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# JRC.B1 contribution to the SWD on the Movement of Capital and the Freedom of Payments

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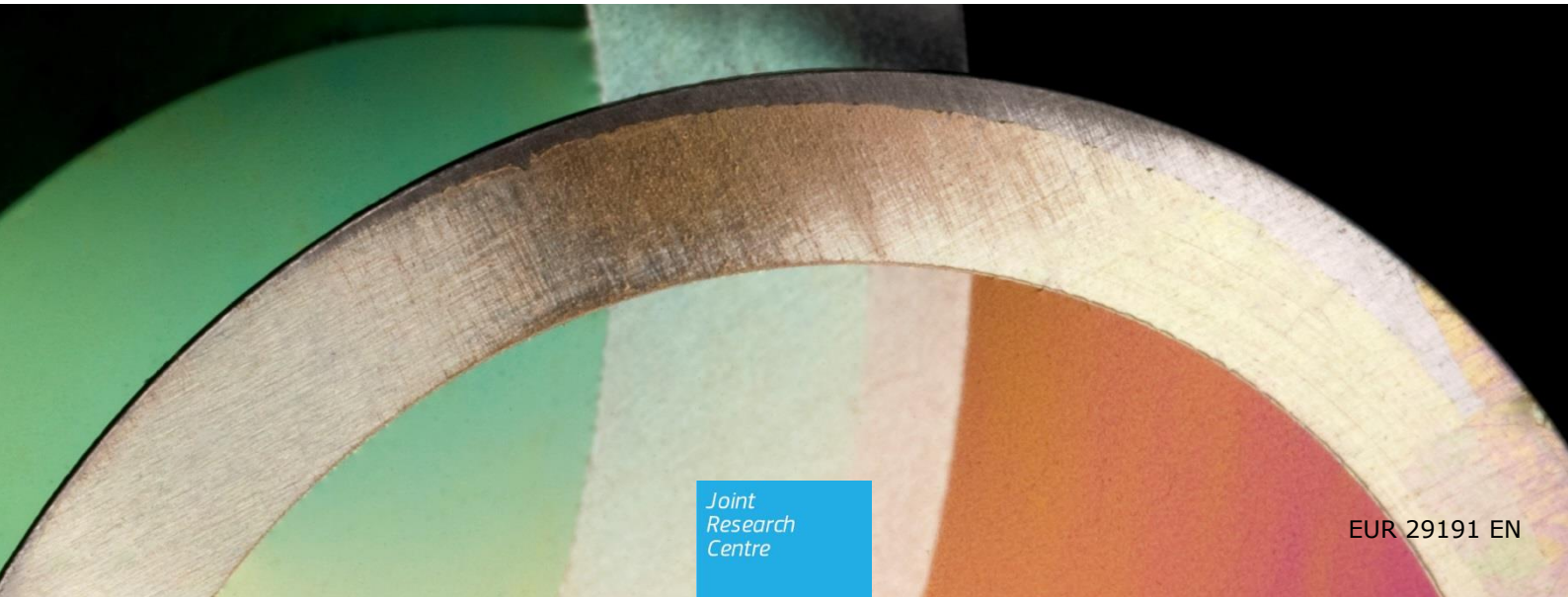

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# Abstract

In the context of the institutional support to DG FISMA, JRC.B1 contributed to the Commission Staff Working Document on the Movement of Capital and the Freedom of Payments. JRC.B1 contribution included: (i) the analysis of home bias (tendency to invest in domestic financial assets); (ii) the analysis of diversification of cross-border investments and (iii) the estimation of the country specific degree of risk sharing for EU28 (risk sharing is the possibility to use cross-border capital markets to smooth domestic shock). JRC.B1 contribution appears in sections 2.5 and 2.6, and in Appendix III and IV[1].

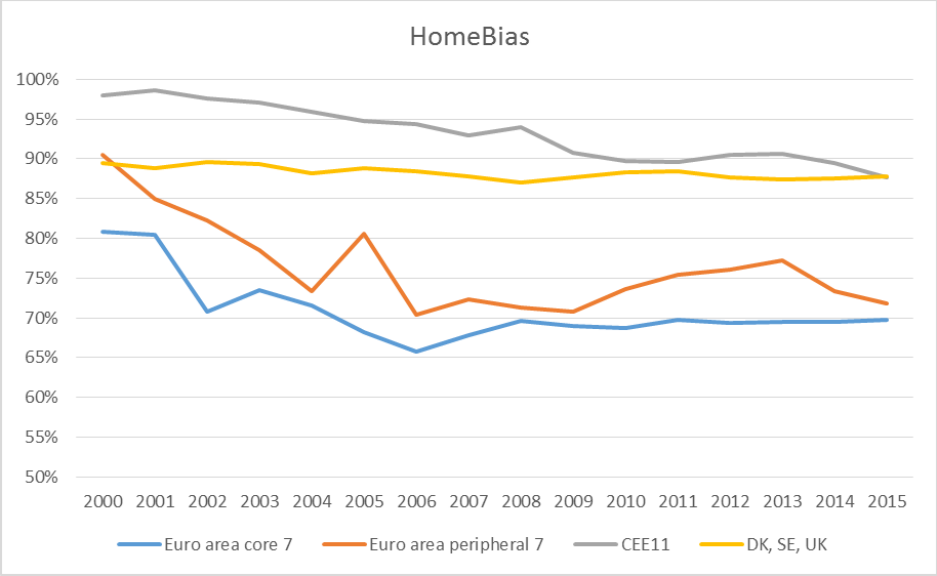
[1] The content of this report does not reflect the official opinion of the European Union. Responsibility for the information and views expressed therein lies entirely with the authors.

# Contribution for the main text of the Commission Staff Working Document on the Movement of Capital and the Freedom of Payments

## 1. Home bias in equity and bond markets

Home bias is the tendency to invest in domestic equities or bonds, despite the theoretical benefits of international diversification. Albeit an increasing financial liberalization since the 1990s and a considerable reduction in barriers to international portfolio investment, recent studies suggested that equity and bond home bias remains significant. In US for example, investors keep over 70% of their assets in US equities despite the fact that US stock market makes up the 36% of the global market[2]. Home bias in equity investments for Euro-area countries is ten percentage points higher[3].

*Figure 1: Home bias in bond and equity market*




Source: Finflows, JRC computations. Average between equity and debt home bias. Euro area core includes Austria, Belgium, Finland, France, Germany, Luxembourg and Netherlands. Euro area peripheral includes Cyprus, Malta, Greece, Spain, Portugal, Italy, and Ireland. CEE11 includes all the Eastern countries, including Baltics.

Figure 1 details the average home bias in equity and bond markets measured by the share of domestic equities and bonds in the investment portfolio of residents in each of the EU28 member states (see the Appendix for details on definitions and construction methodology). For the calculations we used bilateral cross-border holdings of debt and equities coming from the Finflows dataset[4].

[2] http://www.businessinsider.com/world-stock-market-capitalizations-2016-11?IR=T 2016 data.
[3] Detailed figures for equity and debt home bias are in Appendix
[4] Finflows is a joint JRC-ECFIN dataset of bilateral cross-border investments stocks and flows for about 200 countries worldwide. The dataset, based on multiple data source (OECD, IMF-CPIS, IMF-CDIS, BIS, ESTAT) distinguishes between foreign direct investments, portfolio investments and other investments (mainly banking flows) and records both equity and debt instruments. The data used here are the bilateral cross-border stocks of portfolio investments (debt and equity) for the 28 EU countries.

Euro area countries display the lowest home bias within EU28, about 20% points lower than those registered in the Eastern countries. After 2008, home bias in the Euro area core countries is steadily around 70%, few percentage points lower than Euro area peripheral countries that display a decreasing trend and in the two last years – 2014 and 2015 – are almost back to the pre-crisis level. A relatively constant downward trend is observed for the CEE11 where home bias continuously drops - from 94 to 88 per cent exception made in 2008. No significant change is observed on the aggregate DK, SE and UK.

## 2. Sharing risks: diversification of portfolio investments within the EU and consumption smoothing

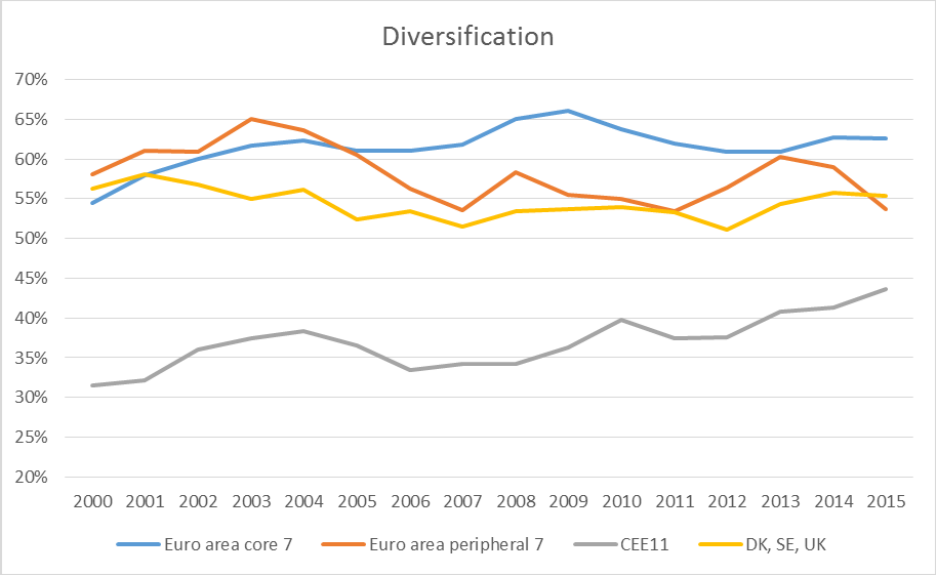
When a shock hits the economy of a country it is likely to affect people consumption, investments and savings. Market and institutional channels (e.g. fiscal policy, cross-border capital and credit markets, and government intervention) should dampen shock's effects permitting households and individuals to preserve their consumption levels. The percentage of output shocks absorbed and, therefore, not passed into consumption is known as risk sharing. Among the channels, the cross-border capital markets cushion is key in insuring domestic consumers. To measure the extent of domestic protection using cross-border channels we compute two measures of risk-sharing.

The first, an indirect measure, is based on the idea that more diversified inward and outward cross-border holdings improves a country ability to respond to idiosyncratic shocks. 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 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).

Figure 2 displays an average of outward and inward diversification indicators for bond and equity investments within EU countries[5] (further details in the Appendix). Euro area core countries tend to be more diversified as compared to the rest of EU28 after 2005 After the effects of 2008 crisis diversification is back to pre-crisis level in 2015. The diversification of the aggregate of DK, SE, DK countries is rather stable from 2005 onwards. The Euro area peripheral countries present volatile trend in the level of diversification: relative peaks are observed 2004, in 2008 and in 2013. However in 2015 a strong decrease is observed due both to inward and outward diversification indicators. Finally, CEE11 countries show a continuous improvement of their diversification exception made of 2006 and 2011; its level is still rather low compared to the other EU countries.

[5] Being interested in risk-sharing within European countries, we only consider EU28 investments within Europe. This implies that a country with low diversification in EU could be diversified outside Europe.

*Figure 2: Diversification in bond and equity investments within the EU*




Source: Finflows, JRC computations. Average between outward and inward diversification. Euro area core includes Austria, Belgium, Finland, France, Germany, Luxembourg and Netherlands. Euro area peripheral includes Cyprus, Malta, Greece, Spain, Portugal, Italy, and Ireland. CEE11 includes all the Eastern countries, including Baltics.

A more traditional approach to risk sharing looks directly at the cross-border channels which are at work in smoothing income and consumption when a country is hit by an output shock. The channels considered are three: (1) the capital markets, essentially based on the income from cross-border activities; (2) the credit channel (gross savings) includes net lending/borrowing to/from the rest of the world and (3) the fiscal channel including the international transfers made by the government and workers' remittances by migrants. The risk sharing model is estimated for all EU countries using annual data from National Accounts statistics for the sample 1960-2016 (the Appendix contains additional details on methodology and estimation).

Our findings are the following:

**Amount of risk-sharing for EU countries**

- The average amount of risk sharing for the whole sample EU14[6], 1960-2016, is around 40% as compared over 80% for US[7]. In other terms about 40% of GDP shock is not directly transmitted to consumption but rather absorbed by the different channels. This figure slightly increases for the subsample 1999-2016.

- The bulk of risk sharing takes place through the credit markets (savings) channel which counts for over 30% of the total risk sharing, comparable with the 27% computed for US on a similar time frame.

[6] EU14 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden and UK.
[7] Quarterly Report on the Euro Area, vol. 15 n. 2, 2016

- Although practically non-existing during the first part of the sample, the capital markets channel is growing, reaching 12% in the period 1999-2016 after the introduction of the Euro. In the US the risk sharing via capital markets is about 45%.

- In Europe, risk sharing through international transfers (fiscal channel) is almost non-existent for all periods and countries analysed. US figure is around 8%.

## Closer look at the channels

- A dynamic analysis of the channels shows that they tend to act as substitutes, so if one increases over time, the others tend to decrease. This implies that policies fostering one of the channels are likely to have spill-overs in the effectiveness of the other channels.

## Closer look at the countries

- A country by country analysis (below) reveals that the degree of risk sharing across countries is quite heterogeneous, higher in Ireland, Sweden, Finland, Belgium, and the Greece. It involves principally the credit channel.

**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.

# Appendix I: Home bias in equity and bond markets

In frictionless international financial markets, where financial assets of similar risks are priced similarly, regardless of where they are traded, investors are expected to hold international portfolios[8]. The world market portfolio should generate in fact higher risk/return profiles for domestic investors as the world capital market entails lower systematic risk than any domestic capital market. In reality there is robust evidence showing that domestic investors tend to prefer domestic investments, especially in the bond market, leading to an overweighting of domestic assets in their portfolios, this is the home bias. Schoenmaker and Soeter (2014) have shown that the introduction of the common currency, by eliminating the exchange rate risk, has favoured a decrease in home bias for EU countries, while the 2008 crisis had the opposite effect. Investors have withdrawn their investments from abroad (retrenching) favouring domestic assets.

Following Schoenmaker and Bosch (2008)[9] and Darvas, Hüttl and Schoenmaker (2016)[10] and Schoenmaker and Soeter (2014)[11], we measure the home bias in equity and bond markets by calculating to which extent domestic equity/bond is overweighed in the domestic investment portfolio. We use domestic portfolio as a synonymous of the portfolio held by residents of a given country likewise we use the term domestic investors to indicate those investors that reside in a given country.

The equity home bias, $EHB_i$, of country *i* is measured as the difference between the relative weight of domestic equity in the portfolio of country *i* and the relative weight of country *i* in the total world market portfolio[12].

$$EHB_i = 1 - \frac{Foreign\ Equity_i}{Foreign\ Equity\ to\ Tot\ Market_i}$$

Where $Foreign\ Equity_i$ is the share of country *i*'th holdings of foreign equity in country *i*'th total portfolio.

Country *i*'th total portfolio is calculated as domestic market capitalization plus domestic holdings abroad minus domestic liabilities (domestic assets held by foreigners).

The $Foreign\ Equity\ to\ Tot\ Market_i$ is the share of foreign equities in the world portfolio available to country *i* (1-share of country *i* in the tot market capitalization). $EHB_i$ measures to what extent domestic equities are overweighed (overrepresented) in the domestic portfolio: $EHB_i$ will be equal to zero if investors show no preference for domestic equities (i.e. there is no home bias). If Domestic investors have a preference for domestic equities then there will be home bias and the indicator $EHB_i$ will be between 0 and 1, one being the entire domestic portfolio invested in domestic assets. Notice that $EHB_i$<0 could in theory happens when a country has a bias for holding foreign assets.

[8] Elton E., Gruber M., Brown S., Goetzmann W, (2007) Modern Portfolio Theory and Investment Analysis, 7th edition, John Wiley & Sons, New York.

[9] Schoenmaker D., and Bosch T., (2008), Is Home Bias in Equities and Bonds Declining in Europe? Investment Management and Financial Innovations, 5(4), 90-102.

[10] Darvas Z., Hüttl P., Schoenmaker D., (2016), Analysis of developments in EU capital flows in the global context, Bruegel.

[11] Schoenmaker D., Soeter C., (2014), New evidence on the Home Bias in European Investments, DSF Policy Briefs, n. 34, September 2014. For alternative ways of constructing an home bias indicator see Vanpée R., De Moor L., (2012), Bond and Equity Home Bias and Foreign Bias: an International Study, working paper Catholic University of Leuven, Fac. Dep. of Accountancy, Finance and Insurance (AFI)

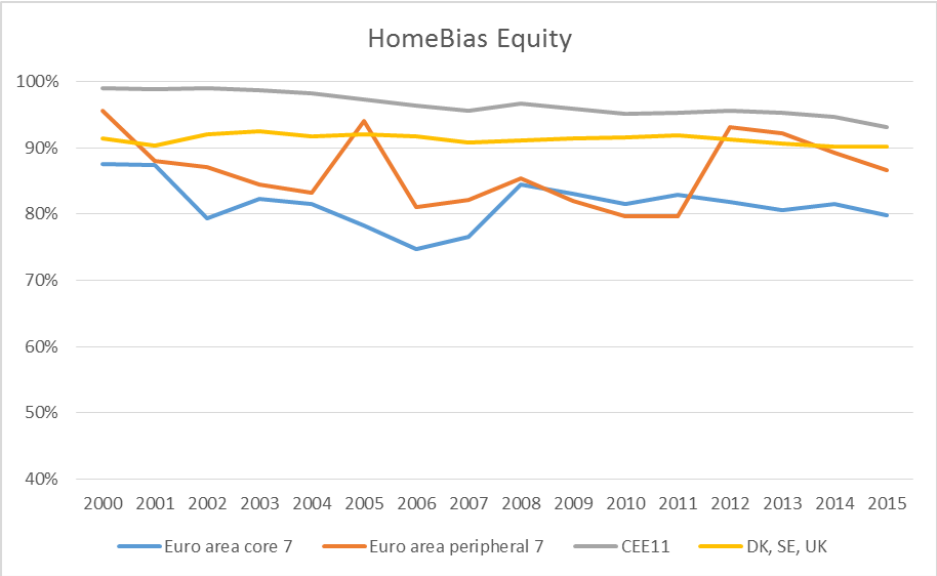
[12] For domestic equities we mean equities issued domestically.

The bond home bias $BHB_i$ is defined analogously as the share of country *i*'th holdings of foreign debt in country *i*'th total debt portfolio. For the actual calculation of $EHB_i$ and $BHB_i$ we use bilateral cross-border holdings of debt and equities coming from the Finflows dataset. For the definition of world portfolio we distinguish 2 cases:

- For $BHB_i$ the world portfolio is based on data about 42 countries, market capitalization is calculated using Bank of International Settlements data.
- For $EHB_i$ the world portfolio is based on data about 38 countries and data stock market capitalization (last available year). For comparison purposes we also consider data asset holdings coming from National Accounts (in that case we use ESTAT figures).

### 1.1 Home bias for (portfolio) equity investments

*Figure 3: Home bias in equity market*




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 Netherlands. Euro area peripheral includes Cyprus, Malta, Greece, Spain, Portugal, Italy, and Ireland. CEE11 includes all the Eastern countries, including Baltics. Data are partially available for IE, LU, LV, MT and PL.

Figure 3 shows that EU membership is driving for equities[13]: equity home bias in the Euro area and in UK, DK and SE is lower than in the newer member states (result in line with the literature, Beakert et al. 2013). There is little sign of influence of the crisis on home bias for equity, pointing to a rebalancing of portfolios rather than to an increasing the home bias as confirmed by Wynter (2012)[14] at the world level. Less cross-border investments due to the crisis were compensated by the change in the value of these investments (due to exchange rates differentials) and the change in evaluation of existing stocks. Between 2008 and 2011, we notice an increase in home bias Euro area peripheral countries diversifying their portfolio equities mainly towards other Euro area countries (also found in Darvas et al., 2016). This trend dramatically reverses with the

[13] Sharp decline in home bias from 1997-2004, see Darvas, Hüttl, Schoenmaker (2016) and Schoenmaker-Soeter (2014)

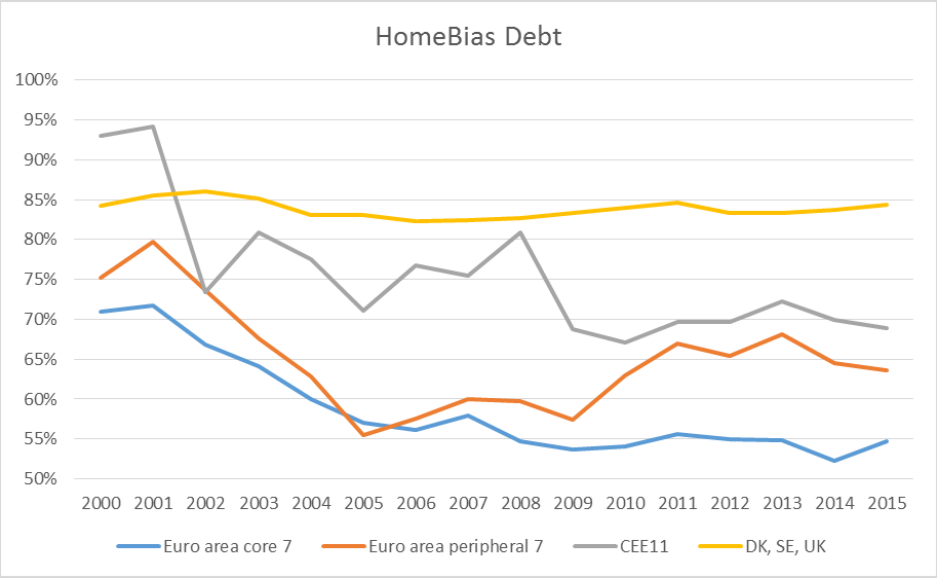
[14] Wynter M., (2012), Why did the equity home Bia Fall During the Financial Panic of 2008? Mimeo Ohio State University.

sovereign crisis with home bias increasing from 80 to 95 per cent. DK, SE and UK and CEE11 exhibit rather stable level of home bias showing lesser financial integration than Euro area.

### 1.2 Home bias for (portfolio) debt investments

From Figure 4 we observe downward trends in debt home bias for all Euro area countries after the introduction of the Euro, confirming the literature (see Darvas, Huttl, Schoenmaker, 2016 and Schoenmaker-Soeter, 2014 among others). In 2005, both Euro aggregate (core or peripheral countries) show similar level of home bias between 55 and 60 per cent, however after the financial crisis, their evolution diverges. We observe a slight increase in home bias in the Euro-area peripheral countries hit harder by the crisis: foreign investors left these countries' debt while core Euro-area countries' home bias almost remains stable to pre-crisis level. For the hit countries, home bias stabilises between 2011 and 2013 and slightly decreases after 2013. CEE11 countries invested in core Euro area debt to decrease their risk after the crisis, hereby decreasing the home bias down from around 75 to 70 per cent and improving their diversification of investment. For the main non-Euro countries (DK, SE, UK) home bias remains very high, above 80 per cent showing a lesser integration with EU countries.

*Figure 4: Home bias in bond market*




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 Netherlands. Euro area peripheral includes Cyprus, Malta, Greece, Spain, Portugal, Italy, and Ireland. CEE11 includes all the Eastern countries, including Baltics. No data is available for BG, HR and RO. Data are partially available for CZ, EE, IE, LU, LV and PL.

# Appendix II: Sharing risks, inward and outward diversification in cross-border capital stocks and consumption smoothing

# 1 Sharing risks: inward and outward diversification

Following Schoenmaker and Wagner (2011)[15] we construct two indicators measuring inward and outward diversification in cross-border capital movements within EU28 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 EU28 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 EU28). The index of outward diversification for country *i* will be defined as:

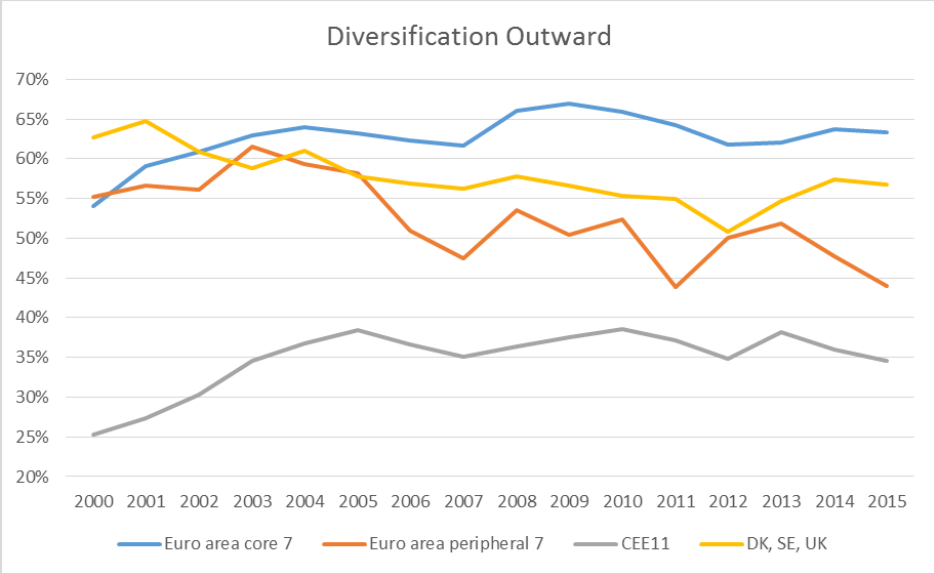
$$Div_i^{out} = 1 - \frac{1}{2}\sum_{j,j\neq i}\left|\frac{f_{i,j}}{\sum_{k,k\neq i,} f_{i,k}} - \frac{a_j}{\sum_{k,k\neq i,} a_k}\right| \qquad (1)$$

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 5). Similarly the group DK, SE and 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.

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

*Figure 5: 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 Netherlands. Euro area peripheral includes Cyprus, Malta, Greece, Spain, Portugal, Italy, and Ireland. CEE11 includes all the Eastern countries, including Baltics. No data is available for HR. Data are partially available for CY, GR, HU and RO.

### 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 destabilize 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:

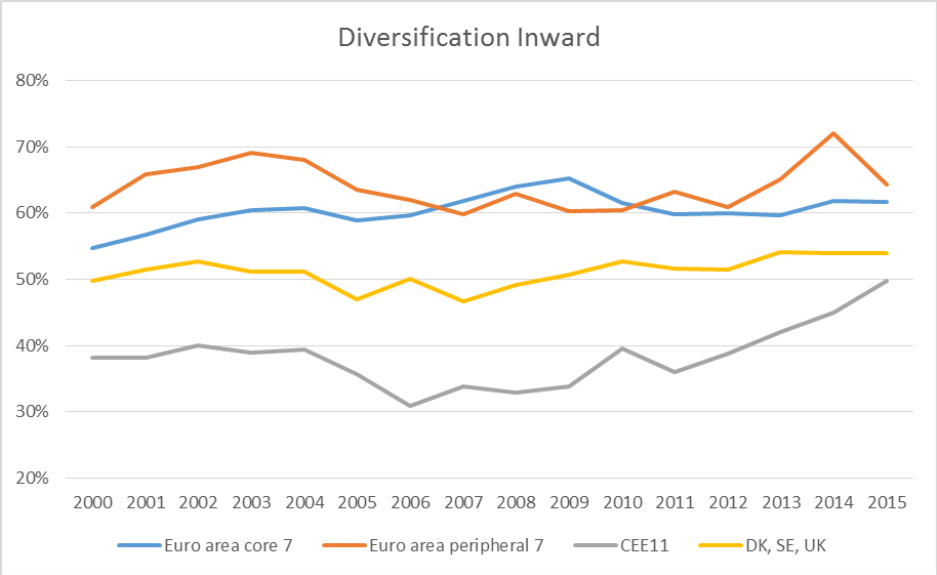
$$TP_i = \sum_{j\neq i} A_{i,j} + (NA_i - \sum_{j\neq i} L_{j,i})$$

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 6). 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 6: 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 Netherlands. Euro area peripheral includes Cyprus, Greece, Spain, Portugal, Italy, and Ireland. CEE11 includes all the Eastern countries, including Baltics. No data is available for HR and SK. Data are partially available for BG and CY.

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

Following the structure of national accounts, Asdrubali et al. (1996[16]) 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[17]:

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

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[18]) one obtains workable expressions for the three channels:

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

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

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

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

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[19] 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.

[16] 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.

[17] 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.

[18] 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.

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

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 organizations. 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).

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[20].

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-$\beta_U$ 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-$\beta_U$, 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

[20] 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.

information relative to the countries, we estimate the following system of equations for each country[21]:

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

For each country *i* and each time period *t*, $X_{i,t}$ is the $4 \times 1$ 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 $4 \times 4$ 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 normalization 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[22]) 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[23] country for the largest available period 1960-2016. In the ideal case of full risk sharing among the 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

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

[22] 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).

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

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 2 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 US 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 markets showed a very volatile behavior during the last subprime and sovereign debt crises leading to a very low incidence of this channel.

**Target group: EU28, available sample 1995-2016**

Due to data availability, the sample used for the estimation of EU28 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 EU28. 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.

| EU28 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.

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