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Natalia Martín Fuentes, Alexandra Born,  
Franziska Bremus, Wieger Kastelein,  
Claudia Lambert

A deep dive into the capital channel of  
risk sharing in the euro area

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## Abstract

This paper investigates the contribution of capital markets to international risk sharing in the euro area over the 2000Q1-2021Q1 period. It provides three main contributions: First, the estimation of country-specific vector autoregressions (VAR) shows that shock absorption through capital markets remains modest, particularly in the southern euro area. Second, we analyse the geographical patterns of the capital channel. While risk sharing between southern and northern euro area countries led the improvements in income smoothing at the beginning of the 2000s, intra-regional capital flows supported income smoothing in the recent past. Third, based on a panel threshold VAR, we analyse how the composition of external capital positions impacts the capital channel. Long-term portfolio debt assets and liabilities as well as equity liabilities significantly improved income smoothing. The effect is more pronounced for northern countries, in line with their larger cross-border portfolios, when compared to the southern countries. Regarding foreign direct investment, only northern countries benefited from inward positions.

Keywords: international risk sharing, capital channel, external financial structure, CMU, panel threshold vector autoregression (TVAR) model.

JEL Classification: C23, E62, G11, G15.

## Non-technical summary

The COVID-19 crisis represents a shock common to all euro area countries. Nonetheless, its economic consequences have been highly asymmetric across countries. In the face of idiosyncratic economic shocks, national public support measures are able to address country-specific impacts. However, international risk sharing through private capital markets could also play an important role in helping mitigate the economic downturn suffered by more severely affected countries and foster their recovery via capital inflows originating in less affected countries. Thus, the pandemic has renewed the need for better integrated capital markets to promote cross-border risk sharing within the euro area (EA) given its asymmetric economic consequences. However, evidence so far suggests a limited contribution of capital markets to risk sharing in the EA. Against this background, this paper presents a deep dive into risk sharing via capital markets, providing fresh evidence of its evolution and its drivers in the euro area. To study how intra-EA capital flows have helped countries smooth out their country-specific shocks to gross domestic product (GDP), we focus on ten longstanding EA countries. This smoothing effect through capital markets, also referred to as “income smoothing”, implies that variations in domestic production do not generate mirroring variations in domestic income or, ultimately, in consumption. Instead, income and consumption are at least partially shielded from country-specific GDP fluctuations via capital flows from and towards other EA countries.

Specifically, this paper provides three main contributions and results. First, we provide time-varying estimates of the capital channel for the period from 2000Q1 to 2021Q1, covering the first year of the COVID-19 pandemic, based on country specific vector autoregression (VAR) models. The results show that income smoothing remained modest, but also resilient when including the first quarters of the COVID-19 pandemic. Looking at the evolution between 2000Q1 and 2021Q1, our analysis suggests that income smoothing improved during the early 2000s and until around the sovereign debt crisis. However, this aggregate trend masks important geographical patterns.

Therefore, in a second step, we analyse the geographical patterns of the capital channel, by grouping countries according to their similarities in their external capital positions, resulting in a group of northern and a group of southern euro area countries. We observe that the positive evolution of the capital channel was largely driven by the contribution of capital holdings between southern and northern countries (i.e. inter-regional capital positions). After the global financial crisis and the subsequent sovereign debt crisis, income smoothing collapsed. This deterioration was significant for southern countries, which faced a tightening in international financial markets that prompted a decline in their cross-border intra-EA liabilities, particularly affecting inter-regional liabilities (i.e. liabilities where the investor is located in a northern country). This decline materially weakened risk sharing via capital markets in southern countries. In fact, over the last years, inter-regional capital flows exerted a dis-smoothing effect for these countries, thereby exacerbating rather than smoothing out the differences in the GDP growth rates among the two regions.

In a third contribution, we analyse how the composition of external capital positions impacts the capital channel based on a panel threshold VAR. To do this, we combine the national accounts data with information on intra-EA cross-border financial portfolios and direct investment positions from the Coordinated Portfolio Investment Survey and the Coordinated Direct Investment Survey. We find that the financial instruments significantly differ in their contribution to income smoothing. Long-term portfolio debt assets and liabilities as well as portfolio equity liabilities benefited risk sharing, the impact being significantly larger in northern countries - in line with the more sizeable cross-border portfolios in these countries. Regarding the role played by foreign direct investment (FDI), our results suggest that only northern countries were able to benefit from inward flows, which relates to the fact that the bulk of FDI in the euro area flew towards northern countries during the analysed period.

# 1 Introduction

This paper provides fresh evidence on the evolution of income smoothing and its drivers in the euro area using country-specific and panel threshold vector autoregression (TVAR) models. The COVID-19 crisis has renewed the need for better-integrated capital markets to promote cross-border risk sharing within the euro area. While the pandemic represents a shock common to all euro area countries, its economic consequences are highly asymmetric, depending on country-specific factors such as domestic mitigation strategies and the importance of economic sectors hit more or less severely (Guerrieri et al., 2022; Muggenthaler et al., 2021; Milesi-Ferretti, 2021). Besides public support measures via fiscal policy to address country-specific effects, private capital markets can be crucial to limit economic downturns and to foster the recovery. However, previous empirical evidence suggests that the contribution of cross-border capital markets to risk sharing remains largely unexploited in the European Monetary Union (EMU), particularly in comparison to a long-established monetary union like the United States (Asdrubali et al., 1996; Mélitz and Zumer, 1999; Furceri and Zdzienicka, 2015; Beck et al., 2016; Poncela et al., 2019; Milano, 2017; Cimadomo et al., 2018; Hoffmann et al., 2019).

While international risk sharing works through different channels, we focus on the role of capital market integration, and, hence, on the smoothing of domestic shocks through net factor income on external capital positions.<sup>1</sup> For example, if a country is hit by an idiosyncratic adverse shock, foreign liabilities imply that losses do not only accrue to the domestic economy but are also shared with foreign investors. At the same time, domestic income can, among others, be stabilised through interest, dividend, or profit receipts from foreign assets. Hence, internationally diversified asset and liability positions can mitigate the link between domestic business cycles and domestic income.

Efficient and integrated financial markets are a prerequisite for private risk sharing, and periods with more capital market integration are associated with more international risk sharing (Sørensen et al., 2007; Rangvid et al., 2016). Since the 1990s, financial globalization and the creation of the EMU have created cross-border investment opportunities and contributed to greater ownership diversification, allowing investors to spread their income risk across a larger number of countries (Kalemli-Ozcan et al., 2004; Kose et al., 2009; Balli et al., 2013). However, not all financial instruments are equally conducive to risk sharing. This is especially the case during financial stress periods, when financial markets are likely to suffer from abrupt tightening and instruments that are state-contingent or for which the conditions have been negotiated before the negative shock materialised are particularly desirable. Theory suggests that the capital channel has special features that could make it particularly resilient and, hence, well-suited for handling large-scale and long-lasting crises featuring uncertain recovery prospects. Thus, it is highly relevant to revisit the evolution and drivers of the capital channel of risk sharing in the euro area at this point in time.

Against this background, and following policy efforts to promote capital market integration via the European Capital Markets Union (CMU), this paper contributes three novelties to the literature. First, we provide time-varying estimates of the capital channel using quarterly national accounts data for a set of ten long-standing EMU countries over the 2000Q1 to 2021Q1 period. Given previous findings of heterogeneous developments between countries related to risk sharing in the literature (Nardo et al., 2017; Asdrubali et al., 2018; Poncela et al., 2019), we base our analysis on country-specific vector autoregression (VAR) models.<sup>2</sup>

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<sup>1</sup>The bulk of risk sharing through the capital channel takes place via factor income from abroad; that is, rents, interest, and profits (including retained earnings) derived from properties or investment held abroad. Albeit to a lesser extent, risk sharing through the capital channel also takes place through the compensation of workers who receive labour income from abroad. Workers who stay for a year or longer abroad are considered residents and the associated capital flows are categorised as remittances which are instead attributed to the international transfers channel.

<sup>2</sup>So far, the literature analysed the evolution of risk sharing with two different techniques. Some authors use

To better understand the drivers of income smoothing, in a second step we examine the contributions to risk sharing depending on geographical patterns of capital market integration. We group countries according to similarities in their external capital positions, resulting in a group of northern (or: “core”) and a group of southern (or: “periphery”) euro area countries. We then estimate the share of a country-specific shock to domestic production that is smoothed via intra-regional cross-border capital positions, i.e. both the debtor and creditor are in the same region, as well as through inter-regional holdings, where financial assets connect core and periphery debtors and creditors. This allows us to disentangle the contributions to income smoothing that result from capital market integration within and between the two regions.

Third, we analyse the role of the composition of cross-border financial holdings for income smoothing. It is important to provide fresh results for this question as previous studies suggest that income smoothing capacities differ between cross-border equity and debt holding (Hoffmann et al., 2019; Kose et al., 2009), but provide mixed results on which financial instruments are associated with more risk sharing. In addition, the question on whether these effects differ between balance sheet sides is not clearly answered, suggesting that conclusions are largely contingent on the specific samples studied. Furthermore, the bulk of the literature focuses on the period before and during the Global Financial Crisis (GFC). More specifically, Sørensen et al. (2007), analysing EU and OECD countries between 1993 and 2003, conclude that larger holdings of foreign assets are associated with better risk sharing. Demyanyk et al. (2008) find similar results when looking at both EMU and EU samples over the 1995-2006 period. According to Balli et al. (2013), who focus on industrial countries between 1999 and 2009, income smoothing in the euro area was achieved mainly through interest receipts originating from debt asset securities during the GFC, and, to a lesser extent, through dividend payments on equity liabilities. Balli et al. (2014) obtain similar results for a subset of EU countries.

To identify the importance of different financial instruments for past increases or decreases in risk sharing via the capital channel, we estimate a threshold panel VAR model. To the best of our knowledge, we are the first to investigate the role of capital market integration within a multi-equation dynamic framework. Previous analyses use interaction terms in static models employing univariate regressions (Sørensen et al., 2007; Artis and Hoffmann, 2008; Balli et al., 2013; Hoffmann et al., 2019). We take a granular look at the composition of countries’ external capital holdings: Besides differentiating between debt and equity components of portfolio positions and foreign direct investment (FDI), we also consider the effects of cross-border investments (i.e., assets) and cross-border funding (i.e., liabilities) on income smoothing separately.

Our empirical analysis yields the following main results. First, we confirm for the post-GFC period that income smoothing remained modest in the euro area, with capital market integration smoothing no more than 8-10% of the idiosyncratic shocks to GDP, on average. This is in stark contrast to the US, where inter-state factor income smooths out around 50% of the idiosyncratic shocks to GDP (Alcidi et al., 2017). Despite some variation in the contribution of the capital channel over the sample period, income smoothing remained resilient when including the first quarters of the COVID-19 pandemic. Yet, our country-specific results uncover significant cross-country heterogeneity. These suggest that the core countries were better able to smooth income via external capital positions than peripheral countries, where the capital channel collapsed during the second half of the sample period. This seems to be explained by the significantly smaller intra-euro area portfolio and foreign direct investment holdings in the periphery when compared to the core countries.

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static models via seemingly unrelated regressions (SUR) and include interaction terms with time-varying variables that capture the financial structure (Nardo et al., 2017; Hoffmann et al., 2019; Cimadomo et al., 2020) Others use VAR models and perform sequential estimates over limited sub-samples following a rolling window approach (Cimadomo et al., 2018). Unlike the former, the VAR approach accounts for dynamics and feedbacks among the different channels. In our analysis, we make use of country-specific VAR models to implicitly account for country heterogeneity, in line with Asdrubali et al. (2018).

Second, the collapse of income smoothing witnessed by peripheral countries after the GFC and the subsequent sovereign debt crisis relates to the decline in cross-border liabilities, particularly those for which the investor is located in a core country. In fact, our results suggest inter-regional capital flows have exerted a dis-smoothing effect for peripheral countries over the last years, implying they have travelled from worse off (periphery) to better off (core) countries, thereby exacerbating (rather than smoothing out) the differences in the growth rate among the two regions. In addition, inter- and intra-regional capital positions contributed differently to the evolution of income smoothing. In the aftermath of the GFC, improvements in risk sharing via the capital channel were mainly driven by better inter-regional risk sharing. In contrast, since around the sovereign debt crisis, income smoothing relied on intra-regional mechanisms, pointing to the need to improve financial integration between euro area regions. An exploratory analysis of the data reveals increases in cross-border holdings within the two country groups over the sample period, while integration across the two country groups via debt instruments rather declined over this time span.

Third, turning to the importance of the composition of external capital holdings, we show that the contribution to income smoothing varied not only by financial instrument, but also by its position in the balance sheet (i.e., portfolio assets and liabilities, inward and outward FDI positions). Zooming in on portfolio holdings, our dynamic model suggests that interest receipts and payments associated with long-term portfolio debt assets and liabilities benefited risk sharing in both regions. However, the identified impact is significantly larger for core countries, which coincides with their more sizeable cross-border portfolios when compared to periphery countries. Equity liabilities also greatly contributed to risk sharing, particularly in core countries, despite their lower magnitude when compared to debt. Looking at the role played by foreign direct investment (FDI), we find that inflows only had a large and significant effect on income smoothing in core countries. This result mirrors the magnitude of FDI (in % of GDP), which is much larger for northern compared to southern countries. The bulk of the FDI in the euro area flows towards northern countries.

The remainder of the paper is structured as follows. In Section 2, we provide background information on the theory of international risk sharing and its channels. Section 3 describes the data and stylized facts on the composition of cross-border financial holdings. Section 4 lays out our empirical approach, while Section 5 presents the results. Section 6 offers concluding remarks and policy implications.

## **2 Theoretical background: international risk sharing**

### **2.1 The concept of international risk sharing**

The concept of international risk sharing refers to the idea that countries can insure themselves against purely domestic shocks. Unexpected changes in national income can be smoothed through net income flows, both public and private, from unaffected countries. As a result, domestic consumption and income fluctuations are milder than output fluctuations, thus decoupling domestic welfare from variations in domestic output. At the margin, perfect risk sharing implies that domestic output fluctuations are not passed on to consumption, which instead depends solely on global output. In such a situation, agents are insured against every diversifiable risk and consumption growth rates are equalized across countries (Mace, 1991). This means that international risk sharing works as an insurance mechanism that helps attenuate the adverse consequences of country-specific downturns. Likewise, excessive positive deviations in economic growth can also be smoothed via income outflows toward foreign economies. This stabilizing effect softens the need for fiscal and monetary interventions, which is of particular importance in the EMU, where the single monetary policy is unable to react to asymmetric shocks. In this vein, as highlighted in the Five Presidents' Report (European Commission, 2015), international risk-sharing

within the EMU is needed to complement national tools employed by euro area countries to counter the impact of domestic shocks.

Private risk sharing operates through two main channels.<sup>3</sup> First, the credit channel refers to the ability of (cross-border) net borrowing providing access to credit in times of downturns to insulate consumption. This is usually referred to as “consumption smoothing”.<sup>4</sup> Second, the capital channel contemplates that geographically diversified investment portfolios generate factor income flows that are unrelated to the domestic economy. In this sense, the possibility to receive labour income, interest, dividend or profit payments from foreign investments can help sustain income during country-specific economic downturns, thus providing “income smoothing”. During booms, the opposite mechanisms, e.g. income outflows in the form of interest payments, also help to smooth income and, ultimately, consumption.

## 2.2 Empirical foundations of estimating international risk sharing

In order to analyse the contribution of the capital channel and, subsequently, of cross-border financial instruments to international risk sharing, we follow the framework developed in the seminal paper by Asdrubali et al. (1996). This empirical set-up is based on the decomposition of the cross-sectional variance of country-specific (idiosyncratic) output growth. To derive this decomposition, we first rewrite country output growth as follows:

$$\widehat{\Delta gdp}_t^i = [\widehat{\Delta gdp}_t^i - \widehat{\Delta gni}_t^i] + [\widehat{\Delta gni}_t^i - \widehat{\Delta nni}_t^i] + [\widehat{\Delta nni}_t^i - \widehat{\Delta nndi}_t^i] + [\widehat{\Delta nndi}_t^i - \widehat{\Delta c}_t^i] + \widehat{\Delta c}_t^i \quad (1)$$

where the variables refer to the logarithms of real per capita gross domestic product (*GDP*) of country *i* at time *t*, gross national income (*GNI*), net national income (*NNI*), net national disposable income (*NNDI*), and consumption (*C*). Given that common shocks cannot be insured, the variables are expressed in terms of the country-specific component of the variables, i.e. their deviation with respect to the weighted aggregate at the EA10 level. As highlighted by Asdrubali et al. (2018), the idea behind this econometric approach is that if two successive income measures (i.e. those between brackets in equation (1) do not co-move perfectly, shocks are smoothed through the risk-sharing channel represented by their difference. For example, a positive correlation coefficient between  $\widehat{gdp}_t^i$  and  $\widehat{gni}_t^i$  below one implies that cross-border income flows provided a certain degree of income smoothing. Instead, a negative correlation would point towards a dis-smoothing effect, meaning that this channel increases fluctuations of income compared to GDP fluctuations.

In a second step, we rearrange equation (1) after taking the covariance with  $\widehat{\Delta gdp}_t^i$  and divide it by the variance of  $\widehat{\Delta gdp}_t^i$  to arrive at equation (2), which represents the decomposition of the cross-sectional variance of country-specific output growth in terms of the coefficients that can be interpreted as the contributions of the different risk-sharing channels.

$$\beta_I^i + \beta_D^i + \beta_F^i + \beta_C^i = 1 - \beta_U^i \quad (2)$$

<sup>3</sup>Public and private mechanisms for risk sharing cannot be mapped one-to-one to the different channels described above. Regarding public risk sharing, it can be achieved through direct fiscal transfers at a supra-national level. However, the institutional architecture of the EMU and, more specifically, the lack of central fiscal power embedded in its design, limits the potential of this stabilisation mechanism. Still, since the 2010s, public risk sharing in the EMU has benefitted from several financial assistance facilities, i.e. the European Financial Stability Facility (EFSF), the European Financial Stability Mechanism (EFSM), and the European Stability Mechanism (ESM) (Milano and Reichlin, 2017; Cimadomo et al., 2018, 2020). Likewise, the “Next Generation EU” and its Recovery Resilience Fund activated during the COVID-19 crisis seem to have positively contributed to risk sharing (Cimadomo et al., 2022). Public risk sharing could also complement private risk sharing, given that a central fiscal capacity could, for example, reduce financial frictions associated with cross-border private financial markets, making private external borrowing more convenient (Giovannini et al., 2022).

<sup>4</sup>It includes private but also public elements if risk sharing is facilitated through the use of public resources.

$$\beta_I = \frac{\text{cov}(\widehat{\Delta gdp}_t^i - \widehat{\Delta gni}_t^i, \widehat{\Delta gdp}_t^i)}{\text{var}(\widehat{\Delta gdp}_t^i)} \quad (3)$$

$$\beta_D = \frac{\text{cov}(\widehat{\Delta gni}_t^i - \widehat{\Delta nni}_t^i, \widehat{\Delta gdp}_t^i)}{\text{var}(\widehat{\Delta gdp}_t^i)} \quad (4)$$

$$\beta_F = \frac{\text{cov}(\widehat{\Delta nni}_t^i - \widehat{\Delta nndi}_t^i, \widehat{\Delta gdp}_t^i)}{\text{var}(\widehat{\Delta gdp}_t^i)} \quad (5)$$

$$\beta_C = \frac{\text{cov}(\widehat{\Delta nndi}_t^i - \widehat{\Delta c}_t^i, \widehat{\Delta gdp}_t^i)}{\text{var}(\widehat{\Delta gdp}_t^i)} \quad (6)$$

$$\beta_U = \frac{\text{cov}(\widehat{\Delta c}_t^i, \widehat{\Delta gdp}_t^i)}{\text{var}(\widehat{\Delta gdp}_t^i)} \quad (7)$$

Specifically, these channels represent the capital channel for income smoothing ( $\beta_I^i$ ), the depreciation channel ( $\beta_D^i$ ), the international transfers channel ( $\beta_F^i$ ) and the credit or savings channel for consumption smoothing ( $\beta_C^i$ ).  $\beta_U^i$  refers to the share of the shock that remains unsmoothed, which would be zero for the case that there is perfect international risk sharing, meaning that the GDP and consumption of a country are uncorrelated. In such a case of full risk sharing, real consumption growth would not respond to idiosyncratic shocks to domestic output but would depend only on global output. For each country, total risk sharing through the four channels is represented by  $1 - \beta_U^i$ .

In our analysis, we focus on the smoothing through the capital channel ( $\beta_I^i$ ), which indicates the extent to which cross-border net factor income flows, i.e. investment income receipts from cross-border financial assets and payments on cross-border financial liabilities, help to shield income from country-specific output fluctuations.

## 2.3 Focusing on the capital channel

Analysing the evolution and determinants of the capital channel in the euro area is highly relevant given that it has certain elements that could make it particularly resilient and, hence, well-suited for handling large-scale and long-lasting crises featuring uncertain recovery prospects.<sup>5</sup> In particular, there are certain features that might make the capital channel more resilient than the credit channel, namely its *ex-ante nature*, *inter-spatiality* and *state-contingency*. However, not all financial instruments present these three features to the same degree and, thus, the composition of countries' external portfolios is crucial for building resilient and effective private risk sharing mechanisms (Hoffmann et al., 2019; Kose et al., 2009).

First, the *ex-ante* nature relates to the moment when the conditions of the related financial flows are negotiated. For equity instruments, these are usually agreed upon before the shock materialises, thus endowing the capital channel with an *ex-ante* smoothing capacity (Becker and Hoffmann, 2006) that tends to be less vulnerable to the recovery expectations in terms of magnitude and persistence of the downturn.<sup>6</sup> Long-term financial debt negotiated before the shock, which does not need to be rolled over during the crisis, would also have this feature. In contrast, the credit or savings channel is considered to be an *ex-post* channel, as borrowing is triggered by the credit demand of affected countries.

<sup>5</sup>Among others, Hoffmann et al. (2019) document that, while the consumption smoothing provided by the credit channel was significantly impaired during the GFC, the capital channel for income smoothing remained rather resilient and only deteriorated during the sovereign debt crisis and its aftermath.

<sup>6</sup>In fact, the low degree of international risk sharing tends to be associated with a lack of *ex-ante* mechanisms (Asdrubali et al., 1996; Sørensen and Yosha, 1998).



Second, *inter-spatiality* relates to the cross-sectional dimension of financial flows. Equity instruments provide an inter-spatial shock absorption capacity, as dividends flow from less affected to more affected economies, without entailing future re-payment commitments. Instead, debt instruments offer an inter-temporal smoothing effect, which could be hampered, at least partially, in the long run, when the repayment duties have to be faced. The intertemporal nature also applies to the credit channel. Giannone and Reichlin (2006) show that consumption can be hedged via borrowing and lending only for a restricted period of time. According to Alcidi et al. (2017), even though shocks tended to be more persistent in the euro area when compared to the US, international risk sharing in the euro area strongly relied on the credit channel, which is less stable in response to persistent shocks. Therefore, developing the capital channel is of particular importance. In contrast to borrowing and lending, the inter-spatial effect provided by equity avoids any future reversals of the short-term positive smoothing effect. Consequently, these instruments tend to generate more resilient and longer-lasting income smoothing effects (Beck et al., 2016).

Third, payments that are contingent on the financial situation of the borrower and could be interrupted during downturns are particularly desirable from a risk sharing perspective. Equity securities are beneficial in this respect, as they entail *state-contingent* payoffs. While equity holders receive a compensation depending on the financial situation of the borrower, they also share the downside risks (e.g., dividend outflows might be suspended during recessions), without the need to enter insolvency proceedings. With debt instruments, investors only incur losses if there is a default.

Further, equity contracts are concluded without an end date and do not entail rollover risks.<sup>7</sup> Unlike equity, debt finance in general - in particular, short-term debt - tends to be comparatively more pro-cyclical, as the associated payments tend to be independent of economic fluctuations. Normally, principal repayments and interest duties need to be paid unconditionally, which may become harder during a crisis. Therefore, their main contingency (the default risk) tends to increase during bad times, leading to abrupt tightening of borrowing conditions for newly issued debt, which increases the likelihood and severity of financial crises (Montiel and Reinhart, 1999). This could make the potentially positive effects of financial market integration disappear during downturns if cross-border portfolios are mainly composed of pro-cyclical debt finance (Albertazzi and Bottero, 2014).

For these reasons, existing studies highlight that international cross-border holdings of equity may be better able to provide resilient capital flows and guarantee a higher degree of long-term risk sharing than debt securities (Artis and Hoffmann, 2011). Thus, the weak income smoothing capacity in the euro area could be related to the magnitude and composition of its cross-border financial holdings, specifically the lack of cross-border equity. This is why we analyse the importance of the geographical patterns and different financial instruments for income smoothing in the following sections.

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<sup>7</sup>Rollover risk is a risk associated with the refinancing of debt. When a loan or other debt obligation needs to be converted and if interest rates have risen in the meantime or the borrower has become riskier, the debt needs to be refinanced at a higher rate. There is also the risk that the debt may not be refinanced at all, potentially leaving the borrower with a financing gap. Rollover risk is commonly faced by countries and companies when a loan or other debt obligation (like a bond) is about to mature and needs to be converted, or rolled over, into new debt.

## 3 Data

### 3.1 Macroeconomic variables

Our analysis of international risk sharing and, more specifically, income smoothing within the euro area uses quarterly National Accounts data from Eurostat for the period 2000Q1-2021Q1. Data extracted from National Accounts includes gross domestic product (*GDP*), gross national income (*GNI*), net national income (*NNI*), net national disposable income (*NNDI*), and total consumption (*C*). We limit our sample to ten long-standing euro area-member countries (EA10),<sup>8</sup> namely Austria, Belgium, Germany, Greece, Finland, France, Italy, the Netherlands, Spain, and Portugal. By limiting our sample to countries that were members of the euro area during the entire time horizon considered in our estimation, we abstract from the potential effects of currency risk and the implications of new countries joining the monetary union. Hence, while our analyses focuses on risk sharing among the ten euro area countries, technically income smoothing can also be provided by cross-border positions vis-à-vis the rest of the world, including through currency risks and opportunities. In this vein, Giovannini et al. (2020) highlight the sensitivity of risk sharing estimates to the country sample, among other factors. In particular, risk sharing is not an “absolute” estimate but rather a “relative” concept, always interpreted against a certain subset of reference countries. This implies the results in this literature need to be carefully interpreted as measuring risk sharing among the countries included in the specific sample.

The variables enter the model as quarterly real per capita country-specific deviations, expressed in log-differences. To construct these variables, we deflate nominal values with their national harmonised consumer price index (HCPI)<sup>9</sup> and divide them by their respective population numbers, before transforming them into log-differences. Country-specific idiosyncratic deviations are computed using the difference between each variable and its cross-country weighted average for the ten countries included in our sample. We follow the procedure described in Beyer et al. (2001), whereby the aggregate values are constructed performing the aggregation directly in growth rates and using time-varying weights representing the share of each country in aggregate real GDP instead of per capita terms, whereby small countries with very high income per capita would be given too high weights.

National Accounts data are disaggregated into specific sub-components identifying the different channels of international risk sharing:

- *Capital channel*:  $GDP - GNI$  (net factor income from abroad).
- *Depreciation channel*:  $GNI - NNI$ , mainly imputed values.
- *International transfers channel*:  $NNI - NNDI$  (using net international transfers). This channel includes supra-national fiscal efforts such as EU structural funds and private remittances.
- *Credit or savings channel*:  $NNDI - C$  (using net private and public savings). This includes national government lending/borrowing, including borrowing from euro area financial assistance facilities like the EFSF, the EFSM, and the ESM.

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<sup>8</sup>Luxembourg and Ireland are excluded as financial centres due to their particular structures of financial holdings. In addition, Ireland, which had large revisions in its GDP, has also been excluded in related analyses (Giovannini et al., 2020).

<sup>9</sup>The choice of the deflation method is based on Sørensen and Yosha (2007), who illustrate that CPI deflated GDP (i.e., the “consumption value” of output) is the appropriate method for deflating nominal GDP for the purpose of studying risk sharing, rather than using a GDP deflator (i.e., the “volume” of output).

## 3.2 Capital market variables

In order to assess the importance of capital market integration, we analyse the role of the composition of external financial holdings, relying on cross-border portfolio holdings data from the Coordinated Portfolio Investment Survey (CPIS) and cross-border direct investment positions from the Coordinated Direct Investment Survey (CDIS), both published by the International Monetary Fund. CDIS data comprises cross-border investment decisions that are not covered in CPIS and through which a resident in a specific economy seeks to gain control or exert a significant degree of influence on the management of the acquired foreign enterprise. The threshold for the ownership of equity or debt to be considered FDI is defined as the investor being entitled to 10% or more of the voting power.

In line with Balli et al. (2013), we look at portfolio data for assets and liabilities separately to distinguish which of the two sides (receipts arising from foreign holdings or payments due to cross-border liabilities) was more important for risk sharing. Similarly, we split our analysis for FDI into inward and outward intra-EA10 FDI positions. Direct investment data provided by the IMF refers to equity and debt stocks in countries' foreign portfolios, with data on "inward" direct investment positions referring to direct investment into the reporting economy, and "outward" positions relating to direct investment abroad by the reporting country. The CPIS data is available on an annual basis from 2001 until 2012 and bi-annually from mid-2013 to 2020 for many (but not all) countries, while CDIS data is available from 2009 until 2020 on a yearly basis.<sup>10</sup>

Given the differences in the frequency and time availability between the datasets, we estimate different models to look at the effects of portfolio and direct investment separately. We use the ratio of intra-EA10 cross-border holdings over GDP as a measure of capital market integration within the euro area by aggregating the bilateral holdings for the ten countries included in the sample. As risk sharing is analysed relative to the other countries in the sample, it is only natural to look at financial integration in the form of cross-border positions vis-à-vis the same country sample.<sup>11</sup> External portfolio positions are broken down into debt (short-term<sup>12</sup> and long-term<sup>13</sup>) and portfolio equity<sup>14</sup> holdings. Similarly, we consider equity and debt FDI.

## 3.3 Stylised facts on the composition of cross-border financial holdings

Overall, intra-EA10 cross-border portfolio holdings increased strongly at the beginning of our sample period. Subsequently, their volume has been more stable (Figure 1, upper left panel). When interpreting the data in the charts, it should be borne in mind that CPIS data might provide a biased view on both total and bilateral portfolio linkages across the countries in our sample due to the financial activity taking place in Luxembourg, Ireland and the Netherlands, which Beck et al. (2023) refer to as "onshore offshore financial centers" (OOFCS)

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<sup>10</sup>We use annual figures for 2013 for all countries in the sample and bi-annual data as of 2014.

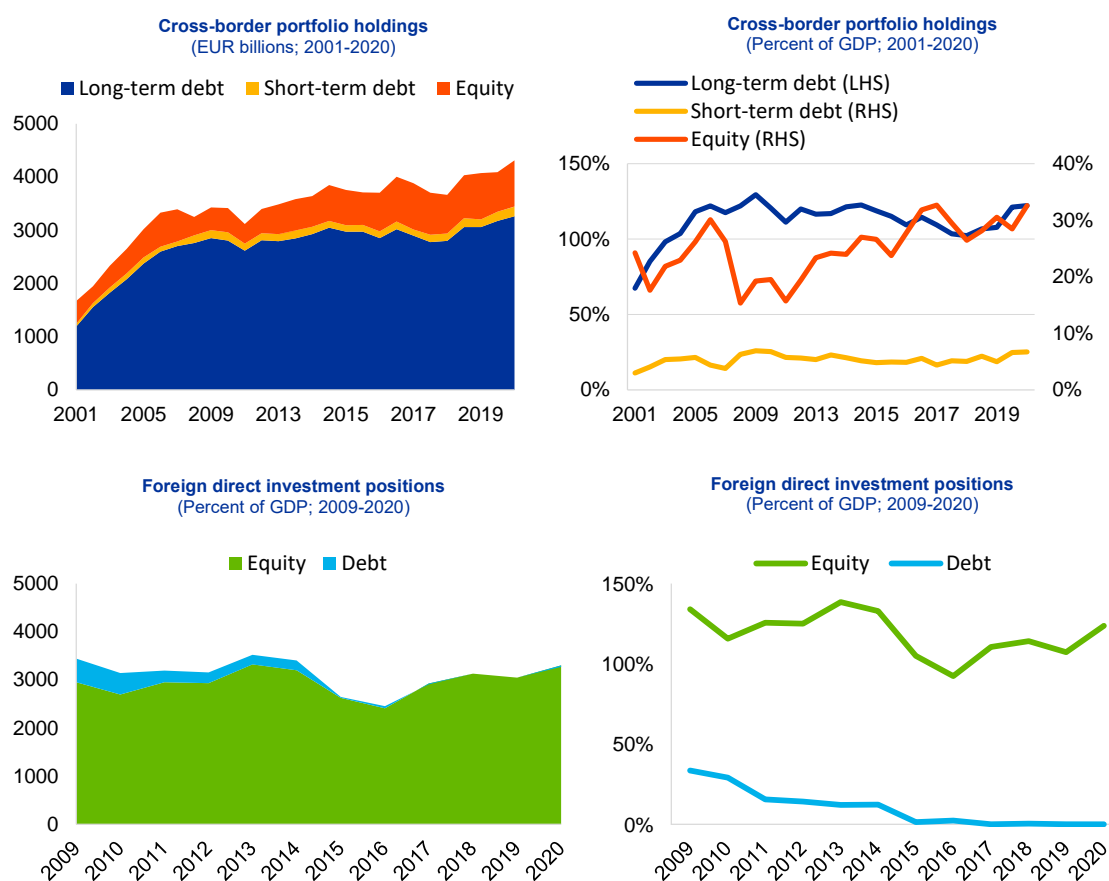
<sup>11</sup>Cimadomo et al. (2020) also calculate their financial integration measures among the country pairs within their country sample.

<sup>12</sup>Short-term debt securities cover treasury bills, negotiable certificates of deposits, commercial paper, and bankers' acceptances that generally give the holder the unconditional right to a stated fixed sum of money on a specific date. These instruments are usually traded on organized markets at a discount and have an original maturity of one year or less.

<sup>13</sup>Long-term debt securities cover instruments such as commercial and government bonds, debentures and notes that usually give the holder the unconditional right to a fixed money income or contractually determined variable money income and have an original maturity of more than one year.

<sup>14</sup>Equity securities comprise all instruments and records that acknowledge claims on the residual value of corporations or quasi corporations, after the claims of all creditors have been met. Shares, stocks, participations, or similar documents usually denote ownership of equity.

Figure 1: Evolution of cross-border portfolio and direct investment positions within EA10



Sources: IMF, Coordinated Portfolio Investment Survey, Coordinated Direct Investment Survey.

Note: The upper figures plot total intra-EA10 cross-border positions held by EA10 countries, both in absolute magnitudes in EUR billions (left panel) and as a percentage of total nominal GDP (right panel). Therefore, it could be regarded as either total intra-EA10 assets or liabilities. The CPIS data is available annually from end-2001 to end-2012, and bi-annually starting from the end of June 2013. The lower figures plot total intra-EA direct investment positions reported by EA10 countries, both in absolute magnitudes in EUR billions (left panel) and as a percentage of total nominal GDP (right panel). Therefore, they could be regarded as either total intra-EA10 direct investment inward or outward positions. The CDIS data is available annually from end-2009 to end-2020.

within the euro area as most European investment funds reside there. Specifically, Beck et al. (2023) document the statistical implications of the dual roles of OOFs, as hubs of financial intermediation and as places of securities issuance.<sup>15</sup>

Long-term debt instruments dominate intra-EA10 cross-border portfolios with a share of almost 76%, while equity only represents 20%, and short-term debt is negligible at around 4%. Relative to GDP, long-term debt amounted to roughly 100% during our sample period, while equity was significantly lower, with 25% on average (Figure 1, upper right panel). Portfolio equity and long-term debt displayed differing dynamics during our sample period. Equity holdings halved during the early stage of the GFC and subsequently followed an upward trend. Long-term debt still expanded at the beginning of the GFC but dropped significantly around the time of the sovereign debt crisis and continued to decrease (relative to GDP) before slowly moving upwards again as of 2018 (Figure 1, upper right panel).

Looking at foreign direct investment positions, we observe the bulk of it takes the form of equity securities (Figure 1, lower left panel). In particular, equity FDI followed an upward trend during the 2010-2013 period, before sharply declining over 2014-2016. Since then, it resumed an increasing trend and rose to around 123% relative to GDP in 2020 (Figure 1, lower right panel).

Moving from the euro area aggregates to the country-level, we find heterogeneous patterns both in terms of overall size and evolution of external capital positions. Total cross-border portfolio (long-term and short-term debt plus equity) and direct investment positions (both in % of GDP) are lower for a group of countries including Italy (IT), Spain (ES), Greece (GR) and Portugal (PT) compared to a group of countries including Austria (AT), Belgium (BE), Finland (FI), France (FR), Germany (DE), and the Netherlands (NL) over our sample period. Therefore, we divide our country sample into a northern region including AT, BE, DE, FI, FR, NL (or: “core”), while the southern region includes ES, GR, IT, PT (or: “periphery”).

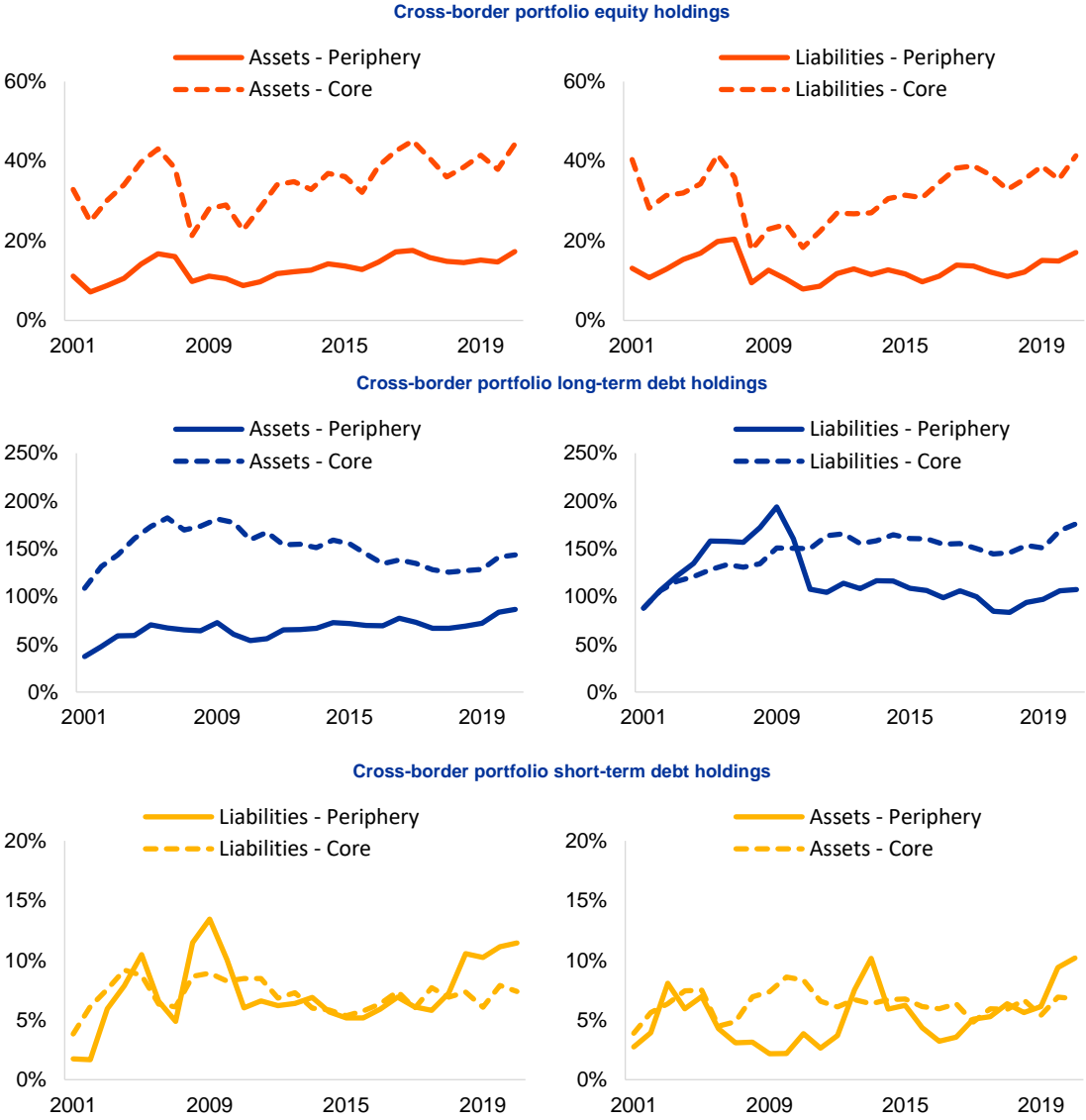
Splitting the external capital positions not only by instrument and balance sheet side, but also by country group, reveals that the evolution was quite heterogeneous across the two regions. Zooming into portfolio holdings (Figure 2, Table 1), both portfolio equity assets and liabilities (in % of GDP) were, on average, a bit less than three times greater in northern countries. While cross-border equity assets increased since the GFC in both regions, surpassing their pre-crisis levels by mid-2017, the gap between the two groups widened. Cross-border equity liabilities show a similar pattern. Southern and northern countries still heavily rely on long-term debt, particularly on the funding side. The importance of debt is particularly striking for the southern countries in the years before the GFC until around 2009. Short-term debt positions were small and volatile, particularly in the southern countries.<sup>16</sup>

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<sup>15</sup>As an example of this bias, “indirect” or “intermediated” bilateral linkages, such as German shares held by Luxembourg-based investment funds owned by Spanish residents, would not be included in our analysis as Luxembourg is excluded from our data sample. Similarly, German shares held by investment funds based in the Netherlands are interpreted as bilateral flows between this country and Germany regardless of the residence of the ultimate owner of the investment fund shares. Our analysis does not take into account indirect bilateral linkages due to lack of comparable data across countries noting the previous literature that has pointed to difficulties in obtaining the data as well as to the wide set of assumptions that would need to be taken in order to provide such detailed estimates (Felettigh and Monti, 2008; Della Corte et al., 2018).

<sup>16</sup>Short-term debt generated sudden and massive reversals in capital flows (Montiel and Reinhart, 1999). However, causality runs in both directions and the lack of equity holdings and excessive fluctuations in short-term debt holdings might not only cause but also reflect financial instability. In this sense, Diamond and Rajan (2001) remark that unstable funding structures might be associated with low creditworthiness and debt repayment capacity of the borrower.

Figure 2: Intra-EA10 cross-border portfolio holdings by country group and instrument, in percent of GDP



Sources: IMF, Coordinated Portfolio Investment Survey, 2001 - 2020.  
 Note: “Periphery” refers to euro area countries with lower total cross-border portfolio and direct investment positions (ES, GR, IT, PT), while “core” encompasses the remaining countries (AT, BE, DE, FI, FR, NL). The chart displays simple averages for the ratios across the countries composing every group. The CPIS data is available annually from end-2001 to end-2012, and bi-annually starting at end-June 2013.

Table 1: Intra-EA10 cross-border portfolio holdings by country group and instrument (in % of GDP)

	Periphery			Core		
	Min	Mean(Median)	Max	Min	Mean(Median)	Max
<u>Assets</u>						
Equity	0.064	0.123 (0.135)	0.165	0.196	0.337 (0.345)	0.422
Short-term debt	0.020	0.051 (0.049)	0.102	0.037	0.061 (0.063)	0.084
Long-term debt	0.349	0.640 (0.668)	0.887	1.038	1.445 (1.465)	1.769
<u>Liabilities</u>						
Equity	0.081	0.124 (0.122)	0.195	0.163	0.306 (0.309)	0.393
Short-term debt	0.015	0.071 (0.063)	0.126	0.037	0.068 (0.068)	0.088
Long-term debt	0.811	1.143 (1.081)	1.833	0.838	1.410 (1.479)	1.772

*Sources:* IMF, Coordinated Portfolio Investment Survey.

*Note:* “Periphery” refers to euro area countries with lower total cross-border portfolio and direct investment positions (ES, GR, IT, PT), while “core” encompasses the remaining countries (AT, BE, DE, FI, FR, NL). Table includes simple averages for each group for the period 2001-2020.

Focusing on FDI (Figure 3, Table 2), cross-border equity holdings are the bulk of intra-EA positions (see also Figure 1). Both inward and outward equity FDI is around twice as high in core countries compared to periphery countries, revealing these economies do not just receive a larger amount of investment from abroad, but also tend to hold greater positions when investing in other EA10 economies. The evolution of inward and outward equity FDI was similar across regions (upper panels in Figure 3). Interestingly, while outward equity holdings improved for both regions, in particular in 2020, inward FDI increased mostly in core countries. FDI taking the form of debt was less than one fifth of equity FDI. It steadily declined since 2009 and represented a very small part of intra-EA10 direct investment by 2020.

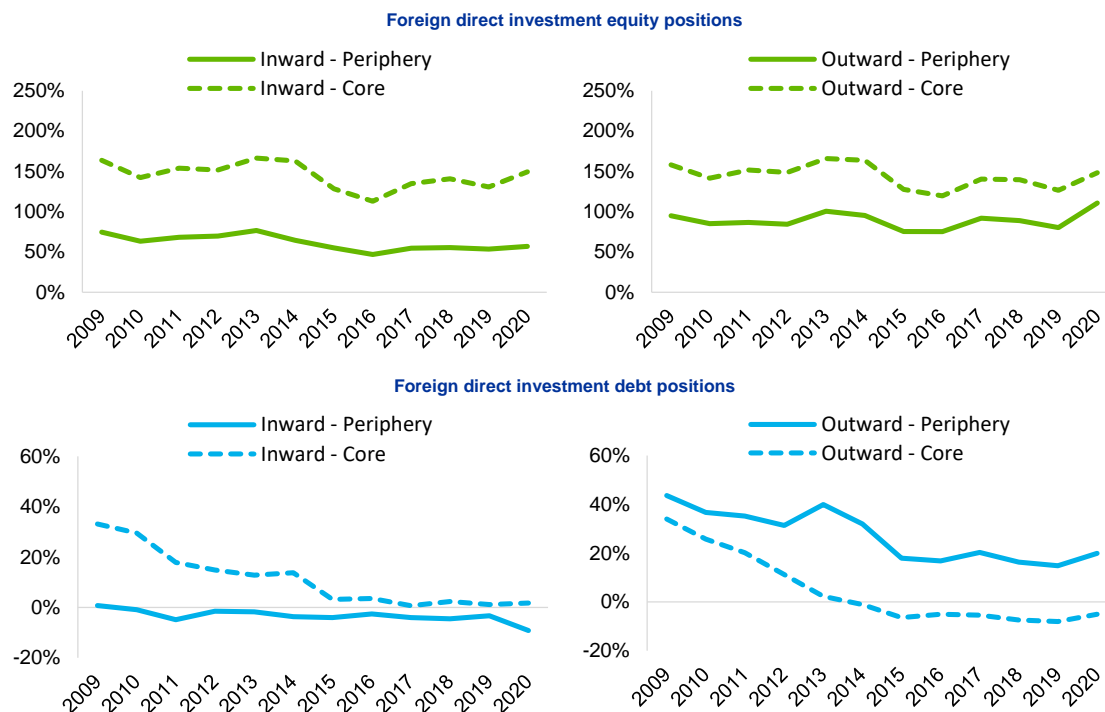
## 4 Empirical methodology

### 4.1 Country-specific VAR - Disentangling intra- and inter-regional risk sharing

In order to address endogeneity between the different GDP components and to factor in the complex dynamics and feedback arising between the different risk sharing channels and GDP, we rely on a multi-equation approach to estimate all coefficients jointly in a VAR framework (Asdrubali and Kim, 2004; Asdrubali et al., 2018).<sup>17</sup> Unlike

<sup>17</sup>The empirical analysis is performed using the Bayesian estimation, analysis, and regression (BEAR 4.2) toolbox developed by Dieppe et al. (2016) at the European Central Bank. We accept the End User Licence

Figure 3: Intra-EA10 foreign direct investment holdings by country group and instrument, in percent of GDP



Sources: IMF, Coordinated Direct Investment Survey, 2001 - 2020.

Note: "Periphery" refers to euro area countries with lower total cross-border portfolio and direct investment positions (ES, GR, IT, PT), while "core" encompasses the remaining countries (AT, BE, DE, FI, FR, NL). The chart displays simple averages for the ratios across the countries composing every group. The CDIS data is available annually from end-2009 to end-2020. Direct investment positions are negative when a direct investor's claims on its direct investment enterprise are below the direct investment enterprise's claims on its direct investor. Direct investment equity positions can also be negative due to negative retained earnings, which might result from the accumulation of negative reinvested earnings.

static approaches based on SUR models, VAR models capture dynamic dependencies between variables and trace how every risk-sharing channel reacts over time in the presence of an exogenous structural shock to GDP. More specifically, in a VAR framework, all variables in the system, including output, are endogenously determined by both contemporaneous and lagged values of all the variables comprising the model. Previous studies using dynamic frameworks to quantify international risk sharing employ pooled models, where the parameters are assumed to be equal across countries and derived using group mean estimators (Asdrubali and Kim, 2004; Becker and Hoffmann, 2006). The financial fragmentation that prevailed during the GFC casted doubts on the plausibility of the homogeneous coefficients' assumption, as EMU countries benefited to differing degrees from income smoothing. Consequently, more recent studies suggest estimating separate models for each country (Kalemli-Ozcan et al., 2014; Nardo et al., 2017; Asdrubali et al., 2018; Poncela et al., 2019). In the following, we start by estimating

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Table 2: Intra-EA10 cross-border direct investment holdings by country group and instrument (in % of GDP)

	Periphery			Core		
	Min	Mean(Median)	Max	Min	Mean(Median)	Max
<u>Inward</u>						
Equity	0.469	0.617 (0.603)	0.767	1.129	1.449 (1.456)	1.665
Debt	-0.92	-0.033 (-0.035)	0.008	0.007	0.112 (0.082)	0.033
<u>Outward</u>						
Equity	0.753	0.891 (0.878)	1.108	1.196	1.444 (1.450)	1.659
Debt	0.148	0.271 (0.258)	0.436	-0.08	0.046 (-0.031)	0.340

Sources: IMF data (Coordinated Direct Investment Survey).

Note: “Periphery” refers to euro area countries with lower total cross-border portfolio and direct investment positions (ES, GR, IT, PT), while “core” encompasses the remaining countries (AT, BE, DE, FI, FR, NL). Table includes simple averages for each group for the period 2009-2020. Direct investment positions are negative when a direct investor’s claims on its direct investment enterprise are below the direct investment enterprise’s claims on its direct investor. Direct investment equity positions can also be negative due to negative retained earnings, which might result from the accumulation of negative reinvested earnings.

country-specific models and then extend this framework to understand how income smoothing evolved between different regions, namely core and periphery countries, in the euro area.

VAR analyses obtain country-specific estimates of risk sharing for each channel by considering the conditional moments of the vector  $Y_t^i = [\widehat{\Delta gdp}_t^i, \widehat{\Delta gdp}_t^i - \widehat{\Delta gni}_t^i, \widehat{\Delta gni}_t^i - \widehat{\Delta nni}_t^i, \widehat{\Delta nni}_t^i - \widehat{\Delta nndi}_t^i, \widehat{\Delta nndi}_t^i - \widehat{\Delta c}_t^i]'$ . In our analysis, we expand this empirical framework to not only look at country-specific estimates, but also to explicitly model two paths through which the capital channel might provide its income smoothing effect, namely intra- and inter-regionally. The overall capital channel in the vector above is represented by the second term,  $\widehat{\Delta gdp}_t^i - \widehat{\Delta gni}_t^i$ , where magnitudes are expressed as country-specific deviations with respect to the weighted aggregate values for the entire sample. To understand regional components, we divide the deviations into two sub-components to differentiate between (i) the idiosyncratic deviation of a given country with respect to its own region (i.e., intra-regional component), and (ii) the deviation with respect to those countries in the other region (i.e., inter-regional component):

$$\widehat{\Delta gdp}_t^i \approx \Delta gdp^i - \overline{\Delta gdp}^{EA10} \approx [\Delta gdp^i - \overline{\Delta gdp}^{core}]w_1 + [\Delta gdp^i - \overline{\Delta gdp}^{perip}]w_2 \quad (8)$$

$$\widehat{\Delta gni}_t^i \approx \Delta gni^i - \overline{\Delta gni}^{EA10} \approx [\Delta gni^i - \overline{\Delta gni}^{core}]w_1 + [\Delta gni^i - \overline{\Delta gni}^{perip}]w_2 \quad (9)$$

$$Capitalchannel(intra) = [\Delta gdp^i - \overline{\Delta gdp}^{intra}]w_{intra} - [\Delta gni^i - \overline{\Delta gni}^{intra}]w_{intra} \quad (10)$$

$$Capitalchannel(inter) = [\Delta gdp^i - \overline{\Delta gdp}^{inter}]w_{inter} - [\Delta gni^i - \overline{\Delta gni}^{inter}]w_{inter} \quad (11)$$

where  $w_1$  and  $w_2$  are the weights of core and periphery in terms of GDP, respectively.<sup>18</sup>

<sup>18</sup>An illustration of the two sub-components (intra- and inter-regional deviation) for the case of the capital channel is provided in Figure A.3 in the Appendix for the case of Italy. It appears that the deviation of Italian net capital flows growth from the northern EA-countries average is larger than its deviation with respect to the

The dynamic interactions among the set of endogenous variables in  $Y_t^i$  is governed by the following system of autoregressive simultaneous equations in reduced form:

$$Y_t^i = \sum_{j=1}^p A_j^i Y_{t-j}^i + B^i + \epsilon_t^i \quad (12)$$

The superscript  $i$  refers to the countries included in our sample and corresponds to the ten long-lasting EMU-members, while  $t$  refers to nine-year periods covering the time horizon from 2000Q1-2008Q4 to 2012Q2-2021Q1 following a rolling-window approach.<sup>19</sup>  $B$  denotes a vector of country-specific intercepts and  $A_j$  are matrices of coefficients on the  $j$  lags of the variables. The error term,  $\epsilon_t^i$ , is an uncorrelated multivariate white noise with a diagonal variance-covariance matrix,  $\Sigma$ . We set the autoregressive order,  $p$ , equal to 4, as determined by the likelihood ratio test.

We want to trace the dynamic response of the different risk sharing channels - especially that of the capital channel - after an orthogonal shock to GDP. For this purpose, and in order to recover the parameters in the structural form equation from those estimated in the reduced form, we use a recursive identification scheme. Following Asdrubali and Kim (2004), Becker and Hoffmann (2006), and Asdrubali et al. (2018), we impose a zero recursive structure on the contemporaneous structural parameters. The reduced-form equation is then expressed in structural form as

$$G_0^i Y_t^i = \sum_{j=1}^p G_j^i Y_{t-j}^i + D^i + u_t^i, \text{ where } A_j^i = G_0^{i-1} G_j^i, B^i = G_0^{i-1} D^i \text{ and } \epsilon_t^i = G_0^{i-1} u_t^i \quad (13)$$

This identification scheme leverages the statistical properties of National Accounts data, with more exogenous variables ordered first in  $Y_t^i$ . This way it exploits the natural short run recursiveness in the data. It implies, for example, that  $\widehat{\Delta gni_t^i}$  follows  $\widehat{\Delta gdp_t^i}$  inasmuch as output must be first generated in order to generate factor income in the form of dividends, rents, and interest. Likewise,  $\widehat{\Delta nni_t^i}$  follows  $\widehat{\Delta gni_t^i}$  inasmuch as taxes presuppose a taxable income has been previously generated. In other words, the variables are contemporaneously affected only by those ordered before (above) them.<sup>20</sup> Note that all variables are country-specific deviations from the log-difference of the EA10 aggregates, which can be separated into inter- and intra-regional deviations.

## 4.2 Interacted panel VAR - The role of cross-border capital holdings

In a second specification, we analyse the contribution of the composition of external financial holdings for international risk sharing via the capital channel. To gauge the effects of different instruments on risk sharing in the EMU, for portfolio holdings, we distinguish between equity, short-term and long-term debt on both the asset and liability side. In the same vein, for FDI, we distinguish between equity and debt for both outward and inward positions.

We extend the baseline methodology to account for non-linearities and estimate a panel threshold vector autoregression (TVAR) model for each of the ten different threshold variables, namely, the country-specific holdings of short-term debt, long-term debt, the portfolio equity assets and liabilities (as a share of GDP), as well as the country-specific direct investment holdings of both outward and inward debt and equity. This nonlinear analysis consists of conditioning the coefficient measuring risk sharing via the capital channel on a threshold variable so

group of southern EA-countries.

<sup>19</sup>We choose nine-year periods in order to provide results covering the aftermath of the global financial crisis and the sovereign debt crisis while, at the same time, maintaining the largest amount of information (i.e., using the longest time window possible) needed to identify structural shocks.

<sup>20</sup>This recursive structure is suitable to identify an exogenous shock to gross domestic product. However, this approach/ordering would face limitations if the aim were to identify a different type of shock (e.g., a tax shock that affects taxable income).

as to provide a view on the within-country variation in income smoothing that is induced by the variation of cross-border portfolios. For each measure, we define two regimes, namely “high” and “low” holdings, and assume that the risk-sharing parameters of our model can differ between these different states. The state-contingent estimates seek to capture the importance of de facto financial integration in each capital market segment. More specifically, we extend the structural equation to:

$$Y_t^i = \sum_{j=1}^p A_j^{i1} Y_{t-j}^i + B^{i1} + \left( \sum_{j=1}^p A_j^{i2} Y_{t-j}^i + B^{i2} \right) I(s_t^i \geq m^i) + \epsilon_t^i \quad (14)$$

where  $A^1$  and  $B^1$  are, respectively, the slopes and intercepts prevailing under state 1, where a given financial integration measure,  $s_t$ , is below a certain threshold level,  $m$ .  $I$  is an indicator function that takes the value of 1 if the specific measure of cross-border financial holdings is higher than the threshold value  $m$  (state 2), and 0 otherwise (state 1). The indicator function that acts as an interaction term has the capacity to influence both the level and the dynamic relationship between endogenous variables through the vector of constants  $B^2$  and the matrix of contemporaneous coefficients  $A^2$ . The interaction term allows us to derive impulse response functions for different states of the financial structure distribution and to examine how cross-border financial portfolios affect the capital channel. In our case, the threshold value that governs different risk-sharing regimes is, *a priori* not known. Therefore, in order to distinguish the periods with “high” and “low” financial integration, for each country and financial integration measure, we specify a univariate regression, allowing for the covariance between the idiosyncratic deviation of GDP and that of the capital channel to differ among the two states:

$$\widehat{\Delta gdp}_t - \widehat{\Delta gni}_t = c + \beta_I^1(\widehat{\Delta gdp}_t) + \left( \beta_I^2(\widehat{\Delta gdp}_t) \right) I[s_t \geq m] + \epsilon_t \quad (15)$$

Following Li and St-Amant (2010), we apply Hansen’s methodology, which both tests for the existence of a threshold effect and detects the level of the threshold variable creating the inflection point. In practice, this model is estimated for all possible threshold values,  $m$ , and the sum of squared residuals is compared through a likelihood ratio test to identify the threshold level that provides the best fit. In other words, for each financial instrument, the final threshold we employ in our analysis is the one that maximizes the difference (in terms of income smoothing) between the two regimes. This approach allows the data to endogenously reveal the threshold level, instead of imposing it arbitrarily. The null hypothesis of no differential impact between regimes is tested using the Wald statistic.<sup>21</sup> Nonlinearity tests confirm that the use of a non-linear framework with regime switches determined by external capital positions is warranted by the data. In order to avoid that one regime has a too-low number of observations, we exclude the threshold’s values for which the less populated regime contains less than 10% of the observations.

## 5 Results

### 5.1 Income smoothing in the euro area

#### Aggregate evolution

Figure 4 presents the estimation results from a country-specific VAR for all channels of risk sharing.<sup>22</sup> It confirms

<sup>21</sup>See Tables A.1 and A.2 in the Appendix

<sup>22</sup>To derive useful results for policy recommendations from these estimates we have to take into account the dynamic behavior. For this reason, we present the cumulative response, as the dynamic patterns differ across channels. For example, for the capital channel, the bulk of the effect takes place contemporaneously, while the credit channel displays a longer-lasting profile that presents a certain degree of dis-smoothing effect in the medium to long run

previous findings that a significant part of shocks to GDP remains unsmoothed in the euro area. In line with the previous literature, our results suggest that while the credit channel was historically the most important mechanism for cross-border risk sharing in the euro area, it significantly collapsed during the GFC. Since then, it resumed a solid upward trend, partially supported by the activation of supranational public loans to some euro area economies, such as the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM) (Milano, 2017; Cimadomo et al., 2018, 2020). International transfers still play a very limited role (around 3%).<sup>23</sup> In line with the literature (e.g. (Sørensen and Yosha, 1998)), the coefficient for the imputed depreciation channel is negative, indicating a dis-smoothing effect.<sup>24</sup>

Turning to our main object of interest in this paper - the capital channel -, the results reveal that the degree of income smoothing was historically rather modest in the euro area, hovering below 10% (Figures 4 and 5), in line with existing literature (Furceri and Zdzienicka, 2015; Nardo et al., 2017; Asdrubali et al., 2018; Hoffmann et al., 2019; Poncela et al., 2019). Still, risk sharing through the capital channel underwent a period of sustained improvement, increasing from about 4% at the beginning of our sample to a peak slightly above 8% for the period spanning 2004Q4 - 2013Q3. However, the impact of the GFC and the subsequent sovereign debt crises significantly eroded the income smoothing capacity in the euro area, which temporarily returned to levels below those seen at the beginning of our sample. Our estimates as of 2010 suggest a positive recovery trend, although it remains at low levels of around 5%. Overall, at the end of the sample period, around 60% of the shock remained unsmoothed, meaning this part of the deviation in gross domestic product passed through to domestic consumption. This figure is larger than the magnitude at the beginning of the 2000s, when it stood at around 40%, highlighting that the sum of the smoothing effects provided by the different channels has not recovered to past levels.

### Geographical patterns of the capital channel

However, income smoothing was quite heterogeneous across countries and the intra- and inter-regional contributions evolved differently. For our sample of EA10 countries, the improvement in income smoothing in the aftermath of the GFC was driven by increasing contributions of inter-regional risk sharing (Figure 5). Subsequently, its contribution collapsed and remained at around zero or even negative values as of the 2010s. The intra-regional contribution to income smoothing was more resilient and entirely drove the increase in income smoothing for the estimation windows starting mid-2011.

Turning to the disaggregated results for the southern and northern euro area countries shows that income smoothing was significantly lower in southern (Figure 6, left panel) than northern countries (Figure 6, right panel).<sup>25</sup> While income smoothing in the southern countries improved to almost the same level as for the northern countries until around the sovereign debt crisis, it subsequently fell to zero. This breakdown of the capital channel in the southern countries is mainly explained by the inter-regional contributions to income smoothing, which increased quite strongly and were higher compared to the intra-regional income smoothing in the period up to the GFC. However, since the GFC, the inter-regional capital channel steadily declined, even becoming negative during the last years. At the same time, the intra-regional contributions started to increase but only partially compensating the inter-regional contributions to income smoothing. Thus, income smoothing fell to zero at the end of our sample period. For northern countries, the intra-regional contributions to risk sharing via the capital channel

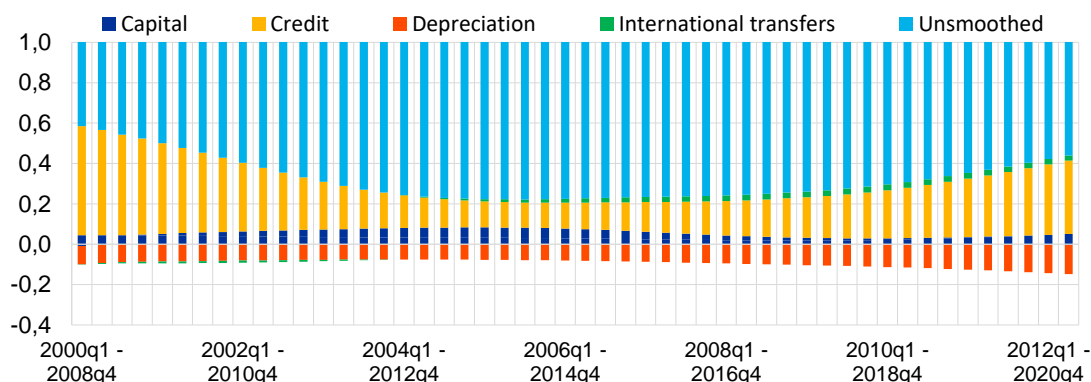
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<sup>23</sup>The contribution of the international transfers channel to overall risk sharing is largely explained by the design of fiscal policy at the EMU level. While pro-cyclical supra-national fiscal policy seems to have provided a slight dis-smoothing effect during the first years of the sample, fiscal transfers undertaken at the European level (e.g., transfers through EU structural funds) together with international remittances, seem to have increased the positive contribution to risk sharing since the GFC.

<sup>24</sup>This is not surprising, as in the National Accounts data, depreciation constitutes a larger fraction of output during recessions and a smaller fraction during booms, which consequently means that the capital-output ratio is typically countercyclical.

<sup>25</sup>Our results are robust to estimates using the aggregated values for the capital channel. Results are available upon request.

Figure 4: International risk sharing in the EA10, share of total idiosyncratic shock



Sources: Own calculations based on Eurostat quarterly national accounts data.

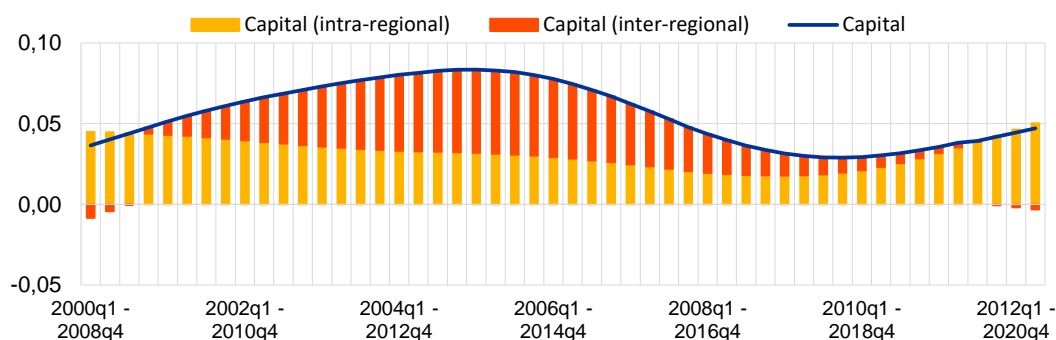
Note: The bars indicate the share of the total idiosyncratic shocks that is smoothed out via each of the channels for risk sharing in the EA10. The shares are computed on the basis of the cumulative impact of the shock on the variables capturing each channel for the two years after the shock. This allows us to account for the potential reversal dynamics that are associated with, for example, debt repayment duties. The contributions of the channels are computed using a country-specific vector-autoregression (VAR). Parameters are estimated over a nine-years rolling window of quarterly data. We compute the results for each country and average over the cross-section using real GDP as weights. The estimates are smoothed using the trend component of the Hodrick-Prescott filter with smoothing parameter equal to 250.

were comparatively larger than in southern countries, while the collapse of the inter-regional risk sharing was less pronounced than for southern countries. Thus, leading to an overall greater income smoothing effect in northern countries, in particular at the end of our sample period.

Looking at the composition of the intra-EA10 cross-border capital portfolios helps to explain these results. At the beginning of our sample, we observe an important increase in long-term portfolio debt assets held by northern countries used to finance the periphery. This dynamic is also observed when looking at inter-regional long-term debt assets and liabilities held by peripheral countries, which increased during the years before the GFC. These developments back the improvement in the inter-regional component of the capital channel enjoyed by southern countries. However, between 2009 and 2011, the size of the inter-regional portfolio debt exposures strongly decreased for southern countries and remained depressed over the following years. After the sovereign debt crisis, inter-regional equity assets held by southern countries not only recovered but also initiated a marked increase, doubling their magnitude (in % of GDP) by 2017. Oppositely, portfolio equity liabilities and long-term debt instruments (on both sides of the balance sheet), remain below pre-crisis levels until the end of the sample period. The increase in inter-regional equity assets held by southern countries suggests a strengthening of capital flowing “uphill” from southern to northern countries. According to Garnier (2014), this led to core countries profiting from *ex-ante* insurance in bad times while southern countries experienced balance of payment crises. The underlying dynamic of equity flows from more distressed countries to less distressed ones (instead of the opposite direction) helps explain not only the overall collapse in inter-regional risk sharing that has taken place since the sovereign debt crisis (Figure 5), but also its negative contribution (i.e. “dis-smoothing” effect) to risk sharing in southern countries (Figure 6).

Regarding southern countries’ intra-regional portfolios, they have been on a sharp increasing trend since 2012,

Figure 5: Risk sharing via the capital channel in the EA10, share of total idiosyncratic shock



*Sources:* Own calculations based on Eurostat quarterly national accounts data.

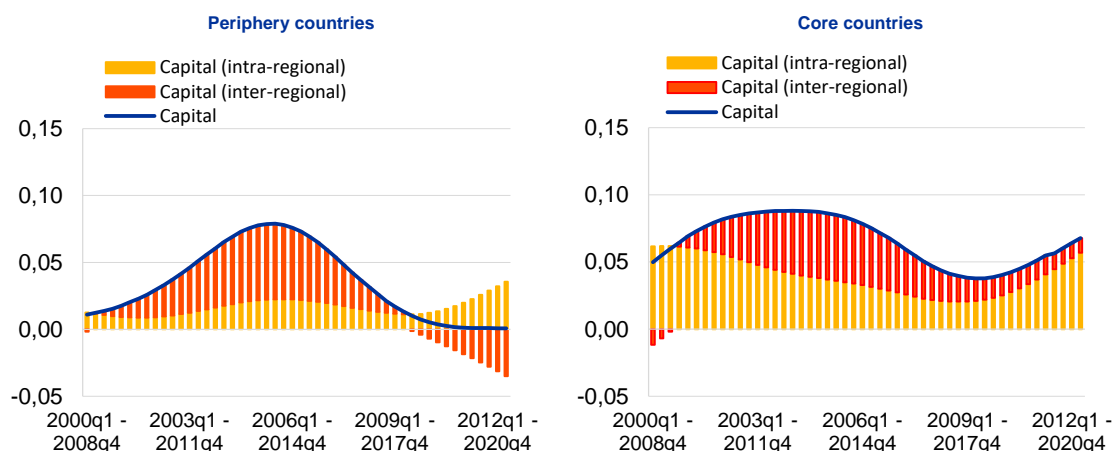
*Note:* The blue line indicates the share of the total idiosyncratic shocks that is smoothed out via the capital channel in the EA10 overall, whereas the bars show the part that is smoothed intra-regionally (i.e. within each of the two regions, yellow bar) and inter-regionally (i.e. between the two regions, orange bars). The shares are computed on the basis of the cumulative impact of the shock on the variables capturing the capital channel for the two years after the shock. The contributions of the capital channel are computed using a country-specific vector-autoregression (VAR). Parameters are estimated over a nine-year rolling window of quarterly data. Therefore, results for e.g. 2008q4 are obtained using a sample covering 2000q1-2008q4. We compute the results for each country and average over the cross-section using real gross domestic product as weights. The estimates are smoothed using the trend component of the Hodrick-Prescott filter with smoothing parameter equal to 250.

mostly fuelled by long-term debt. This seems to have positively contributed to the intra-regional component of the capital channel for southern countries. Looking at direct investment, we observe that inward FDI in southern countries has declined since 2009, when it represented around 40% of GDP (considering both intra- and inter-regional exposures) while it amounted to around 30% of GDP in 2020 (Figure 8, lower left panel). Similarly, the bulk of peripheral countries' equity outward direct investment flew towards northern countries, with this magnitude further increasing in 2019 and 2020 (Figure 8, upper left panel).

Turning to the northern countries, we observe that the bulk of their cross-border portfolios comprises intra-regional holdings (Figure 7), which helps to explain why income smoothing offered by the intra-regional component of the capital channel is particularly relevant. The strong decline of the inter-regional component for risk sharing during the second half of the sample period goes in parallel with an important reduction of inter-regional long-term debt assets, which declined sharply (relative to GDP) between 2009 and 2011 and continued to decrease (albeit on a slower pace) ever since. Compared to pre-GFC inter-regional portfolios, the only item that increased for core countries is equity liabilities, but even at their peak, these represent a lower portion of their cross-border portfolio holdings (less than 10% of GDP), suggesting the crisis left long-lasting scars in the integration of capital markets between northern and southern countries.

Focusing on FDI, Figure 8 shows that intra-regional linkages are above inter-regional exposures in northern countries. Like portfolio holdings, inter-regional inward investment towards core countries is much larger than outward investment from these countries toward the southern region. In fact, both inter- and intra-regional FDI outflows seem to have core countries as their destination (Figure 8, lower panels).

Figure 6: Income smoothing in the EA10 by country group, share of total idiosyncratic shock



Sources: Own calculations based on Eurostat quarterly national accounts data.

Note: “Southern” refers to euro area countries that experienced a significant deterioration in their credit rating since the onset of the global financial crisis (ES, GR, IT, PT), while “northern” encompasses the remaining countries (AT, BE, DE, FI, FR, NL). We compute the results for each country and average for each region over the cross-section using real gross domestic product as weights. The estimates are smoothed using the trend component of the Hodrick-Prescott filter with smoothing parameter equal to 250.

To summarize, the capital channel in both regions seems to be largely driven by long-term portfolio debt holdings and foreign direct equity investment. The variation in long-term debt positions tends to mirror the changes in income smoothing capacity. Due to their small magnitude, short-term debt portfolios and debt FDI do not play a significant role in cross-border exposures.<sup>26</sup>

## 5.2 The role of external portfolio composition for income smoothing

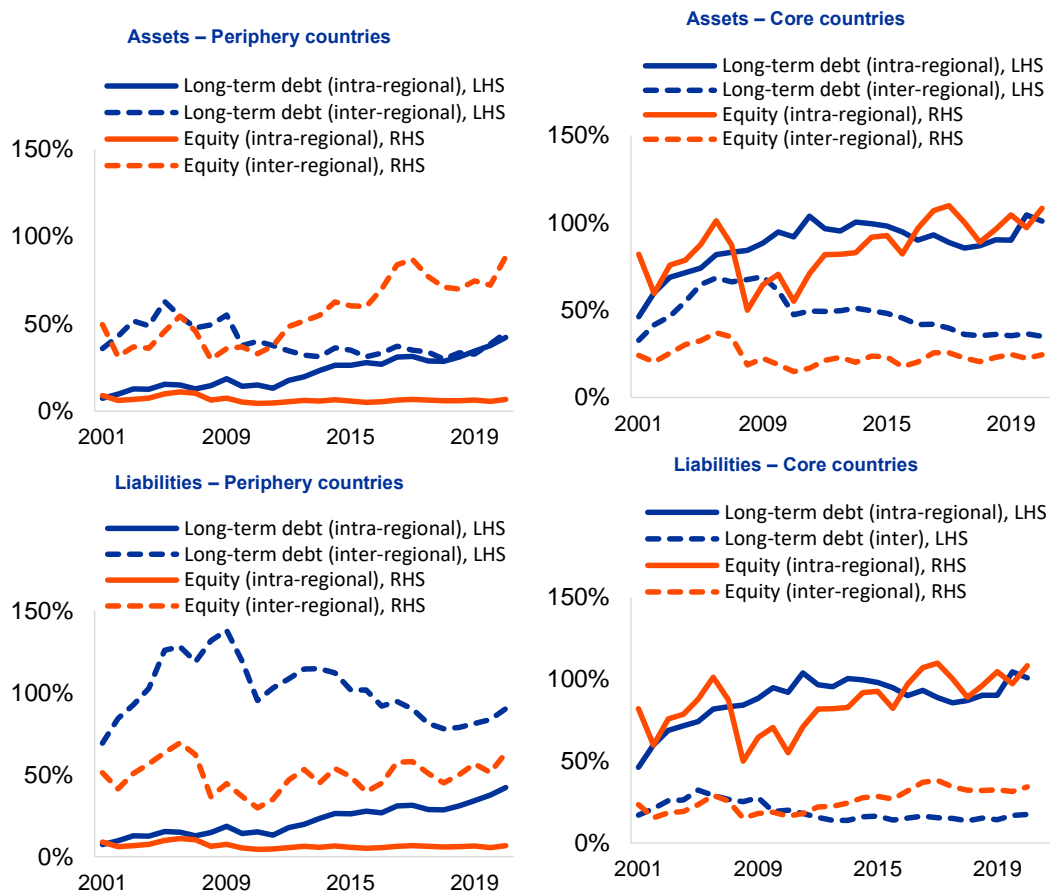
Next, we empirically test the hypothesis that the contribution to income smoothing in core and periphery countries differs across financial instruments, both for portfolio holdings (short-term debt, long-term debt, equity) and direct investment (equity).<sup>27</sup> For each instrument, we test whether there are differences for risk sharing between investment abroad (which generates capital receipts/inflows) and funding from abroad (which generates capital payments/outflows). Due to the differences in the frequency and the time dimension of the datasets employed for retrieving cross-border portfolio (CPIS) and foreign direct investment (CDIS) holdings,<sup>28</sup> we estimate separate models. Furthermore, the results obtained in this section are not directly comparable to the estimates included

<sup>26</sup>See Figures A.1 and A.2 in the Appendix.

<sup>27</sup>The overall holdings of inward and outward direct debt investment are very low (see Figure 3). The estimated effects are insignificant and not included in Figure 11. The results are available upon request.

<sup>28</sup>The CPIS data is available on an annual basis from 2001 until 2012 and bi-annually from mid-2013 to 2020, while CDIS data is available from 2009 until 2020 on a yearly basis.

Figure 7: Intra-EA10 cross-border portfolio holdings by regions, in percent of GDP



Sources: IMF, Coordinated Portfolio Investment Survey, 2001 - 2020. Note: The CPIS data is available annually from end-2001 to end-2012, and bi-annually starting at end-June 2013. Ratios are computed as a percentage of the region of reference's GDP.

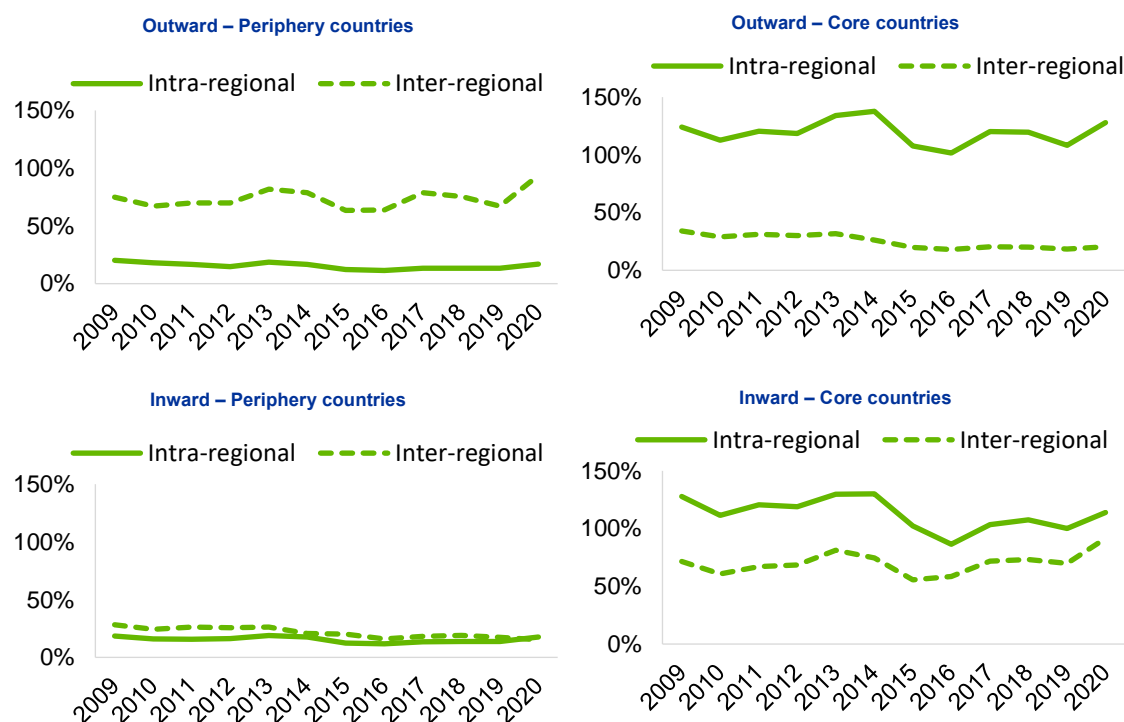
in the previous section (Section 5.1) given that the empirical approaches employed differ.<sup>29</sup> In particular, results included here should be interpreted as the additional income smoothing effect derived during periods when the holdings of a certain cross-border financial instrument are particularly high.

Our results suggest that the income smoothing effect significantly differs across portfolio and direct investment, assets and liabilities, and euro area regions. Figure 9 plots cumulative impulse response functions (IRFs) based

<sup>29</sup>In section 5.1 we estimate country-specific VAR models with quarterly frequency using data for 2000q1-2021q1 and applying a nine-years rolling window approach. Instead, in section 5.2 we estimate panel models to disentangle the differential magnitude associated to the periods where the cross-border holdings of a specific instruments are particularly high. Frequency and time dimension of the models vary so as to accommodate the features of CPIS and CDIS datasets.



Figure 8: Intra-EA10 foreign direct investment holdings by regions, in percent of GDP



Sources: IMF, Coordinated Direct Investment Survey, 2009 - 2020. The CDIS data is available annually from end-2009 to end-2020. Ratios are computed as a percentage of the region of reference's GDP.

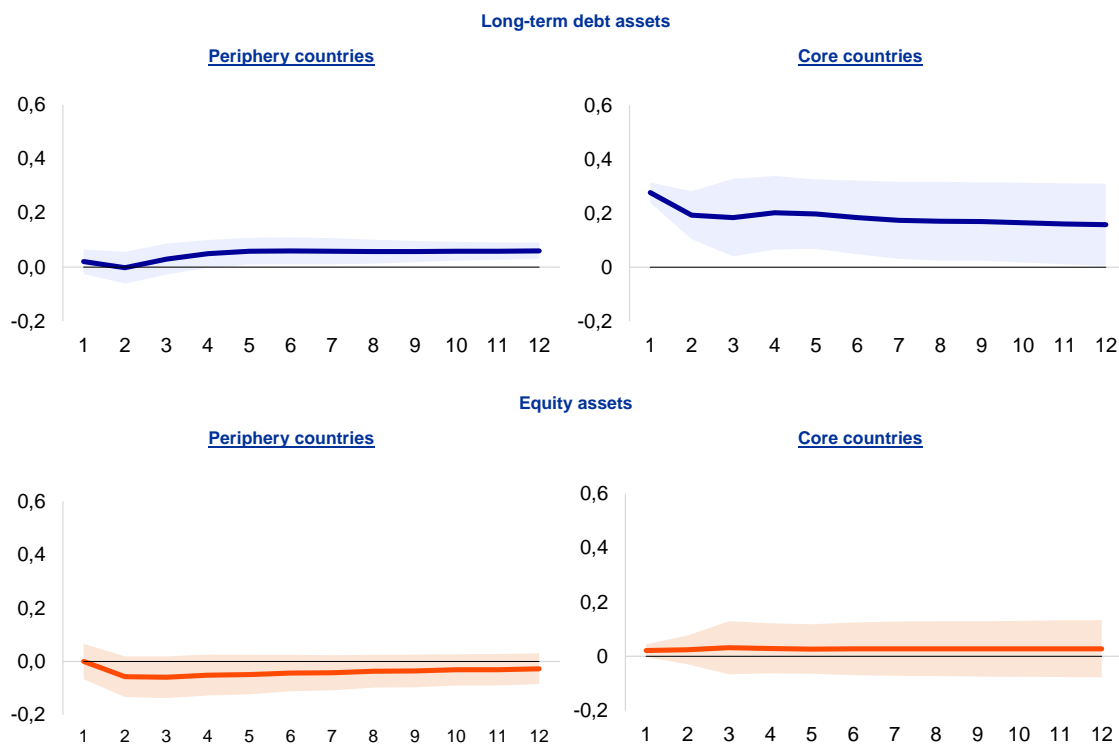
on equation (14) for additional income smoothing in state 2 (times of “high” capital holdings) relative to state 1 (times of “low” capital holdings). The cumulative IFRs are displayed so as to account for the potential (usually partial) dis-smoothing effect associated with instruments that entail a contemporaneous capital inflow that need to be repaid in the future.

In line with Balli et al. (2013, 2014), our results suggest that interest revenues associated with long-term debt assets play a favourable role for income smoothing, especially in core countries, where income smoothing was above 16 percentage points larger during periods of “high” compared to “low” long-term debt assets. In comparison, periods of “high” long-term debt assets seem to have improved income smoothing in peripheral countries by around 6 percentage points. This heterogeneity is in line with the different sizes of the long-term debt assets portfolios across regions (Figure 7, upper panels). Equity assets do not seem to have significantly contributed to risk sharing, as the associated results are statistically non-significant. Short-term debt assets<sup>30</sup> do not matter for

<sup>30</sup>The results for short-term debt assets as well as short-term debt liabilities are not shown in Figures 9 and 10 given the insignificant effects and the overall low magnitude of cross-border short-term debt holdings, but are available upon request.

income smoothing in the euro area due to their low level and rather volatile behaviour when compared with other instruments.<sup>31</sup>

Figure 9: Additional income smoothing in the EA10 by asset type and region, portfolio holdings, cumulative IRFs



Sources: Own calculations based on Eurostat quarterly national accounts and IMF CPIS data.

Notes: These results present the additional risk sharing via the capital channel (in percentage points) associated with periods of “high” portfolio holdings, compared to periods of “low” portfolio holdings. Results present the cumulative impulse response function associated with the interaction term in Equation (14). Solid lines plot the median value, while the band presents 95% confidence intervals.

For external portfolio liabilities, our analysis suggests that long-term debt liabilities contributed to income smoothing, both in the core and in the periphery countries (Figure 10). We observe a positive risk-sharing effect associated with periods of “high” long-term debt liabilities, which amounts to around 14 and 10 percentage points for core and periphery countries, respectively. Similarly, for equity liabilities, dividend payments contributed to income smoothing in both regions, the magnitude of the effect being 20 percentage points for core countries and 9 percentage points for the periphery. The positive income smoothing effect derived from portfolio equity liabilities might relate to the fact that dividend payments are state contingent, roughly proportional to domestic output,

<sup>31</sup>See Figure A.1 in the Appendix.

and behave pro-cyclically as companies pay less dividends during economic downturns, hence smoothing income through the business cycle.

Despite the significant difference in the magnitude of the cross-border equity and long-term debt portfolios in peripheral countries (Table 1), the fact that both instruments seem to have been similarly conducive for risk sharing in peripheral countries highlights the income smoothing potential of equity liabilities. All in all, our results suggest that the collapse in income smoothing suffered by these countries (Figure 6, left panel) might have been driven by the evolution of inter-regional liabilities (Figure 7, lower left panel). In fact, around the sovereign debt crisis, the most affected countries suffered sudden stops and reversals of foreign debt funding. In particular, it was in peripheral countries where, according to our analysis, the sharpest deterioration of income smoothing capacity took place. This could be linked to the fact that, during the last years, inter-regional equity investment has been rather uni-directional. It flew from southern to the northern countries, generating equity assets in southern and equity liabilities in northern countries, thus making northern countries profit more from *ex-ante* insurance in bad times. More research is needed to grasp the unique characteristics and dynamics of equity funding. Understanding better why flows have been mainly in the direction from the southern to the northern countries could be a useful avenue for further work. It could also help in tackling obstacles that hinder further cross-border equity funding in southern countries that, albeit insufficiently, seem to have positively contributed to capital risk sharing - according to our results in Figure 10.

Turning to FDI, we observe that only core countries benefited from FDI-related flows, while income smoothing in periphery countries was unaffected (Figure 11). In particular, high inward equity positions toward core countries are associated with an additional income smoothing effect of more than 20 percentage points. Outward positions also show smoothing capacity, however, the cumulative IRFs turn statistically insignificant relatively quickly. Foreign direct investment via debt<sup>32</sup> does not play a significant role for income smoothing in the euro area due to its low level.<sup>33</sup>

Summing up, we conclude that fluctuations in interest payments related to long-term portfolio debt assets and liabilities, as well as dividend payments stemming from equity liabilities provide significant risk sharing through the capital channel for all euro area countries included in our sample. However, the magnitude of the effect was significantly larger for core countries, which seems to relate to their more sizeable cross-border portfolios when compared to the periphery. Despite equity liabilities only representing a small share of total cross-border liabilities for both regions, these instruments are associated with a similar additional income smoothing effect when compared to long-term debt liabilities. Furthermore, the collapse in the inter-regional component of the capital channel suffered by periphery countries after the GFC seems to be related to the strong decline in the stock of inter-regional cross-border liabilities. Regarding FDI, inward equity positions played an important role for core countries, while the effect is negligible in the periphery.

## 6 Conclusion and policy implications

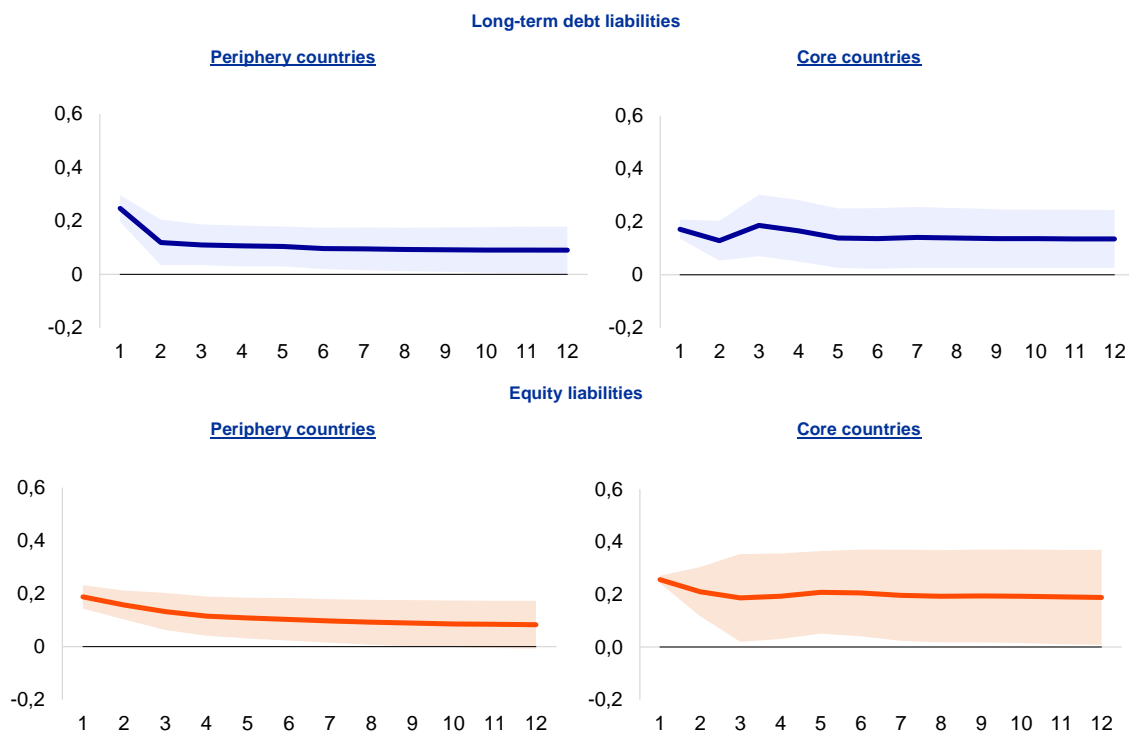
This paper uses country-specific and panel threshold VAR models to analyse international risk sharing via capital markets and its drivers in the euro area. After providing fresh evidence on the evolution of risk sharing, especially of the capital channel, from 2000 through 2021, it contributes to the literature in two main respects. First, we split the sample into core and periphery countries, then disaggregate the capital channel into an intra- and

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<sup>32</sup>The results for both inward and outward direct investment via debt is not shown due to their insignificant effects, which relates to the overall low magnitude of these holdings, but are available upon request.

<sup>33</sup>Figure A.2 in the Appendix.

Figure 10: Additional income smoothing in the EA10 by liability type and region, portfolio holdings, cumulative IRFs



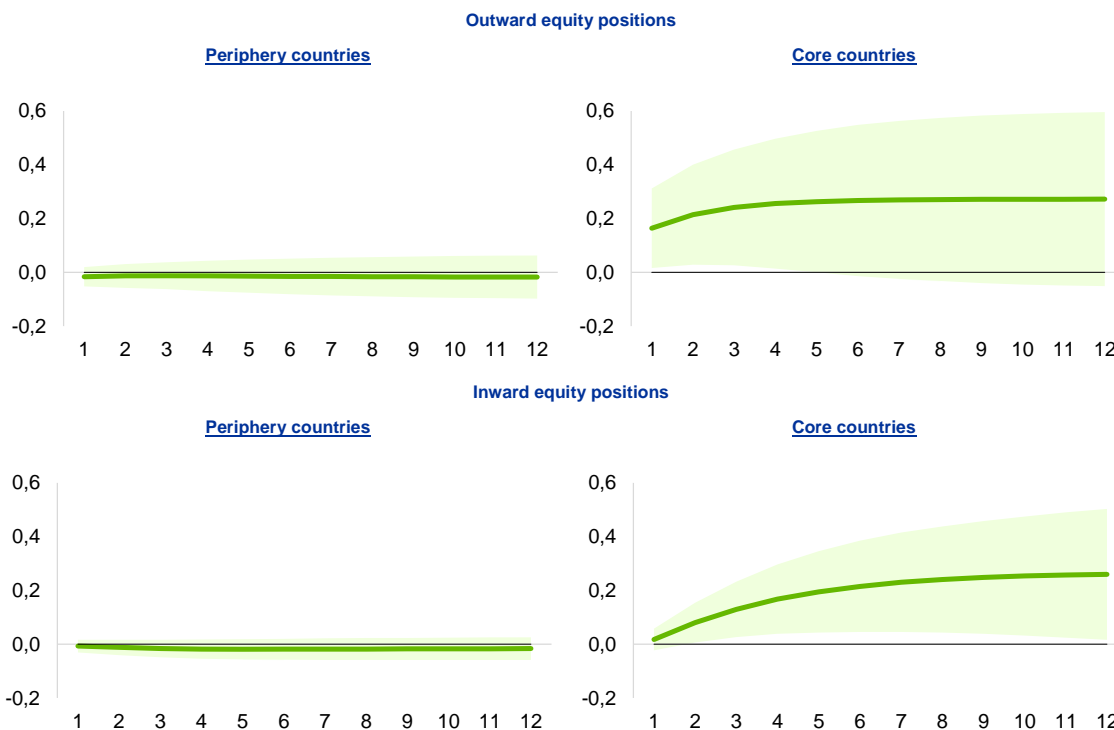
*Sources:* ECB calculations based on Eurostat quarterly national accounts and IMF CPIS data.

*Notes:* These results present the additional risk sharing via the capital channel (in percentage points) associated with periods of “high” portfolio holdings, compared to periods of “low” portfolio holdings. Results present the cumulative impulse response function associated with the interaction term in Equation (14). Solid lines plot the median value, while the band presents 95% confidence intervals.

inter-regional component; this contrasts with existing studies that focus on the euro area (or the EU) as a whole. Second, we are the first to analyse the role of the composition of foreign portfolio and direct investment positions for income smoothing in a panel threshold VAR. Related studies, in contrast, applied univariate frameworks to examine the role of external portfolio composition for international risk sharing.

Our analysis documents an improvement in income smoothing provided by capital markets across euro area countries until the GFC. Yet, the capital channel of risk sharing significantly deteriorated following the sovereign debt crisis, entirely drying up in southern countries. Given that intra-euro area cross-border capital positions remain much larger (also relative to GDP) in core countries, this region was better able to shield against country-specific shocks via capital markets than periphery countries. This gap in income smoothing has even widened since 2011.

Figure 11: Additional income smoothing in the EA10 by direction and region, FDI, cumulative IRFs



Sources: ECB calculations based on Eurostat quarterly national accounts and IMF CPIS data.

Notes: These results present the additional risk sharing via the capital channel (in percentage points) associated with periods of “high” FDI, compared to periods of “low” FDI. Results present the cumulative impulse response function associated with the interaction term in Equation (14). Solid lines plot the median value, while the band presents 95% confidence intervals.

Regarding geographical patterns, we document that income smoothing was largely supported by *intra*-regional external capital holdings during the more recent period. *Inter*-regional risk sharing was unable to provide a significant effect, particularly in periphery countries, where it even induced dis-smoothing. This might be linked to the decrease in inter-regional funding received by these countries after the sovereign debt crisis. Thus, our analysis suggests euro-area risk sharing would benefit from a closer integration between core and periphery.

Not all financial instruments provide the same risk sharing capacity. Analysing the contribution to income smoothing offered by different components of external capital positions shows that interest receipts and payments arising from long-term portfolio debt assets and liabilities as well as capital flows related to portfolio equity liabilities had a positive impact. However, this effect seems to have been more material in core countries, in line with the larger size of their cross-border portfolios than in peripheral countries. Despite the overall smaller magnitude of equity liabilities when compared to long-term debt liabilities (both for core and periphery countries),

the additional income smoothing effect associated with them is largely comparable. This suggests an increase in equity linkages between euro area countries might significantly strengthen international risk sharing. Lastly, looking at FDI, we observe that inward investment towards northern countries (as a % of GDP) was more than six times larger than that received by southern countries. This helps explain why the impact of inward FDI on income smoothing is substantial in the core countries, while no significant effect is found for the periphery.

Our results contribute to the policy debate on the need for better financial integration in the euro area and the implementation of the CMU. Showing that the capital channel still remains unexploited gives a strong rationale for furthering financial integration. Progress on the CMU could strengthen risk sharing via *ex ante* insurance relying on capital market transfers. Moreover, the resilience of the capital channel during the early stages of the pandemic bolsters the argument to focus on capital market integration and its quality. Further research could look into the most important factors driving a wedge between potential and actual risk sharing capacity, including the differences between northern and southern countries.

## References

- Albertazzi, U. and Bottero, M. (2014). Foreign bank lending: evidence from the global financial crisis. *Journal of International Economics*, 92:22–35.
- Alcidi, C., DImperio, P., and Thirion, G. (2017). *Risk-sharing and Consumption-smoothing Patterns in the US and the Euro Area: A comprehensive comparison*. CEPS Working Document No 2017/04.
- Artis, M. J. and Hoffmann, M. (2008). Financial globalization, international business cycles and consumption risk sharing. *Scandinavian Journal of Economics*, 110(3):447–471.
- Artis, M. J. and Hoffmann, M. (2011). The home bias, capital income flows and improved long-term consumption risk sharing between industrialized countries. *International Finance*, 14(3):481–505.
- Asdrubali, P. and Kim, S. (2004). Dynamic risksharing in the United States and Europe. *Journal of Monetary Economics*, 51(4):809–836.
- Asdrubali, P., Kim, S., Pericoli, F., and Poncela, P. (2018). *New risk sharing channels in OECD countries: A heterogeneous panel VAR*. Number 2018/13. JRC Working Papers in Economics and Finance.
- Asdrubali, P., Sørensen, B. E., and Yosha, O. (1996). Channels of interstate risk sharing: United States 1963-1990. *The Quarterly Journal of Economics*, 111(4):1081–1110.
- Balli, F., Basher, S. A., and Balli, H. O. (2013). International income risk-sharing and the global financial crisis of 2008-2009. *Journal of Banking & Finance*, 37(7):2303–2313.
- Balli, F., Pericoli, F. M., and Pierucci, E. (2014). Foreign portfolio diversification and risk-sharing. *Economics Letters*, 125(2):187–190.
- Beck, R., Coppola, A., Lewis, A., Maggiori, M., Schmitz, M., and Schreger, J. (2023). The geography of capital allocation in the euro area. *Available at SSRN 4398898*.
- Beck, R., Dedola, L., Giovannini, A., and Popov, A. (2016). Financial integration and risk sharing in a monetary union. *Financial Integration in Europe*.
- Becker, S. O. and Hoffmann, M. (2006). Intra-and international risk-sharing in the short run and the long run. *European Economic Review*, 50(3):777–806.
- Beyer, A., Doornik, J. A., and Hendry, D. F. (2001). Constructing historical euro-zone data. *The Economic Journal*, 111(469):102–121.
- Cimadomo, J., Ciminelli, G., Furtuna, O., and Giuliodori, M. (2020). Private and public risk sharing in the euro area. *European Economic Review*, 121(103347).
- Cimadomo, J., Gordo Mora, E., and Palazzo, A. A. (2022). Enhancing private and public risk sharing. *ECB Occasional Paper*, (2022/306).
- Cimadomo, J., Hauptmeier, S., Palazzo, A. A., and Popov, A. (2018). Risk sharing in the euro area. *Economic Bulletin Articles*, 3.
- Della Corte, V., Federico, S., and Felettigh, A. (2018). Looking through cross-border positions in investment funds: evidence from Italy. *Bank of Italy Occasional Paper*, (439).
- Demyanyk, Y., Ostergaard, C., and Sørensen, B. E. (2008). Risk sharing and portfolio allocation in EMU. *Available at SSRN 1317692*.
- Diamond, D. W. and Rajan, R. G. (2001). Banks, short-term debt and financial crises: theory, policy implications and applications. In *Carnegie-Rochester conference series on public policy*, volume 54, pages 37–71. Elsevier.
- Dieppe, A., Legrand, R., and Van Roye, B. (2016). The BEAR toolbox. *ECB working paper no. 1934*.
- European Commission (2015). The Five Presidents Report: Completing Europes Economic and Monetary Union. Technical report.

- Feletigh, A. and Monti, P. (2008). How to interpret the cpis data on the distribution of foreign portfolio assets in the presence of sizeable cross-border positions in mutual funds-evidence for italy and the main euro-area countries. *Bank of Italy Occasional Paper*, (16).
- Furceri, D. and Zdzienicka, A. (2015). The euro area crisis: need for a supranational fiscal risk sharing mechanism? *Open Economies Review*, 26:683–710.
- Giannone, D. and Reichlin, L. (2006). Trends and cycles in the euro area: how much heterogeneity and should we worry about it? Technical Report 595.
- Giovannini, A., Horn, C. W., Mongelli, F., and Popov, A. (2020). On the measurement of risk-sharing in the euro area. Box 5 in.
- Giovannini, A., Ioannou, D., and Stracca, L. (2022). Public and private risk sharing: friends or foes? the interplay between different forms of risk sharing. *ECB Occasional Paper*, (2022/295).
- Guerrieri, V., Lorenzoni, G., Straub, L., and Werning, I. (2022). Macroeconomic implications of COVID-19: Can negative supply shocks cause demand shortages? *American Economic Review*, 112(5):1437–74.
- Hoffmann, M., Maslov, E., Sørensen, B. E., and Stewen, I. (2019). Channels of risk sharing in the Eurozone: what can banking and capital market union achieve? *IMF Economic Review*, 67:443–495.
- Kalemli-Ozcan, S., Luttini, E., and Sørensen, B. (2014). Debt crises and risk-sharing: The role of markets versus sovereigns. *The Scandinavian Journal of Economics*, 116(1):253–276.
- Kalemli-Ozcan, S., Sorensen, B. E., and Yosha, O. (2004). Asymmetric shocks and risk sharing in a monetary union: Updated evidence and policy implications for Europe. *CEPR Discussion Paper No. 4463*.
- Kose, M. A., Prasad, E., Rogoff, K., and Wei, S.-J. (2009). Financial globalization: A reappraisal. *IMF Staff papers*, 56(1):8–62.
- Li, F. and St-Amant, P. (2010). Financial stress, monetary policy, and economic activity. Technical report, Bank of Canada.
- Mace, B. J. (1991). Full insurance in the presence of aggregate uncertainty. *Journal of Political Economy*, 99(5):928–956.
- Méltiz, J. and Zumer, F. (1999). Interregional and international risk-sharing and lessons for EMU. In *Carnegie-Rochester Conference Series on Public Policy*, volume 51, pages 149–188. Elsevier.
- Milano, V. (2017). Risk sharing in the euro zone: the role of European Institutions. Technical report.
- Milano, V. and Reichlin, P. (2017). Risk sharing across the US and EMU: The role of public institutions. *Policy brief, LUISS School of European Political Economy*.
- Milesi-Ferretti, G. M. (2021). The travel shock.
- Montiel, P. and Reinhart, C. M. (1999). Do capital controls and macroeconomic policies influence the volume and composition of capital flows? evidence from the 1990s. *Journal of international money and finance*, 18(4):619–635.
- Muggenthaler, P., Schroth, J., Sun, Y., et al. (2021). The heterogeneous economic impact of the pandemic across euro area countries. *Economic Bulletin Boxes*, 5.
- Nardo, M., Pericoli, F., and Poncela, P. (2017). Risk-sharing among European Countries. *Publications Office of the European Union*.
- Poncela, P., Nardo, M., and Pericoli, F. M. (2019). A review of international risk sharing for policy analysis. *East Asian Economic Review*, 23(3):227–260.
- Rangvid, J., Santa-Clara, P., and Schmeling, M. (2016). Capital market integration and consumption risk sharing over the long run. *Journal of International Economics*, 103:27–43.
- Sørensen, B. E., Wu, Y.-T., Yosha, O., and Zhu, Y. (2007). Home bias and international risk sharing: Twin puzzles separated at birth. *Journal of international money and finance*, 26(4):587–605.

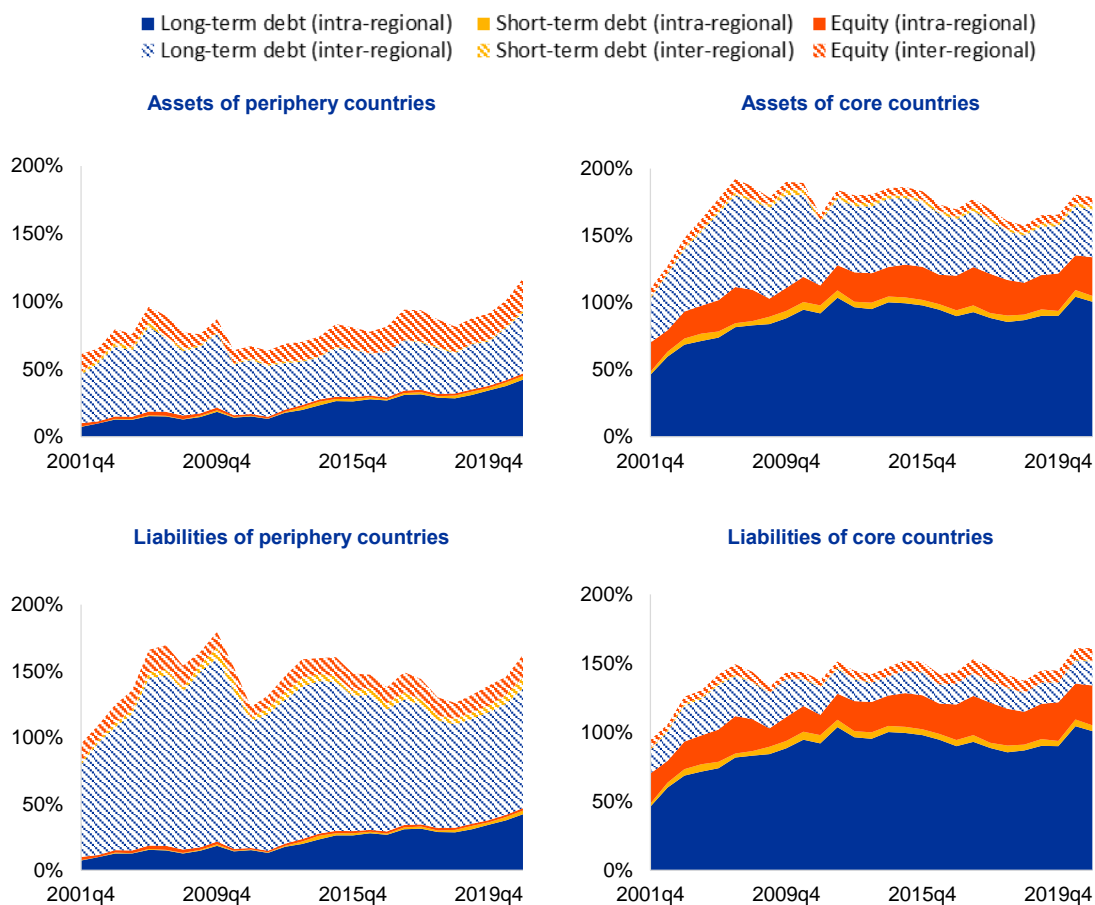


Sørensen, B. E. and Yosha, O. (1998). International risk sharing and European monetary unification. *Journal of International Economics*, 45(2):211–238.

Sørensen, B. E. and Yosha, O. (2007). Producer prices versus consumer prices in the measurement of risk sharing. *Applied Economics Quarterly*, 53(1):3–17.

## A Appendix

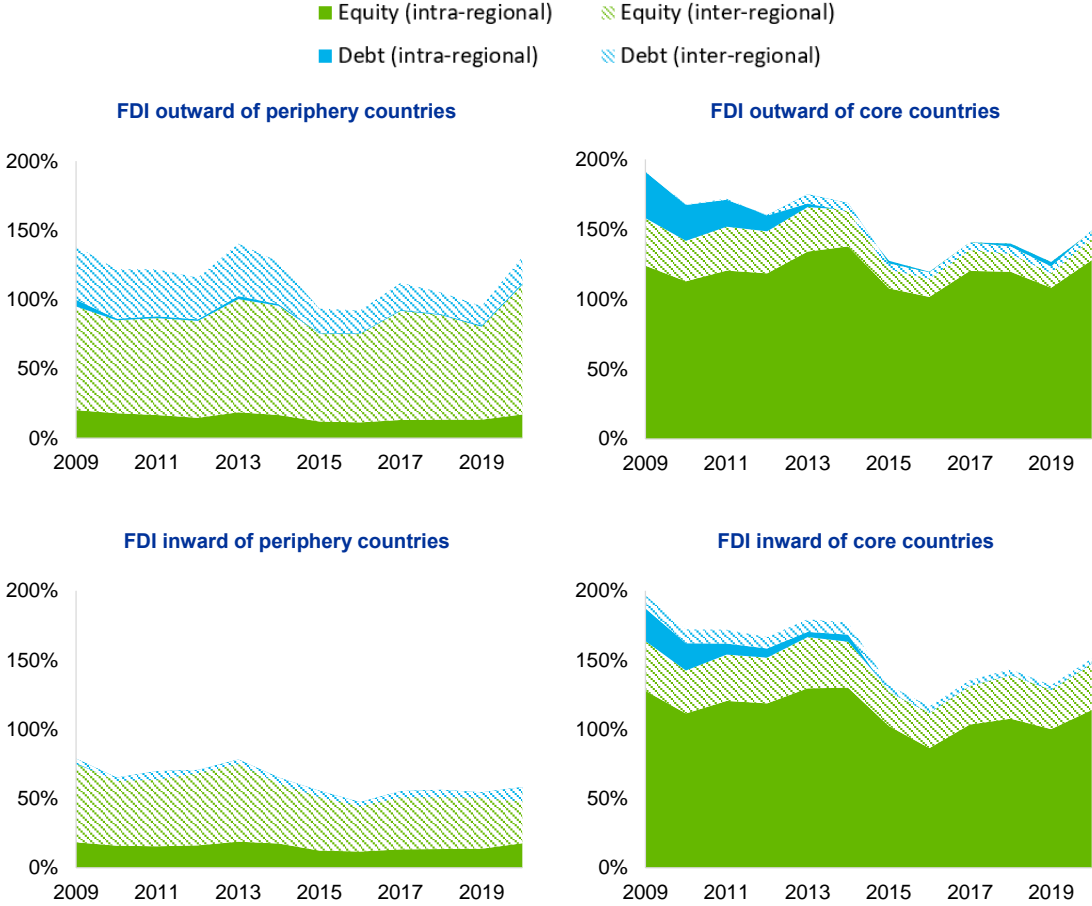
Figure A.1: Distribution of intra-EA10 cross-border portfolio holdings by regions, in percent of GDP



Sources: Sources: IMF, Coordinated Portfolio Investment Survey.

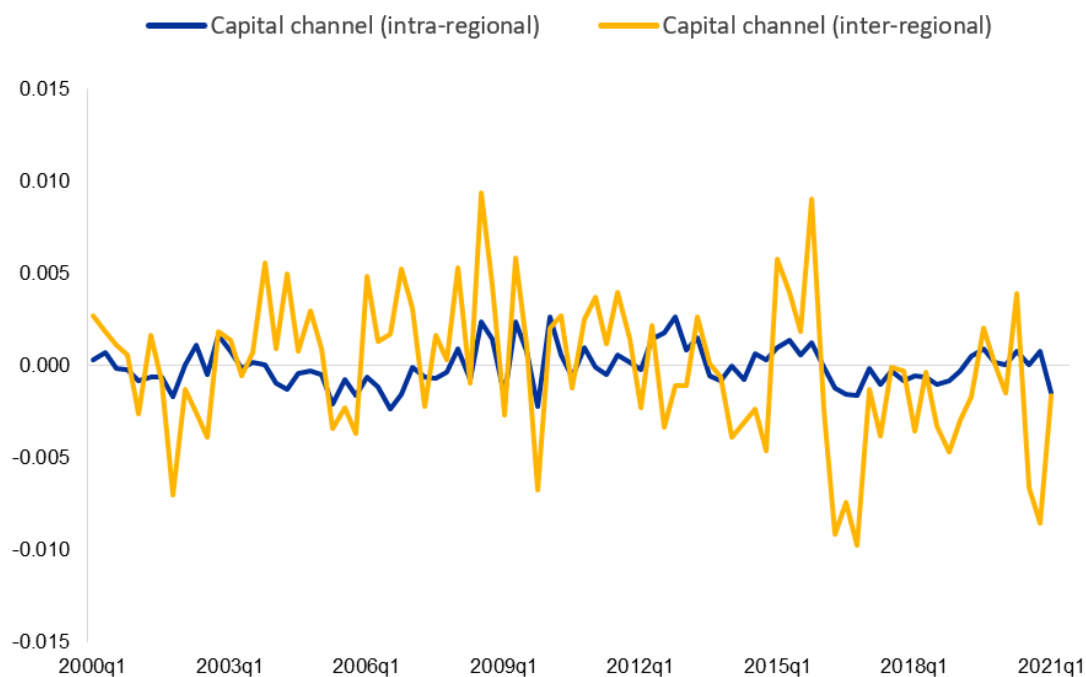
Note: The CPIS data is available annually from end-2001 to end-2012, and bi-annually starting at end-June 2013. Ratios are computed as a percentage of GDP of the region of reference.

Figure A.2: Distribution of intra-EA10 cross-border direct investment holdings by regions, in percent of GDP



Sources: IMF, Coordinated Direct Investment Survey.  
 Note: The CDIS data is available annually from -2009 to 2020. Ratios are computed as a percentage of the GDP for the region investing abroad (i.e., the region for which the CDIS stock is labelled as “outward”).

Figure A.3: Disentangling the capital channel into intra- and inter-regional sub-components, Italy, idiosyncratic deviation



*Sources:* ECB calculations based on Eurostat quarterly national accounts data.

*Note:* Idiosyncratic deviations related to the capital channel split down by country group (i.e., intra- vs. inter-regional). This chart is for illustrative purpose only and shows the case of Italy. It provides the metrics representing the intra-regional (see Equation 10) and inter-regional (see Equation 11) components of the capital channel.

Table A.1: Thresholds per country – Portfolio holdings

Threshold variable	Threshold	Chi <sup>2</sup>	p-value	Obs. (low)	Obs. (high)
<b>Germany</b>					
<i>Liabilities</i>					
Long-term debt	0.767018	7.23392	0.0072	23	4
Short-term debt	0.018392	7.82454	0.0052	4	23
Equity	0.146543	1.45712	0.2274	5	22
<i>Assets</i>					
Long-term debt	0.855064	2.31954	0.1278	4	23
Short-term debt	0.013981	3.28551	0.0699	13	14
Equity	0.160136	12.20254	0.0005	4	23
<b>France</b>					
<i>Liabilities</i>					
Long-term debt	0.756198	2.382851	0.1227	7	20
Short-term debt	0.034142	5.08638	0.0241	14	13
Equity	0.276967	22.81451	0.0000	6	21
<i>Assets</i>					
Long-term debt	1.641897	5.23760	0.0221	23	4
Short-term debt	0.148491	5.23760	0.0221	18	9
Equity	0.283113	22.81451	0.0000	16	11
<b>Italy</b>					
<i>Liabilities</i>					
Long-term debt	1.196114	4.34742	0.0371	19	8
Short-term debt	0.042535	0.70149	0.4023	14	13
Equity	0.107460	0.64711	0.4211	11	16
<i>Assets</i>					
Long-term debt	0.488033	3.79073	0.0515	4	23
Short-term debt	0.006155	0.95718	0.3279	6	21
Equity	0.132928	1.22969	0.2675	16	11
<b>Spain</b>					
<i>Liabilities</i>					
Long-term debt	1.320851	11.04623	0.0009	9	18
Short-term debt	0.071799	8.39323	0.0038	14	13
Equity	0.163257	4.05236	0.0441	4	23
<i>Assets</i>					
Long-term debt	0.489723	3.79021	0.0515	8	19
Short-term debt	0.033154	3.69209	0.0547	21	6
Equity	0.169539	4.29498	0.0382	14	13

Information related to the remaining countries is available upon request. This p-value relates to the Wald test. The null hypothesis refers to the existence of no significant difference between regimes.

Table A.2: Thresholds per country – Direct investment holdings

Threshold variable	Threshold	Chi <sup>2</sup>	p-value	Obs. (low)	Obs. (high)
<b>Germany</b>					
<i>Outward</i>					
Equity	0.458582	7.96208	0.0048	3	9
Debt	0.245277	2.82172	0.0200	3	9
<i>Inward</i>					
Equity	1.004547	0.60009	0.4383	8	4
Debt	-0.236268	3.32741	0.0681	3	9
<b>France</b>					
<i>Outward</i>					
Equity	0.627143	0.39443	0.5300	4	8
Debt	0.107241	1.24131	0.2652	5	7
<i>Inward</i>					
Equity	1.259925	0.54245	0.4614	8	4
Debt	-0.032289	9.29431	0.0023	3	9
<b>Italy</b>					
<i>Outward</i>					
Equity	0.708277	4.661004	0.0309	8	4
Debt	0.093524	3.33561	9.9678	3	9
<i>Inward</i>					
Equity	0.744655	0.921903	0.3370	7	5
Debt	-0.00944	1.102727	0.2937	3	9
<b>Spain</b>					
<i>Outward</i>					
Equity	1.163935	2.089844	0.1483	6	6
Debt	0.5683	7.104288	0.0077	7	5
<i>Inward</i>					
Equity	0.600051	3.56567	0.0590	7	5
Debt	-0.157984	8.21176	0.0042	3	9

Information related to the remaining countries is available upon request. This p-value relates to the Wald test. The null hypothesis refers to the existence of no significant difference between regimes.

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### **Natalia Martín Fuentes**

European Central Bank, Frankfurt am Main, Germany; email: [Natalia.Martin\\_Fuentes@ecb.europa.eu](mailto:Natalia.Martin_Fuentes@ecb.europa.eu)

### **Alexandra Born**

European Central Bank, Frankfurt am Main, Germany; email: [Alexandra.Born@ecb.europa.eu](mailto:Alexandra.Born@ecb.europa.eu)

### **Franziska Bremus**

German Institute for Economic Research (DIW Berlin), Berlin, Germany; email: [fbremus@diw.de](mailto:fbremus@diw.de)

### **Wieger Kastelein**

European Central Bank, Frankfurt am Main, Germany (formerly)

### **Claudia Lambert**

European Central Bank, Frankfurt am Main, Germany; email: [Claudia.Lambert@ecb.europa.eu](mailto:Claudia.Lambert@ecb.europa.eu)

### **© European Central Bank, 2023**

Postal address 60640 Frankfurt am Main, Germany

Telephone +49 69 1344 0

Website [www.ecb.europa.eu](http://www.ecb.europa.eu)

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