and outward diversification

Following Schoenmaker and Wagner (2011)[32] we construct two indicators measuring inward and outward diversification in cross-border capital movements within EU-28 countries. The idea is that economies with more diversified outward investments better cope with domestic shocks as part of the shock will be smoothed using incomes from foreign assets or investments made abroad. Likewise, more diversified inward investments (liabilities) better insulates domestic economies from shock generated abroad as only a fraction of the shock could be transmitted to the domestic economy via foreign retrenching (dis-investments). Our aim is that of measuring diversification within EU-28 countries as a proxy of risk sharing. A complementary measure of risk sharing will be presented below. For the construction of the indices we use FinFlows dataset, and we calculate the index for the stock of portfolio investments.

1.1 Outward diversification

Portfolio theory suggests that a country should optimally allocate its investments abroad according the 'importance' of the partner country, importance being measured as the proportion of this county's assets in the combined pool of assets of all the foreign countries considered.

Let define $f_{i,j}$ as country *i*'s investments in country *j* (i.e. the assets of county *i* in country *j*) and $f_{i,j} \Big/ \sum_{k,k\neq i,} f_{i,k}$ as the share of outward investments of country i that goes in country *j*.

Define as $a_j \Big/ \sum_{k,k\neq i,} a_k$ as the share of country *j* assets in the pool of assets of the target group of countries (in our case EU-28). The index of outward diversification for country *i* will be defined as:

[31] This Appendix has been prepared by the Joint Research Center.

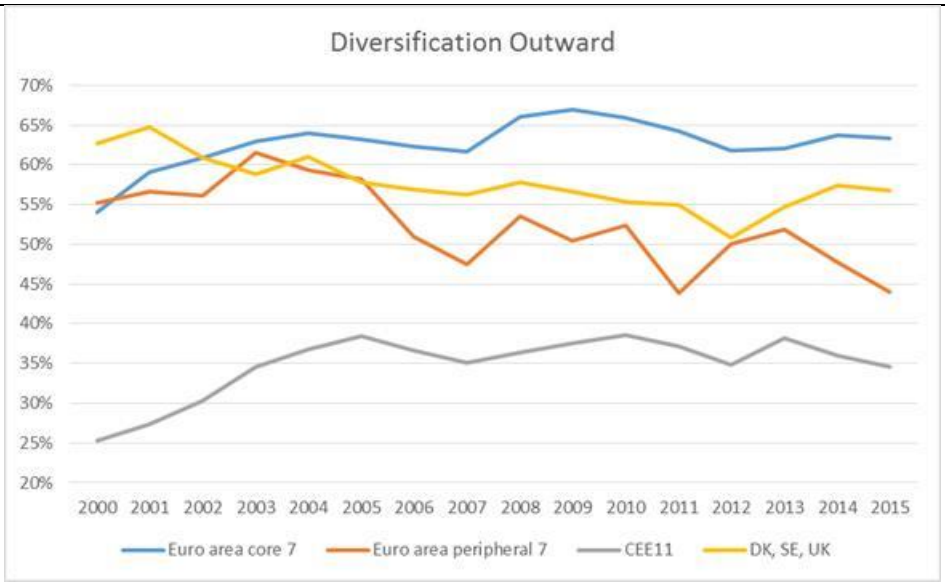
[32] Schoenmaker D., and Wagner W., (2011), the Impact of Cross-Border Banking on Financial Stability, Tinbergen Institute Discussion Paper TI-11-054.

$$Div_i^{out} = 1 - \frac{1}{2}\sum_{j,j\neq i}\left|\frac{f_{i,j}}{\sum_{k,k\neq i,} f_{i,k}} - \frac{a_j}{\sum_{k,k\neq i,} a_k}\right| \qquad (1)$$

The term $\left|\frac{f_{i,j}}{\sum_{k,k\neq i,} f_{i,k}} - \frac{a_j}{\sum_{k,k\neq i,} a_k}\right|$ measures the deviation of country *i*'s asset allocation from the ideal one. Therefore the index is equal to one, if the domestic portfolio is perfectly diversified, and lower than one otherwise. Notice that we could also have negative values when the deviation of country *i*'s allocation from the ideal one is higher enough (higher than 2).

Core Euro area countries shows little change from the diversification of their outward portfolio from 2005 onward — its share varies between 62 and 67 per cent (Figure 1). Similarly the group DK, SE and the UK shows outward diversification between 51 and 58 per cent. The lowest share being obtained in 2012 at the spike of the sovereign debt crisis. Different behaviour is observed for the peripheral countries which present relative strong change in trend over years. The upward trend detected in the period 2011-2013 is followed by an increase in *concentration* in the repartition of their outward investments. CEE11 countries display a relative steady increase in their outward diversification ranging from 31 and 39 per cent after 2005 with a slowdown after the sovereign crisis.

Figure 1, Outward diversification in bond and equity investments within the EU



Source: Finflows, JRC computations. Aggregate values are computed making a simple average over each individual countries. Euro area core includes Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. Euro area peripheral includes Cyprus, Malta, Greece, Spain, Portugal, Italy, and Ireland. CEE11 includes all the Eastern European countries, including the Baltics. No data is available for Croatia. Data are partially available for Cyprus, Greece, Hungary and Romania.

1.2 Inward diversification in bond and equity investments

A similar index can be constructed for inward investments (portfolio liabilities of country *i*).

$$Div_i^{in} = 1 - \frac{1}{2}\sum_{j,j\neq i}\left|\frac{f_{j,i}}{\sum_{k,k\neq i,} f_{k,i}} - \frac{a_j}{\sum_{k,k\neq i,} a_k}\right| \qquad (2)$$

Again the idea is that the closer the inward diversification is, the less likely is that foreign shocks destabilise domestic economy.

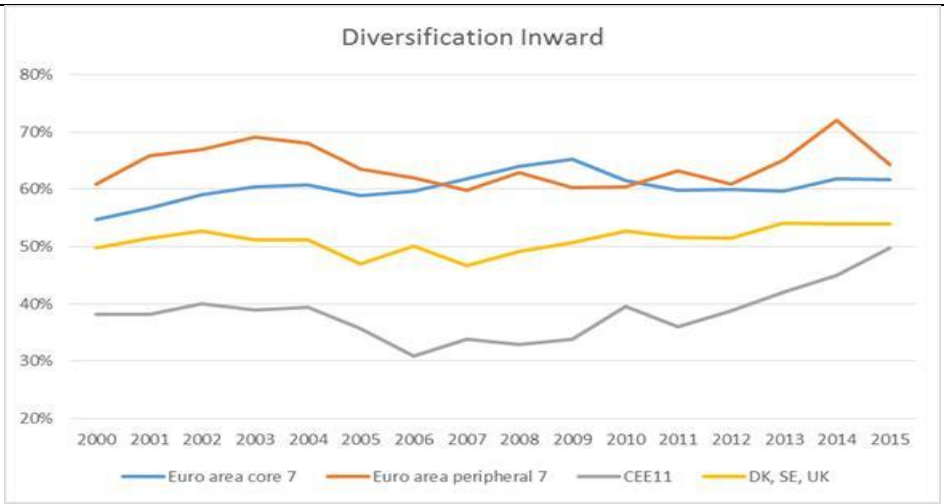
The challenge in creating these measures of inward and outward bias is the calculation of the total assets of each country, which includes not only the assets traded cross-border but also those hold at home. Following Darvas and Schoenmaker (2016) we calculate country i's total equity and debt portfolio TP_i as:

$$TP_i = \sum_{j\neq i} A_{i,j} + (NA_i - \sum_{j\neq i} L_{j,i})$$

Where $\sum_{j\neq i} A_{i,j}$ is the portfolio assets held abroad; $(NA_i - \sum_{j\neq i} L_{j,i})$ are the portfolio holdings of residents calculated as the difference between National Account's (equity plus debt) data (NA_i) minus all foreign claims on the country (country *i*'s liabilities).

Core Euro area countries show a relative increase of their inward diversification up to 2008 (Figure 2). After a slow down due to the crisis inward diversification recovers starting from 2013. The main EU non Euro area countries seems to attract more EU investors after 2005 onwards even if the level remains lower than Euro area countries. The stronger increase in inward diversification is seen in the aggregate of CEE1 countries showing, especially after 2006, the surge of EU investors. Finally, after being rather stable from 2005, the peripheral Euro area countries show a significant increase in 2014 reversed in 2015.

Figure 2: Inward diversification in bond and equity investments within the EU



Source: Finflows, JRC computations. Aggregate values are computed making a simple average over each individual countries. Euro area core includes Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. Euro area peripheral includes Cyprus, Greece, Spain, Portugal, Italy, and Ireland. CEE11 includes all the Eastern European countries, including the Baltics. No data is available for Croatia and Slovakia. Data are partially available for Bulgaria and Cyprus.

2. Sharing risks: smooth consumption using cross-border capital movements

Following the structure of national accounts, Asdrubali et al. (1996[33]) defined three channels for risk sharing (or, equivalently, consumption smoothing): the capital markets channel, the government channel and the credit markets channel. They start from the following identity[34]:

$$GDP = \frac{GDP}{GNI}\frac{GNI}{GDI}\frac{GDI}{C}C$$

[33] Asdrubali, P., Sørensen, B., and Yosha, O. (1996). 'Channels of Interstate Risk Sharing: United States 1963-1990.' The Quarterly Journal of Economics, 111(4):1081-1110.

[34] The identity comes from the GDP as measured using the income approach. GDP=compensation of employees + gross operating surplus and mixed income + taxes less subsidies on production and imports. GNI=GDP + primary incomes receivable from the rest of the world — primary incomes payable to the rest of the world. GDI=GNI + current transfers receivable from the rest of the world — current transfers payable to the rest of the world. S=GDI — final consumption expenditure.

where GDP stands for Gross Domestic Product, GNI for Gross National Income, GDI for Gross Disposable Income and C for Consumption. Manipulating the identity (for details, see Poncela et al. 2016[35]) one obtains workable expressions for the three channels:

$$\Delta\log(\text{GDP}) - \Delta\log(\text{GNI}) = \beta_{0,K} + \beta_K \Delta\log(\text{GDP}) + u_K \quad (1)$$

$$\Delta\log(\text{GNI}) - \Delta\log(\text{GDI}) = \beta_{0,F} + \beta_F \Delta\log(\text{GDP}) + u_F \quad (2)$$

$$\Delta\log(\text{GDI}) - \Delta\log(\text{C}) = \beta_{0,C} + \beta_C \Delta\log(\text{GDP}) + u_C \quad (3)$$

$$\Delta\log(\text{C}) = \beta_{0,U} + \beta_U \Delta\log(\text{GDP}) + u_U \quad (4)$$

The capital markets channel, characterised by Equation (1), is based on the difference between Gross Domestic Product and Gross National Income. It corresponds to national accounts' Net Factor Income category and accounts for two types of transactions between residents and non-residents: compensations to domestic employees working abroad (for less than one year) and the cross-border income flows (e.g. income and profits from property or investments made abroad, that is, income from foreign direct and portfolio investment, and other payments such as payments on debt/equity securities). Notice that capital gains and losses coming from buying or selling activities/securities do not pertain to this channel since they are classified as part of the value of the investments (and recorded under the credit channel). To get a flavour of the importance of each type of transaction on cross-border smoothing through the capital markets channel, The Quarterly Report on the Euro Area (2016) finds that for a group of 13 Euro area countries[36] only 0.2 % of shocks is smoothed through cross-border labour compensation out of the 5.6 % of total shocks smoothed through this channel, This suggests that most of the risk sharing achieved through capital markets channel was due to income from property or investments.

Equation (2) represents the fiscal or government channel (or public risk sharing) and is based on the difference between Gross Disposable Income minus Gross National Income, i.e. the Net International Transfers. It includes transfers made by a resident entity to a non-resident entity without an economic counterpart. It includes general government transfers (transfers between governments and international cooperation). Included here are also transfers between governments and non-residents other than governments and international organisations. For instance, current taxes on income or social security contributions between a government and the non-resident are included here. Certain classes of cross-border transfers made between private sectors are also recorded in this category and include workers' remittances by migrants (staying in the foreign country for more than one year).

[35] Poncela, P. Pericoli, F., Manca, A. And Nardo, M. (2016). 'Risk Sharing in Europe' (2016). European Commission, Joint Research Centre, Policy Report. All the work reported in this section is based on Asdrubali, P., Kim, S., Pericoli, F., and Poncela, P. (2017). 'Country heterogeneity in risk sharing'. Mimeo.

[36] The list of countries included in the sample was DE, EE, ES, FI, FR, IE, IT, LV, NL, PT, SK and SL.

Equation (3) represents the credit markets channel and is based on the difference between Gross Disposable Income and Consumption. This difference is the balancing item in the system of national accounts that corresponds to gross savings. It comprises not only household savings, but also corporate and government savings. This category includes net lending/borrowing to/from the rest of the world plus gross capital formation and net capital transfer to the rest of the world. Notice that this channel has also a domestic connotation, through the gross capital formation, since agents can smooth consumption by borrowing and lending not only in international markets but also in domestic ones or by investing less. This channel, therefore, covers both national and international smoothing effects[37].

Finally, equation (4), relating consumption to GDP, measures the part of the domestic shocks that is directly transmitted to domestic consumption, hence, remains unsmoothed and, therefore, 1-β_U measures the total amount of smoothed shocks. If $\beta_U = 0$, there will be full risk sharing, whereas if $\beta_U > 0$, domestic output shocks are partially passed to consumption. In the extreme case of $\beta_U > 1$, GDP shocks are amplified rather than smoothed.

Each of the estimated parameters $\beta_K, \beta_F, \beta_C$ in the equations (1) to (3) represents the amount of risk sharing (in percentage to 1) that takes place through the capital, government and credit channels, respectively. Alternatively 1-β_U, the total amount of risk sharing can also be given by the sum of percentage smoothed through each one of the channels, that is, $\beta_K + \beta_F + \beta_C$. Notice that we could have negative estimated betas, meaning that the associated channel does not contribute to consumption smoothing but rather amplifies consumption volatility in response to GDP shocks.

2.1 The estimated model

The model actually estimated is a variation of the basic set up described in Poncela et al. (2016). It is based on a dynamic panel approach where, instead of pooling all the information relative to the countries, we estimate the following system of equations for each country[38]:

$$X_{i,t} = A_{0,i} + A_{1,\mathrm{i}}X_{i,t-1} + A_{2,\mathrm{i}}X_{i,t-2} + \cdots + A_{p,i}X_{i,t-p} + U_{i,t} \qquad (5)$$

[37] Further decompositions of the basic channels can be achieved if we go beyond in the System of National Accounts; see, for instance, Balli, Pericoli and Pierucci ('Foreign portfolio diversification and risk-sharing.' Economics Letters, 125(2):187-190, 2014) for the decomposition of the net factor income channel into interests, dividends and retained earnings or Kalemli-Ozcan, Luttini and Sørensen ('Debt Crises and Risk-Sharing: The Role of Markets versus Sovereigns.' Scandinavian Journal of Economics, 116(1):253-276, 2014) for decomposing savings into private and public savings. Nevertheless, the further the disaggregation of the data, the fewer data available and the less reliable. To get a flavour of the share of each category in gross savings, net capital transfers are negligible; net borrowing and lending for Germany (a typical lender country) was around 25 % in 2006-2013, while it was the opposite (around -25 %) for Spain (a typical borrower country) in the same period. The rest is due to gross capital formation. Nevertheless, these figures can heavily change from country to country.

[38] For long sample sizes or very heterogeneous countries, the assumption of constant parameters can be difficult to maintain.

For each country *i* and each time period *t*, $X_{i,t}$ is the 4×1 vector

$$X_{i,t} = \begin{pmatrix} GDP_t^i \\ GDP_t^i - GNI_t^i \\ GNI_t^i - GDI_t^i \\ GDI_t^i - C_t^i \end{pmatrix}$$

$A_{0,i}$ is the 4x1 vector of intercepts that can be country specific, $A_{j,i}$, j=1,…,p; i=1,…,N are 4×4 matrices of coefficients, and $U_{i,t}$ is multivariate white noise. In this setting and according to the literature (i.e., Asdrubali and Kim, 2004) the shock is originated via the error term $U_{i,t}$ and transmitted to the whole system.

Notice that equation (5) is analogous, in compact notation, to the system of equations (1) to (3) plus an equation describing GDP dynamics and the addition of a certain number of past values of the dependent variable $X_{i,t}$. Past values are inserted to capture the long-lasting effects of each channel, i.e. effects that could take place some years after the shock actually hits the country. In so doing we are able to see when a given channel acts/stops acting in smoothing consumption, if a channel is activated immediately after the shock or if it affects the economy only with some delay.

The estimation methodology allows attaching to each estimated effect a measure of uncertainty allowing the construction of confidence bounds for each estimated value. To interpret the results, we set to 100 the effect of a shock on GDP and report the fraction smoothed through each channel. Notice that this normalisation is done for each country. Then, the numbers that appear in the tables should be taken as the percentage of idiosyncratic shocks that each country is able to smooth through the different channels.

For the analysis we use National Accounts statistics (AMECO[39]) covering the timespan 1960-2016.

2.2 Results

Target group: EU14 (sample size 1960-2016)

Table 1 displays the average risk sharing achieved by each EU14[40] country for the largest available period 1960-2016. In the ideal case of full risk sharing among the

[39] The annual macro-economic database of compiled by DG ECFIN (https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/macro-economic-database-ameco_en).

[40] EU14 comprises Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain Sweden and United Kingdom.

countries in the sample, the shock to idiosyncratic GDP should not be transmitted to domestic consumption thanks to cross-border smoothing. The column Total represents the percentage of GDP shocks that is overall smoothed or, in other terms, not transmitted to domestic consumption (e.g. for Ireland is 79 %), while the remaining columns detail the percentage of total risk sharing smoothed through each of the channels (e.g. in Ireland 17 % of the shock is smoothed via the capital markets channel). Negative percentages indicate 'dis-smoothing': the shock not only is transmitted to consumption but that channel induces further reductions.

The analysis for the whole sample indicates that the credit markets channel (or gross savings) as the most important channel for risk sharing. The importance of this channel is however different across countries: It accounts for 72 % of the smoothing in Sweden but has negligible effects in France and Austria. Simple graphs of idiosyncratic GDP and consumption growth rates for these two countries show that, in fact, both variables move very close in each country. Although in both cases consumption is hardly smoothed, the situation in the two economies is different. A more detailed look at the Austrian data reveals that during the two oil recessions and the recession at the beginning of the 21st century, smoothing was actually needed but never took place, so GDP and consumption both dropped. However, during the financial and sovereign crisis, Austria showed positive GDP shocks during some years and, therefore, did not need to smooth consumption during those years. The situation in France is more complex. The subsample analysis reveals that risk sharing was slightly higher during the first part of the sample; however, during the last Great Recession and subsequent sovereign crisis, for some years, the credit market channel acted counter-cyclically to GDP leading, on average over the whole sample, to the absence of risk sharing.

The capital markets channel scores second in consumption smoothing, although far from the credit market channel. Here, again, the estimated values differ across countries: significant values are found only for Ireland. Finally, as regards international transfers, we do not detect significant smoothing through this channel as the numbers that appear in the table are much smaller and never significant.

Table 1. Percentage of risk sharing in case of shocks to domestic output. Analysis per country, target group EU14. Total refers to the percentage of total risk sharing (% of domestic consumption smoothed). Capital, Gov and Credit refer to risk sharing obtained via capital markets, government and credit channels, respectively. Sample: 1960-2016.

EU14, sample 1961-2016				
Country	**Total**	**Capital**	**Gov**	**Credit**
Austria	3	-3	1	4
Belgium	46	0	-3	49***
Denmark	13	-2	1	14
Finland	43	-1	0	45***
France	9	1	2	6
Germany	23	-1	2	22**
Greece	42	0	-2	44***
Ireland	79	17**	3	59***
Italy	26	5	-1	21**

Netherlands	31	0	1	31
Portugal	15	-3	-1	19
Spain	27	3	3	21**
Sweden	63	-8	0	72***
UK	18	2	3	14

Note: data source AMECO, JRC estimations.
The symbols ** and *** indicate significant at 5 and 1 % level.

Target group EU14: sub-sample analysis

A flavour on how sharing risks has worked in recent times can be seen in Table 2, where the sample is split in two periods 1960-1998 and 1999-2016. The credit markets channel seems to be predominant to achieve consumption smoothing during the 1960-1998 period. The top 5 countries in the whole sample remain unchanged in the period 1960-1998, though with a different ordering.

Table 2. Percentage of risk sharing in case of shocks to domestic output. Analysis per country, target group EU14. Total refers to the percentage of total risk sharing (% of domestic consumption smoothed). Capital, Gov and Credit refer to risk sharing obtained via capital markets, government and credit channels, respectively. Different sub-samples.

	Sample: 1960-1998				Sample: 1999-2016			
Country	**Total**	**Capital**	**Gov**	**Credit**	**Total**	**Capital**	**Gov**	**Credit**
Austria	0	-5	2	3	18	-7	-3	28
Belgium	81	1	-1	81***	16	14	-7	9
Denmark	9	0	2	7	-9	-10	2	-1
Finland	48	-5	1	52**	47	1	-2	48***
France	21	-2	2	21	6	-9	-2	16
Germany	17	-3	2	17	40	7	-1	33**
Greece	58	5	1	52***	24	6	-3	21
Ireland	46	-11	5	52***	85	37***	1	46***
Italy	39	8**	-2	33**	-18	4	0	-23**
Netherlands	40	10	2	28	37	18	-9	28
Portugal	20	-6	-2	29	-21	-3	17**	-35
Spain	21	-1	-2	24	58	9	6***	43**
Sweden	79	-7	0	85***	32	13	2	17

UK	25	2	5	19	0	-6	3	3

Note: data source AMECO, JRC estimations.
The symbols ** and *** indicate significant at 5 and 1 % level.

The picture changes in the period 1999-2016. For the first time, the credit markets channel can cause dis-smoothing for some countries (notably IT and PT). This indicates the inability of those countries to put in place short-term measures to counteract the effects of the 2008/sovereign crisis. The net gainer in cross-border risk sharing seems to have been Ireland where the capital markets channel is converted from shock amplifier to shock smoother in the two periods analysed. In the period 1999-2016, 37 % of Irish GDP shocks is smoothed via cross-border capital markets, a figure comparable to that achieved on average in the United States when analysing cross-border state smoothing (Asdrubali et al., 1996, with a sample 1964-1990, estimate that capital markets cross-border risk sharing is 39 %).

As regards the credit channel, Germany and Spain see an increased role in 1999-2016. Belgium and Sweden, on the contrary, exhibit lower effects in the most recent subsample: during 1960-1998, in both countries gross savings followed closely GDP, absorbing shocks to domestic output. However, this behavior changed in the period 1999-2016. In Sweden, real GDP growth rates were close to 0% during the 2000s due to the dot.com worldwide crisis and the credit markets channel was not able to react and could not absorb the downturns in Swedish idiosyncratic output. In Belgium, instead, the credit (or savings) channel, which reflects idiosyncratic movements in the growth rates of savings (that is, net lending/borrowing to/from the rest of the world plus gross capital formation and net capital transfer to the rest of the world) showed a very volatile behavior during the last subprime and sovereign debt crises leading to a very low incidence of this channel.

Target group: EU-28, available sample 1995-2016

Due to data availability, the sample used for the estimation of EU-28 group covers the period 1995-2016, **Table 3** contains the results.

The cross-border risk sharing via capital markets seems to work quite well for the Baltic countries, and Ireland. The percentage is high also for some small and very volatile countries such as Luxembourg and Malta, although due to the high volatility not statistically significant at 5 %.

For some countries (e.g. Latvia) idiosyncratic GDP and consumption growth rates go hand in hand indicating the total absence of smoothing. This is the result of two opposite effects: on the one hand, the capital markets channel acts as unique shock absorber. On the other hand, the credit markets channel (i.e. private savings) acts counter-cyclically to GDP, offsetting the smoothing achieved through the capital markets channel. As expected, Ireland (jointly with Luxembourg and Malta) obtains the highest quota of risk sharing, close to the US figure, with a substantial share obtained via cross-border capital markets.

Table 3. Percentage of risk sharing to shocks to domestic output. Analysis per country, target group EU-28. Total refers to the percentage of total risk sharing (% of domestic

consumption smoothed). Capital, Gov and Credit refer to risk sharing obtained via capital markets, government and credit channels, respectively. Sample: 1995-2016.

EU-28 1995-2016				
Country	**Total**	**Capital**	**Gov**	**Credit**
Austria	3	-2	-1	7
Belgium	4	1	-1	4
Bulgaria	38	17	8	13
Croatia	6	-1	-5	12
Cyprus	-2	22	3	-26
Czech Republic	46	-3	-1	49**
Denmark	12	-3	-2	17
Estonia	32	18***	1	13
Finland	58	10**	-3**	51***
France	-3	0	1	-4
Germany	40	4	0	37
Greece	17	-1	-4**	22**
Hungary	6	-13	-6	25
Ireland	80	27***	0	53***
Italy	-14	3	2	-20
Latvia	3	42***	6	-46**
Lithuania	31	24***	-2	8
Luxembourg	82	64	-28	46**
Malta	92	28	-6	69
Netherlands	14	9	-3	8
Poland	47	21	10	15
Portugal	8	16**	5	-13
Romania	6	5	1	0
Slovakia	37	-11	11	37**
Slovenia	46	12	-3	37**
Spain	39	3	3	33
Sweden	29	-8	-2	39**
UK	8	5	0	3

Note: data source AMECO, JRC estimations.
The symbols ** and *** indicate significant at 5 and 1 % level.