

I. Consumption smoothing and the role of banking integration in the euro area

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Members of a currency union lose their capacity to adjust to idiosyncratic shocks via nominal exchange rate adjustments or monetary policy actions. However, a well-designed currency union strengthens their opportunities for cross-border private risk sharing. Depending on the nature of the shock, several private risk-sharing mechanisms exist, such as the cross-border flow of funds and income from assets held abroad.

This section investigates to what extent cross-border bank sector integration helped smooth private consumption in the face of transitory shocks to household income since the euro was launched. The empirical analysis makes a distinction between direct and indirect bank integration. The former relates to direct interaction between foreign banks and domestic households, the latter to the borrowing and lending between foreign and domestic banks (with only domestic banks interacting with domestic households). The econometric analysis suggests that cross-border banking channels provided a useful countercyclical impulse to consumption over the sample period, smoothing up to half the negative income shocks. This smoothing effect, which can be large in principle, depends on the level of banking integration, which has declined in the wake of the global financial crisis. These findings provide useful policy lessons and underscore the need for further reforms to complete the economic and monetary union (EMU) architecture. This could give cross-border private risk sharing a more sustainable footing (1).

I.1. Introduction

Deep recessions can have a direct negative impact on a country's economy and citizens' welfare as they adversely affect key macroeconomic aggregates such as consumption and investment. While a small economy with its own currency can absorb part of an idiosyncratic shock through nominal exchange rate adjustments and monetary policy actions (2), these specific adjustment channels are not available to an economy that is part of a currency union (3).

However, given the high degree of integration across the members of the currency union, cross-border risk sharing is one of the channels via which they can strengthen their capacity to absorb and recover from (idiosyncratic) shocks. For instance,

the high degree of inter-state risk sharing in the United States of America is widely credited as being central to its success as a monetary union (4).

This is precisely the reason why the Five Presidents' Report of June 2015 (5) called for the shock absorption and recovery capacity of the euro area to be improved by strengthening cross-border risk-sharing channels. This is in addition to the role that the domestic banking system plays in absorbing shocks. As is well documented, the role of the banking system is much more prevalent in the euro area compared with the USA (6).

Cross-border risk sharing (7) can take many forms, including market mechanisms such as the cross-border flow of saving and borrowing - the credit

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(2) See for instance Friedman M. (1953), 'The Case for Flexible Exchange Rates', *Essays in Positive Economics*, Chicago University Press studying the case of idiosyncratic shocks. However common shocks, such as the COVID-19 pandemic in 2020 saw small countries with their own currency experience strong foreign exchange volatility and risks of foreign funding.

(3) For Member States that are part of a currency union, external adjustment occurs via internal devaluation, e.g. lowering labour costs or cutting domestic aggregate demand, e.g. fiscal contraction.

(4) Sala-i-Martin, X., and J. Sachs (1992), 'Fiscal federalism and optimum currency areas: Evidence for Europe from the United States', in Canzoneri, M., Masson, P. and V. Grilli (eds., 1992), *Establishing a Central Bank: Issues in Europe and Lessons from the U.S.*, Cambridge University Press: London.

(5) See Juncker, J.-C., Tusk, D., Dijsselbloem, J., Draghi, M. and M. Schulz (2015), *Completing Europe's Economic and Monetary Union*, European Commission. European Commission (2017), 'Reflection Paper on the Deepening of the Economic and Monetary Union' illustrates possible ways forward for deepening and completing the Economic and Monetary Union up until 2025.

(6) See references in sub-section I.3.

(7) A common definition of risk sharing used in this section refers to the capacity of firms and households to smooth their investment and consumption during economic shocks.

channel) ⁽⁸⁾ - and the cross-border flow of income from assets held abroad (i.e. the capital market channel) ⁽⁹⁾ ⁽¹⁰⁾ as well as public mechanisms such as cross-border fiscal transfers.

This section focuses on the credit channel and investigates to what extent cross-border bank sector integration helped smooth private consumption in the euro area ⁽¹¹⁾. It builds on the recent literature on risk sharing in monetary unions and makes use of the European Central Bank's (ECB) financial integration indicators.

Compared to the more general assessments of risk sharing in the literature ⁽¹²⁾, this section takes a narrow and more focused approach. It examines to what extent bank credit is used to finance temporary deviations of income from permanent income, while also making a distinction between direct and indirect bank integration. The other important macro-economic variable to consider is investment by non-financial corporations. However, such analysis is beyond the scope of this section.

The section starts with a brief description of cross-border integration since the euro was launched and reviews the literature on risk sharing. It then investigates from an econometric viewpoint the impact of cross-border bank integration on consumption smoothing in the euro area, i.e. ex-post risk sharing ⁽¹³⁾. In this econometric exercise, cross-border bank sector integration in the euro area is measured by a set of outcome indicators that are directly related to market integration, such as the amount of cross-border credit flows and

cross-border price dispersions in the banking sector ⁽¹⁴⁾. The final section concludes with some policy implications.

The empirical results suggest that although cross-border bank integration has had a countercyclical impact on private consumption, there is still considerable room to strengthen its potential. From this perspective completing the banking union could help spread country-specific risks across the euro area. However, further bank integration should not be seen in isolation but as part of a holistic approach aimed at completing the EMU architecture. This includes completing the capital markets union and establishing a common fiscal stabilisation mechanism.

While further bank integration may strengthen the efficiency and resilience of Europe's banking sector, this section does not provide an assessment of cross-border contagion risks and their potential costs which can be particularly high if cross-border banking becomes excessive ⁽¹⁵⁾. It also does not analyse possible complementarities with other forms of private risk sharing ⁽¹⁶⁾ or public risk sharing, ⁽¹⁷⁾ or the impact of further financial integration on the banking sector's profitability. In addition, while other studies focus on the stabilising impact of credit aggregates that cover credit to households as well as to firms, this section focuses specifically on the impact of bank lending on private consumption.

⁽⁸⁾ The cross-border credit channel decouples the domestic credit supply from local banks' lending capacity, which makes domestic credit volumes less sensitive to idiosyncratic shocks that adversely affect the capital base of local banks or the solvability of loans.

⁽⁹⁾ The cross-border capital market channel allows the private sector to hold a diversified portfolio of assets that generates an income stream less dependent on adverse idiosyncratic shocks.

⁽¹⁰⁾ Cross-border labour mobility is another market channel, but the available empirical evidence suggests that the impact of labour mobility is limited. For instance, within the limits set by data availability, Alcidi, C. and G. Thirion (2016), 'Assessing the Euro Area's Shock-Absorption Capacity Risk sharing, Consumption Smoothing and Fiscal Policy.', *CEPS Special Report* No. 146 estimate that labour mobility in the euro area absorbs around 0.08% of a 1% shock to GDP.

⁽¹¹⁾ As such, this section does not cover other channels of risk sharing such as remittances from abroad.

⁽¹²⁾ See for instance Asdrubali F., B. Sorensen and O. Yosha (1996), 'Channels of interstate risk sharing: United States 1963-1990', *The Quarterly Journal of Economics*, Vol. 111, No. 4, pp 1081-1110.

⁽¹³⁾ It does not examine the impact of ex ante risk sharing via for instance the holding of diversified financial portfolios, which may limit fluctuations in permanent disposable income.

⁽¹⁴⁾ The law of one price (of bank instruments and services) will prevail in fully integrated markets, and there will be no home bias in economic agents' portfolios of bank related assets and liabilities.

⁽¹⁵⁾ Nevertheless, cross-border banking makes domestic banks and households more vulnerable to external shocks. This may then have a destabilising effect for the domestic economy if cross-border bank integration has taken an excessive form. See for instance Allen, F, T Beck, E Carletti, P R Lane, D Schoenmaker, and W Wagner (2011), *Cross-Border Banking in Europe: Implications for Financial Stability and Macroeconomic Policies*, Centre for Economic Policy Research. Schoenmaker, D. and W. Wolf (2011), 'The Impact of Cross-Border Banking on Financial Stability', *Tinbergen Institute Discussion Paper*, No. 11-054/2/DSF18. Moreover, faced with large common shocks the benefits of diversification can break down. See for instance Draghi (2018), 'Risk-reducing and risk-sharing in our Monetary Union', speech delivered at the European University Institute, Florence, 11 May 2018.

⁽¹⁶⁾ Such as ex-ante risk sharing via capital markets or cross-border labour mobility.

⁽¹⁷⁾ For instance, Draghi (2018), 'Stabilisation policies in a monetary union', speech delivered at the Academy of Athens, argues that there is a strong complementarity between private and public risk sharing – private risk sharing emerges from deep and resilient financial integration, which only arises in the shelter of public risk-sharing, such as strong backstops and deposit insurance schemes.

Importantly, this section covers the period before the outbreak of the COVID-19 pandemic and does not provide estimates of the pandemic's impact on cross-border bank lending that would require a separate analysis once sufficient data are available.

I.2. Risk sharing via the banking sector in the euro area

I.2.1. Shocks and their impact

The effectiveness of capital markets and banks to withstand shocks depends on the nature of the shock. Permanent shocks require allocative transformations and sizeable investments and cannot be offset easily. Capital markets and cross-country equity ownership can help absorb such shocks as they provide a diversified income stream and diversified source of foreign direct investment. The role of the banking system in such transformations may be considered more long-term and comes in the form of investment financing.

Conversely, the banking sector can provide short-term financing to financially viable households and corporates during temporary shocks. However, if credit would only be provided through the domestic banking sector, the credit supply would be constrained by domestic conditions⁽¹⁸⁾.

Financial integration and competition among financial institutions support both the capital and credit market channels. However, this does not mean that all types of financial integration improve risk sharing. While cross-border asset holdings, notably various forms of equity holdings, are found to have strong risk-sharing properties, debt instruments are found to have less so⁽¹⁹⁾. Moreover, while direct cross-border bank lending to firms and households is considered supportive of risk sharing, empirical evidence shows that cross-border interbank lending is not conducive to risk-sharing⁽²⁰⁾.

⁽¹⁸⁾ Nevertheless, foreign lending may be more sensitive to negative information. As such, the European Bank Coordination 'Vienna' Initiative was launched in January 2009 to help ensure that large banks commit to maintaining exposure to subsidiaries and recapitalising them. See <http://vienna-initiative.com/>

⁽¹⁹⁾ Artis, M. J. and Hoffmann, M., "The Home Bias, Capital Income Flows and Improved Long-Term Consumption Risk Sharing between Industrialized Countries", *International Finance*, Vol. 13(3), 2012, pp. 481-505.

⁽²⁰⁾ Allen et al. (2011), *op. cit.*

I.2.2. Slow progress towards a complete Banking Union

While completion of the Single Market in banking and other financial services is crucial for private risk sharing, progress towards a complete Banking Union has been slow – both in terms of the institutional reforms needed to complete a Banking Union⁽²¹⁾ as well as changes in market behaviour.

For instance, Graph I.1 shows that banking sector integration⁽²²⁾, based on a price-dispersion indicator published by the ECB, peaked in the euro area by late 2006-early 2007⁽²³⁾. However, in the wake of the subprime mortgage crisis and Lehman Brothers collapse, the banking sector seems to have fragmented considerably, with integration reaching a low by mid-2012.

Overall, this development reflects the lack of a solid foundation to absorb shocks, especially in the earlier period, with uncoordinated national responses that adversely affected the banking market integration process⁽²⁴⁾.

Financial integration received a new and more sustainable impetus with the agreement between EU Heads of State and Government to create the European banking union in June 2012 and the announcement of the ECB's Outright Monetary

⁽²¹⁾ Such as a European Deposit Insurance Scheme (EDIS). See for instance Grochowska, A. and A. Hild (2019), 'Financial Union: Integration & Stability', *Quarterly Report on the Euro Area*, Vol. 18, No 2, pp. 7-23.

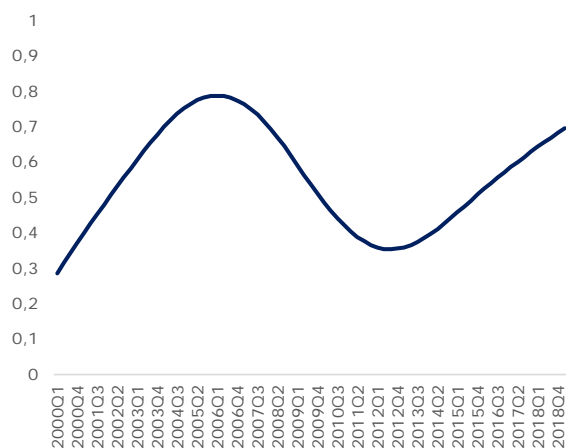
⁽²²⁾ Generally speaking, a market for specific financial instruments or services is fully integrated if all potential market participants "(i) are subject to a single set of rules when they decide to deal with those financial instruments or services, (ii) have equal access to this set of financial instruments or services, and (iii) are treated equally when they operate in the market." See for instance Trichet, J-C (2008), keynote speech at the Second Symposium of the ECB-CFS research network on "Capital Markets and Financial Integration in Europe", Frankfurt am Main.

⁽²³⁾ For more details on this indicator, see for instance, Hoffmann, P., M. Kremer and S. Zaharia (2019), 'Financial integration in Europe through the lens of composite indicators', *ECB Working Paper* No 2319.

⁽²⁴⁾ For instance, European Commission (2012), *European Financial Stability and Integration 2011 Report* argues that the state aid interventions by national governments in 2008 and 2009 aimed at rescuing domestic banks differed in magnitude and design, thereby distorting the level playing field in the banking sector across the euro area. See also Grochowska, A. and A. Hild, (2019), 'Financial Union: Integration and Stability', *op. cit.* for a comparison with overall financial market integration.

Transactions programme ⁽²⁵⁾ – as can be seen in Graph I.1.

Graph I.1: **Bank integration in the euro area**



(1) Normalised indicator (with value between 0 and 1) based on price dispersion, with higher price dispersion values tending to indicate a lower degree of banking integration. Original ECB series HP-filtered ($\lambda=1600$).

The price-based composite indicator aggregates 10 indicators for money, bond, equity and retail banking markets: money markets 17%, bond markets 36%, equity markets 15% and banking markets 32%. For more details, see Hoffmann, Kremer and Zaharia (2019), op.cit.

Source: European Central Bank

Nevertheless, it is widely accepted that the banking union remains incomplete, with several key steps still pending, including a common deposit insurance scheme and common resolution fund ⁽²⁶⁾.

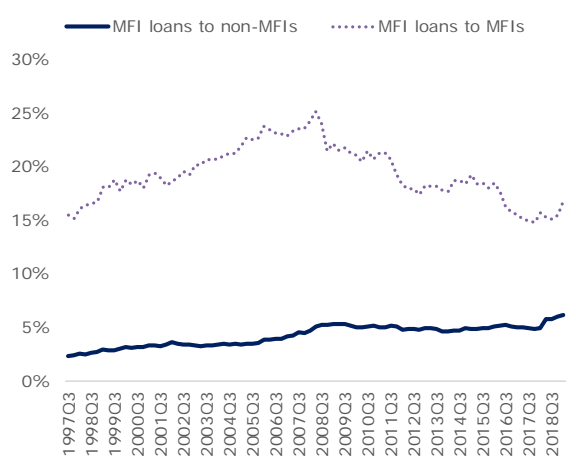
I.2.3. Different paths for direct and indirect cross-border credit channels

On a more disaggregated level, the reversal in bank integration after the crisis was particularly stark in terms of cross-border interbank lending (the indirect channel) after 2008 and intensified subsequently by deteriorating asset quality – see Graph I.2 as well as the graphs presented in Box I.1 ⁽²⁷⁾. While interbank cross-border lending rose

steadily as a share of total interbank lending from 1997 to 2008, it has since fallen almost consistently. In September 2018 it was at the same level as September 1997, – before the start of the third phase of EMU – and before rising slightly in March 2019. Following the Lehman Brothers shock, the interbank channel was effectively shut for a considerable period as banks refused to provide any financing (on-shore or cross-border) through these channels.

The picture for the direct channel (i.e. cross-border lending from foreign financial institutions to domestic non-financial corporations) is completely different. The share of cross-border MFI loans to non-MFIs rose steadily from September 2007 – albeit from a very low base – remained stable following the crisis in 2008, and has started to increase again in the last 18 months ⁽²⁸⁾.

Graph I.2: **Cross-border lending as a share of total lending**



(1) MIF: monetary financial institution

Source: European Central Bank

⁽²⁵⁾ As argued in, for instance, Hoffmann, P., M. Kremer and S. Zaharia (2019), 'Financial integration in Europe through the lens of composite indicators', *ECB Working Paper Series* No 2319.

⁽²⁶⁾ See European Commission (2017), Reflection Paper on the Deepening of the Economic and Monetary Union, and European Commission (2017), Communication on completing the Banking Union, COM(2017) 592 final.

⁽²⁷⁾ See for instance Emter, L., Schmitz, M. and M. Tirpák (2018), 'Cross-border banking in the EU since the crisis: what is driving the great retrenchment?', *ECB Working Paper Series* No 2130. Their econometric analysis suggests that cross-border banking

retrenchment in the wake of the crisis was to a large extent driven by poor asset quality at home in the EU.

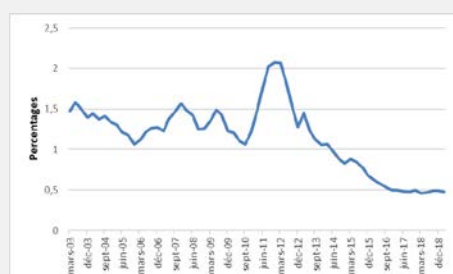
⁽²⁸⁾ Graph E of Box I.1 reveals a similar development, displaying an aggregate indicator of direct cross-border lending. However, this aggregate indicator also includes a measure of interest rate dispersion, which decreased mechanically as nominal interest rates were converging to their effective lower bound in the wake of the global financial crisis.

Box I.1: Direct and indirect cross-border bank sector integration

This section makes a distinction between direct and indirect bank integration. The former relates to direct interaction between foreign banks and domestic households, the latter to borrowing and lending between foreign and domestic banks that interact with domestic households. Complementing the indicators shown in Graph I.3 of the main text, this box first depicts additional indicators for direct and indirect cross-border lending. It then shows two aggregate indicators referring to the direct and indirect credit channel.

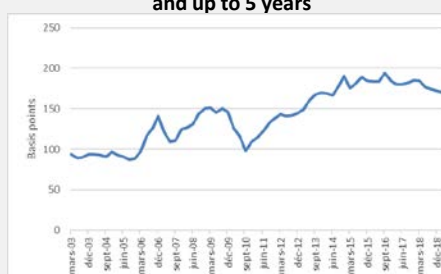
Graph A shows the standard deviation of interest rates on monetary financial institutions (MFI) deposits from households in the euro area, while Graph B shows the standard deviation of interest rates on consumer credit over 1 year and up to 5 years. Full cross-border bank integration would imply that these measures would be equal to zero – if there would be, for instance, no difference in risk preferences between consumers ⁽¹⁾. These indicators are related to the direct cross-border channel. Graphs C and D show respectively MFI holdings of securities issued by MFIs from other euro area countries and MFI deposits from MFIs from other euro area countries. These indicators are related to the indirect cross-border channel.

Graph A: Cross-country standard deviation of interest rates on MFI deposits from households



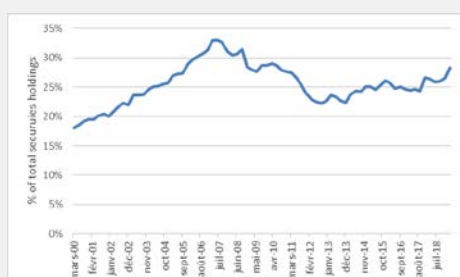
Source: ECB

Graph B: Cross-country standard deviation of interest rate on consumer credit: over 1 year and up to 5 years



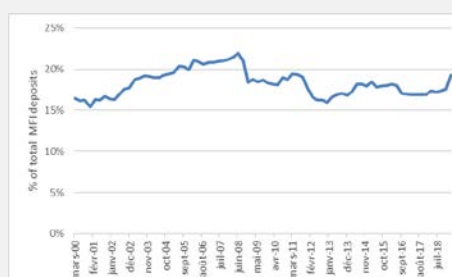
Source: ECB

Graph C: MFI holdings of securities issued by MFI from other euro area Member States



Source: ECB

Graph D: MFI deposits from MFIs from other euro area Member States



Source: ECB

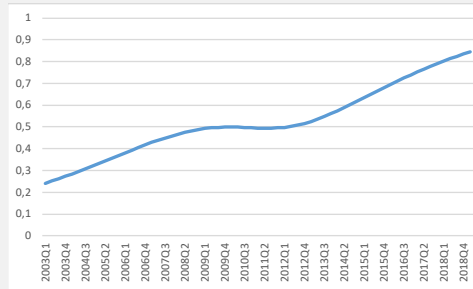
⁽¹⁾ It should be noted that different interest rates between Member States might also reflect different levels of credit risk. This could well be the case even with full banking sector integration, when banks discriminate against borrowers based on where they reside.

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Box (continued)

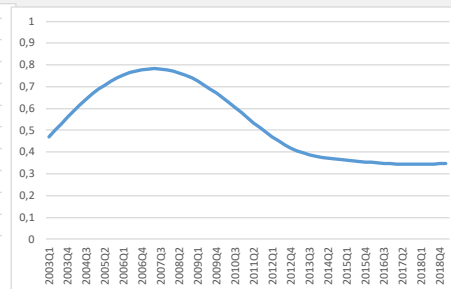
Aggregating several ECB sub-indicators ⁽²⁾, Graph E suggests that the direct bank channel ⁽³⁾ improved steadily after the euro was launched but stalled at the height of the global financial crisis and regained momentum as of 2014. Graph F suggests that the indirect bank channel (or bank-to-bank lending) ⁽⁴⁾ increased notably after the euro was launched but weakened dramatically during the global financial crisis, lacking growth momentum afterwards.

Graph E: Direct cross-border bank integration in the euro area



Note: Authors' estimate based on ECB indicators of financial integration S26 and S34
Note: A rise indicates an increase in direct cross-border bank integration

Graph F: Indirect cross-border bank integration in the euro area



Note: Authors' estimate based on ECB indicators of financial integration S27, S28 and S29
Note: A rise indicates an increase in direct cross-border bank integration

- ⁽²⁾ In this section, both price and quantity indicators have been used to monitor financial market integration and construct aggregates used in the econometric analysis. No absolute preference should be given to either quantity-based or price-based indicators as both have their specific advantages and shortcomings. See for instance Adam, K., Menichini, A., Padula, M. and M. Pagano (2002), 'Analyse, Compare, and Apply Alternative Indicators and Monitoring Methodologies to Measure the Evolution of Capital Market Integration in the European Union' and Hoffman et al. (2019), *op. cit.*
- ⁽³⁾ Making use of the ECB Financial Integration Indicators database, direct bank integration is approximated by the average of the normalised sub-indicator S26 measuring loans by domestic MFI to non-MFIs in the rest of the euro area (as a percentage of their total outstanding amount to non-MFIs) and sub-indicator S34 measuring cross-country dispersion interest rates on MFI deposits from households in the euro area. For sub-indicator S26 a rise indicates increased integration, whereas for sub-indicator S34 a rise indicates decreased integration. As such, in the aggregation the S34 series has been multiplied by -1. The aggregate is normalised to a Hodrick-Prescott filtered indicator ranging between 0 and 1, i.e. a transformation such as $1 - 1 / (1 + \exp(x))$ with X the untransformed series. As such, a higher value indicates stronger bank integration.
- ⁽⁴⁾ An aggregate of ECB sub-indicators S27 measuring loans by domestic MFIs to MFIs in the rest of the euro area (as a percentage of their total outstanding amount to MFIs), S28 measuring holdings by domestic MFIs of securities issued by MFIs in the rest of the euro area (as a percentage of their total outstanding amount) and S29 measuring MFI deposits from MFIs in the rest of the euro area (as a percentage of their total outstanding amount).

All in all, these stylised facts provide further evidence of the fact that direct bank-to-non-bank lending is more resilient as a risk-sharing mechanism than indirect bank-to-bank lending ⁽²⁹⁾.

1.3. Some empirical evidence on cross-border risk-sharing

Several studies highlight the stabilising effect of private risk sharing via the banking sector. Typically, these studies examine the aggregate impact on inter-state GDP without making a distinction between credit to households and firms. The analysis in the following sub-section focuses on the impact of bank credit on private consumption only.

⁽²⁹⁾ See for instance Hoffmann, M., Maslov, E., Sørensen, E.B., and I. Stewen (2019), 'Channels of Risk Sharing in the Eurozone: What Can Banking and Capital Market Union Achieve?', *IMF Economic Review*, No 67, pp. 443–495.

One of the first econometric analyses of risk sharing provided by the banking sector via credit markets was undertaken for the United States ⁽³⁰⁾. This study reported that between 1963-1990, inter-state shocks to the per capita state gross product were smoothed as follows: 13% by the federal tax transfer and grant system, 39% by insurance or cross-ownership of assets, and 23% by borrowing or lending via cross-border banking ⁽³¹⁾.

This analysis was updated with data up to 2013 for the United States and extended to include the euro

⁽³⁰⁾ See for instance Asdrubali, Sørensen and Yosha (1996), *op. cit.* This was based on a cross-sectional variance decomposition of shocks to GDP.

⁽³¹⁾ Nevertheless, Dullien, S. (2017), 'Risk Sharing by Financial Markets in Federal Systems: What Do We Really Measure?', *FMM-Working Paper*, No. 2 argues that the methodology proposed by Asdrubali et al. (1996), *op. cit.* may overestimate income smoothing through credit markets as their estimates also cover effects that are purely domestic and have nothing to do with cross-border risk-sharing and cross-border income smoothing.

area for 1999–2015. It found that risk sharing via credit markets in the USA was equal to 26.7% of shocks, while in the euro area it was 18%⁽³²⁾.

The comparatively low levels of risk sharing for credit markets in the euro area compared to the United States reflect the different levels of banking sector integration. In the United States, the removal of barriers to entry for out-of-state banks started in 1978 and accelerated banking integration: for example, while the average share of total bank assets in each state that was held by cross-border banks was under 10% in the 1970s, it rose to around 60% by the mid-1990s.

In the euro area, the equivalent metric was 9.8% in 2018, around the level seen in the United States before banking integration began⁽³³⁾. This increase in banking integration has contributed to an increase in access to finance, in particular for small firms, and to lower state-level business cycle volatility⁽³⁴⁾ as well as better and more resilient inter-state risk sharing⁽³⁵⁾.

Other research has reaffirmed that the effectiveness of risk-sharing mechanisms in the euro area is significantly lower than in existing federations such as the USA⁽³⁶⁾ and Germany⁽³⁷⁾.

However, while in the early years of EMU only around a third of idiosyncratic output shocks were smoothed, this share increased to almost 60% in the aftermath of the European sovereign debt crisis. This outcome can be attributed to stronger financial integration as well as to the provision of

public financial assistance to countries under stress since 2010⁽³⁸⁾. Nevertheless, while the direct credit channel⁽³⁹⁾ together with public financial assistance helped absorb shocks in the euro area, cross-border interbank lending tended to be ineffective⁽⁴⁰⁾.

Available studies also highlight that the deleveraging from interbank loans in euro area banks' credit portfolios increased significantly in the wake of the 2007–08 global financial crisis⁽⁴¹⁾. This retrenchment was mainly driven by source country factors, such as poor asset quality at home⁽⁴²⁾. Furthermore, it is also reported that credit markets' effectiveness in smoothing shocks decreases with the persistence of the shock⁽⁴³⁾.

Research also suggests that the effectiveness of financial market risk depends on the existence of fiscal insurance mechanisms. This is because market and fiscal insurance react upfront to disequilibria in different markets and crises in different parts of the economy (real economy versus financial/banking markets)⁽⁴⁴⁾.

I.4. Private consumption and cross-border bank integration

This sub-section establishes the analytical framework to investigate the impact of transitory income fluctuations⁽⁴⁵⁾, financing gaps⁽⁴⁶⁾ and

⁽³²⁾ Nikolov, P. (2016), 'Cross-border risk sharing after idiosyncratic shocks: evidence from the euro area and the United States.', *Quarterly Report on the Euro Area*, Vol. 15, No. 2, pp. 7–18.

⁽³³⁾ ECB financial integration indicators (sub indicator 30) June 2019

⁽³⁴⁾ Morgan, D P, B Rime, and P E Strahan (2004), "Bank integration and state business cycles", *The Quarterly Journal of Economics*, Vol. 119, No. 4, pp. 1555–1584.

⁽³⁵⁾ Demyanyk, Y, C Ostergaard, and B E Sorensen (2007), 'US banking deregulation, small businesses, and interstate insurance of personal income', *The Journal of Finance*, Vol. 62, No. 6, pp 2763–2801. Hoffman M. and I. Shcherbakova-Stewen (2011), 'Consumption risk sharing over the business cycle: The role of small firms' access to credit markets', *Review of Economics and Statistics*, Vol. 93, No. 4, pp 1403–1416.

⁽³⁶⁾ See for instance Furceri, D and A. Zdzienicka (2015), 'The Euro area crisis: Need for a supranational fiscal risk sharing mechanism?', *Open Economies Review*, Vol. 26, pp. 683–710, using an unbalanced panel of 15 euro area countries over 1979–2010.

⁽³⁷⁾ Hepp and von Hagen (2013), 'Interstate risk sharing in Germany: 1970–2006', *Oxford Economic Papers*, Vol. 65, pp. 1–24 estimate that in Germany before reunification, 19% of a shock was smoothed by private factor markets, 50% was smoothed by the German government sector, and a further 17% was smoothed through credit markets

⁽³⁸⁾ See Cimadomo, J., Ciminelli, G., Furtuna O. and M. Giuliodori (2020), 'Private and public risk sharing in the euro area', *European Economic Review*, Vol.121, pp. 1–20. This study covers 11 euro area countries over 2001–2017.

⁽³⁹⁾ Credit to households and firms together.

⁽⁴⁰⁾ See Cimadomo et al. (2020), *op. cit.*

⁽⁴¹⁾ Using highly disaggregated bank-firm data covering credits above €30 000 n Italy from the last quarter of 2006 until the last quarter of 2010, Albertazzi, U. and M. Bottero (2014), 'Foreign bank lending: Evidence from the global financial crisis', *Journal of International Economics*, Vol. 92, Supplement 1, pp. S22–S35, report that foreign lenders restricted credit supply (to the same firm) more sharply than their domestic counterparts.

⁽⁴²⁾ See for instance Schmitz, M. and M. Tírpák (2017), 'Cross-border banking in the euro area since the crisis: what is driving the great retrenchment?', *ECB Financial Stability Review* November 2017 – Special features, pp. 145–157. Emter, L, M Tírpák, and M Schmitz (2018), 'Cross-border banking in the EU since the crisis: What is driving the great retrenchment?', *ECB Working Paper Series* WP 2130.

⁽⁴³⁾ As foreign lenders may be more reluctant to provide credit in the face of a long-lasting recovery period. See for instance Furceri and Zdzienicka (2015), *op. cit.*

⁽⁴⁴⁾ See Alcidi and Thirion (2016), *op. cit.*

⁽⁴⁵⁾ Transitory income fluctuations refers to changes in income that are not permanent, i.e. mainly the cyclical fluctuations in income. Box I.3 explains how these transitory income fluctuations have been estimated.

cross-border bank integration on private consumption smoothing. The next sub-section briefly describes the econometric results, while the subsequent sub-section presents simulation results based on the estimates obtained.

I.4.1. Financing gap

Households prefer to smooth consumption evenly over time, consistent with their expected long-term average income, i.e. permanent income. For each period, consumption has to be paid for in cash or another liquid asset. When current income falls temporarily below permanent income, households face a financing gap, and they will have to apply for credit ⁽⁴⁷⁾ or draw from their deposits in order to keep their consumption in line with permanent income. In the same way, households will deposit money with banks (including banks abroad) if they overshoot their permanent income temporarily or want to engage in precautionary saving ⁽⁴⁸⁾.

While the available literature on private consumption makes a distinction between permanent and transitory income, it often ignores barriers to financing such expenditures –it assumes perfect credit markets. In this section, a consumption function is estimated whereby consumption growth is conditioned by the permanent and transitory component of current income, as well as by households’ access to bank credit. Box I.2 at the end of this section tackles the issue in a more formal way.

Households obtain bank credit (deposits) from domestic or foreign sources. Cross-border bank

lending flows to domestic consumption via a direct or indirect channel. Under the direct channel, foreign banks provide funds directly to domestic households. Under the indirect interbank channel, foreign banks lend to domestic banks, which in turn lend to domestic households. However, access to these channels may vary over time – as discussed in sub-section 2.

The impact of direct and indirect cross-border bank integration on consumption smoothing is captured by interacting the level of integration with the transitory income component. Specifically, the regression analysis makes a distinction between the domestic bank channel, direct cross-border bank integration and indirect cross-border bank integration – with these indicators described and measured in Box I.3.

Moreover, available evidence suggests that wealth factors such as changes in the prices of residential buildings also affect private consumption ⁽⁴⁹⁾. In several Member States, there have been strong fluctuations in residential real estate prices since the launch of the euro (see Graph I.3).

The subsequent econometric analysis assumes that changes in residential real estate prices affect consumption via two channels. First, fluctuations in residential real estate prices relative to consumer prices have an autonomous impact on consumption, whereby the representative household consumes more (or less) when residential real estate prices increase at a stronger (or weaker) pace than consumer prices. This is known as the ‘house price effect’⁽⁵⁰⁾.

⁽⁴⁶⁾ The difference between the amount of money earned in the period and the amount of money needed to finance the consumption in line with permanent income.

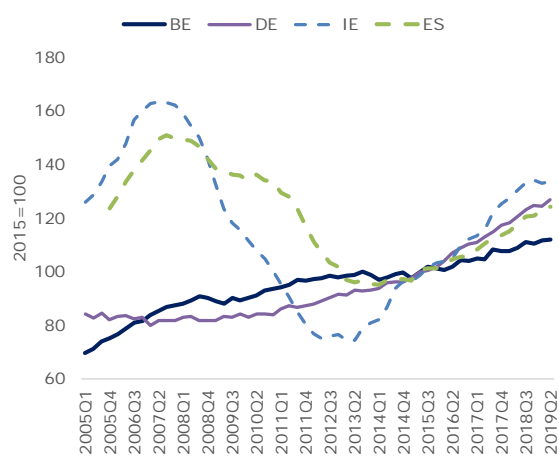
⁽⁴⁷⁾ To be paid back at a later date. Households are able to pay back what they borrow as up and down deviations from permanent income are on balance zero over the lifecycle. Implicitly no collateral has to be deposited to get this credit as it is assumed that temporary deviations above or below permanent income cancel each other out so there is not solvency problem getting credit to finance a temporary bank credit.

⁽⁴⁸⁾ This section focuses on the former effect. For instance, Lugilde, A., Bande, R. and D. Riveiro (2017), ‘Precautionary Saving: a review of the theory and the evidence’, MPRA Paper No. 77511, report that the empirical results on precautionary saving are inconclusive, and that there is neither consensus on the intensity of the motive for saving, nor on the most appropriate measure of uncertainty. However, available estimates in the literature suggest that forced savings seem to be the main driver of the spike in household savings during the first months of the COVID-19 pandemic. See for instance Dossche, M. and S. Zlatanov (2020), COVID-19 and the increase in household savings: precautionary or forced?, ECB Economic Bulletin, Issue 6/2020. This period is not covered by this section.

⁽⁴⁹⁾ See for instance Contreras, J. and J. Nichols (2010), ‘Consumption Responses to Permanent and Transitory Shocks to House Appreciation’, *Federal Reserve Board Finance and Economics Discussion Papers* No. 2010-2032

⁽⁵⁰⁾ Houses play a dual role in the economy: they provide house services and they are a durable asset that affects the wealth of the household. When residential real estate prices increase (while other prices remain constant) two effects emerge: (i) a relative price effect that decreases the consumption of house services but increase the consumption of goods, and (ii) a wealth effect that raises the demand for goods and services as it increases the value of residential real estate. In this reduced-form regression analysis, ‘house price effect’ refers to both effects - which point in the same direction in terms of consumption.

Graph I.3: Residential real estate prices
House prices



(1) 2015=100

Source: Eurostat

Second, deviations of residential real estate prices from their trend level⁽⁵¹⁾ affect the marginal propensity to spend out of transitory income as households feel less (or more) inclined to make precautionary savings out of their current income when residential real estate prices increase (or decrease). This is known as the ‘precautionary wealth effect’.

I.4.2. Econometric results

Following the above theoretical framework in the econometric analysis, private consumption growth is regressed on a set of macroeconomic factors such as permanent income component YP⁽⁵²⁾, transitory income component YT⁽⁵³⁾, the nominal interest rate LI, inflation INFL, and the price of residential real estate, PH, relative to the harmonised index of consumer prices HICP. In addition, the transitory income component is

⁽⁵¹⁾ The trend level is estimated by applying a Hodrick-Prescott filter, i.e. a series filtered from its cyclical component.

⁽⁵²⁾ Permanent income in the strict sense refers to the discounted income stream arising from both human and capital wealth including houses. In the subsequent empirical analysis, deviations from permanent income refer to deviations of contemporaneous labour income from permanent labour income. In the reduced from regression specification below, the other components of permanent income are approximated by residential real estate prices relative to HICP. As discussed in Box I.3 permanent income is estimated by regressing the total wage bill (per employed person) on trend price level, trend productivity, trend unemployment rate and a deterministic trend. Box I.3 also provides a robustness test by explicitly taking into account possible measurement errors in the estimated, unobservable permanent income. It suggests that the obtained point estimates are fairly stable.

⁽⁵³⁾ Current income is equal to permanent income plus transitory income.

interacted with an indicator measure of the domestic bank channel (dom BI)⁽⁵⁴⁾, as well as with indicators measuring direct (EA DIR) and indirect (EA INDIR) cross-border bank integration⁽⁵⁵⁾. The regression also includes the lagged error correction term ECT, which measures past deviations of actual consumption from equilibrium consumption⁽⁵⁶⁾. The sample covers the first quarter of 2016 to the first quarter of 2019. Box I.3 contains a brief description of the specification and data, as well as a more detailed discussion of the estimation results including robustness tests.

These robustness tests include regressions with (i) the short-term interest rate instead of the long-term interest rate, (ii) residential real estate prices instrumentalised as these prices may also be affected by random shocks to consumption,⁽⁵⁷⁾ (iii) permanent income instrumentalised to deal with possible ‘measurement problems’ as permanent income cannot be observed directly, (iv) the income tax rate as additional explanatory variable, (v) the direct and indirect cross-border bank integration indicators interacting with a dummy for each of the programme countries in the sample, and (vi) a regression with an autoregressive error term.⁽⁵⁸⁾ These tests suggest that the point estimates of the baseline specification are fairly stable.

Overall, the results show that most explanatory variables are significant and have the expected sign. However, the indirect cross-border bank channel

⁽⁵⁴⁾ The domestic bank channel is approximated by a Bank for International Settlements (BIS) indicator measuring domestic credit to private non-financial sector as a percentage of GDP.

⁽⁵⁵⁾ As discussed in Box I.1 the indicators measuring bank integration are Hodrick-Prescott filtered and are therefore not correlated with any cyclical fluctuations in consumption or the other explanatory variables. With an unconditional correlation between EA-DIR and EA-INDIR equal to -0.7 inefficiency in the point estimates (i.e. high standard errors and low t-statistics for the point estimates) seems to be limited.

⁽⁵⁶⁾ Equilibrium consumption is determined by permanent income, the nominal interest rate, the inflation rate and residential real estate prices. It assumes that preference ordering (i.e. utility function) does not change.

⁽⁵⁷⁾ A simultaneity bias may arise if the correlation between residential real estate prices and the random term of the regression equation has an expected value different from zero.

⁽⁵⁸⁾ Ireland, Spain and Portugal. Note that a programme also tempers the transitory income shock which is a predetermined variable in the regression analysis. This transmission channel is not studied in this section.

Table I.1: Short-term consumption (semi-)elasticities

| | | Constant elasticities | | | | | |
|-------------------------|-----------------------|---|--------------------|---------------|----------------|-------------|----------------------------|
| | | Permanent income | House price /HICP | Interest rate | Inflation | | |
| | | 0,39 | 0,09 | -0,1 | 0,14 | | |
| | | Decomposition of variable elasticities w.r.t. transitory income | | | | | |
| Strength of integration | Net transitory income | Domestic BI | Domestic BI * PROG | EA BI DIRECT | EA BI INDIRECT | House price | constant transitory income |
| weakest | 0,79 | -0,84 | 0,07 | -0,25 | -0,05 | -0,08 | 1,94 |
| average | 0,42 | -0,92 | 0,07 | -0,54 | -0,13 | 0,00 | 1,94 |
| strongest | 0,04 | -0,96 | 0,07 | -0,87 | -0,20 | 0,06 | 1,94 |

(1) Constant elasticities are the values of the point estimates under variant V4 – all effects significant except the euro area indirect cross-border bank integration and interest rate. Variable elasticities are equal to the point estimate multiplied by the value of the indicator, measuring the domestic bank sector channel, direct and indirect cross-border direct bank integration respectively, as well as residential the real estate price deviation from the trend residential real estate prices. (2) The value of the variable elasticities vary over time. ‘Weakest’ evaluates the elasticity for the lowest value (i.e. lowest level of bank integration) observed over the period the data are available, while the ‘strongest’ evaluates the elasticity for the highest value observed. The ‘average’ evaluates the elasticity for the average value of the indicator. The highest level of direct and indirect euro area bank integration was reached in the first quarter of 2019 and second quarter of 2007 respectively, while the lowest level was reached in the first quarter of 2003 and the fourth quarter of 2017 respectively. See also Box I.1. (3) While the indicators measuring direct and indirect cross-border bank integration have the same value for all Member States, the indicators for the domestic bank channel and residential real estate prices vary across Member States. The estimates in this table are the country average.

Source: Authors’ estimate based on variant V4 in Table A of Box I.3

(i.e. interbank lending) does not appear to be statistically significant ⁽⁵⁹⁾.

The negative point estimates for the domestic and direct cross-border channel imply a countercyclical response by the banking system. Put simply, when there is a large deviation from permanent income, the banking system helps to absorb part of the shock. In the Member States under an economic adjustment programme, the domestic credit channel lost some of its countercyclical impact as the banking system was deleveraging due to the deterioration of its domestic assets (loans to non-financial corporation or public sector bonds).

I.4.3. Elasticities

Table I.1 summarises the point estimates ⁽⁶⁰⁾ by showing the responsiveness of consumption to a unit change in each of the explanatory variables ⁽⁶¹⁾.

⁽⁵⁹⁾ In assessing the effectiveness of these channels it should be noted that interbank lending may have an impact on the capacity of domestic banks to lend to domestic consumers. Moreover, the ECB’s Asset Purchase Programme in the wake of the global financial crisis provided ample Eurosystem liquidity, which reduced the need for interbank lending. As such, the significance of the indirect channel may be low as the reduced from regression specification does not allow these channels to be captured explicitly.

⁽⁶⁰⁾ Based on variant V4 in Table A of Box I.3.

⁽⁶¹⁾ A 1% change in permanent and transitory income, and a 1 percentage point change in the interest rate and inflation rate.

The elasticities of consumption with regard to permanent income and residential real estate prices (relative to the HICP) as well as the interest rate and inflation rate have the expected sign and are significant – except for the nominal interest rate ⁽⁶²⁾. The first row of Table I.1 shows these elasticities.

The elasticity of consumption with regard to transitory income is broken down into six sub-parts (columns two to six). As this is based on interaction terms, its value is always conditional on the value of the other variables, which tend to vary over time – for example, in line with the level of bank integration ⁽⁶³⁾.

The estimated elasticities are as follows (second part of Table I.1): the constant (or time-invariant) part of the elasticity of consumption with regard to the transitory income is positive and large: a 1% fall in transitory income will induce a 1.94% fall in consumption (last column). This ‘gross’ effect of transitory income is tempered in varying degrees by the domestic bank channel (second column), cross-border direct bank integration (fourth column) and indirect bank integration (fifth column). Their elasticities are consistently *negative* as expected,

⁽⁶²⁾ The low significance of the interest rate is partly due to the low variability in the time series in particular from 2008. However, in the estimated long-run equation V0, the interest rate is significant.

⁽⁶³⁾ As discussed in sub-section 2 above.

providing a *smoothing or countercyclical* effect on consumption after a transitory income shock ⁽⁶⁴⁾.

Moreover, these elasticities vary over time as the level (of different types) of bank integration vary over time. Table I.1 (rows two to four) summarises this variability by showing the elasticities for the lowest ⁽⁶⁵⁾, average and highest bank integration level observed over the sample period. The first column shows the net effect ⁽⁶⁶⁾, taking into account the different smoothing channels.

With a high level of bank integration a 1% change in transitory income is associated with a very small 0.04% net impact on consumption – i.e. 96% of the transitory income shock is smoothed by the banking system (domestic and cross border). By contrast, with a low level of bank integration a 1% change in transitory income leads to a 0.79% change in consumption, implying only 21% of the transitory income shock is absorbed. On average, a 1% transitory income shock results in a 0.42% change in consumption, implying 58% ⁽⁶⁷⁾ of the impact of the shock was smoothed.

The domestic banking system (second column) appears to have the largest countercyclical effect following a transitory income shock, with an elasticity of between -0.84 and -0.96. Direct cross-border integration has the second largest countercyclical effect, with elasticities ranging from -0.25 to -0.87.

All in all, this econometric analysis offers two important messages: first, that the cross-border direct banking channel can be as important as the domestic bank channel for consumption smoothing; second, that the cross-border smoothing effect is *volatile*, reflecting the trends observed in bank integration over the last two

decades, suggesting the need to deepen cross-border bank integration in a sustainable way. Indirect cross-border bank integration also has a countercyclical effect, but the elasticity is significantly smaller (-0.05 to -0.2) than direct cross-border bank integration.

The following sub-sections discuss how the various factors affected consumption at country level between 2008 and early 2019.

I.5. Effectiveness of cross-border bank integration: illustrative simulations

This sub-section uses the estimation results presented in Box I.3 to simulate the banking sector's impact on private consumption variability in the euro area countries for which the data are available ⁽⁶⁸⁾. The intensity at which these channels operate depends on the level of cross-border bank integration in each of these segments.

The following simulations distinguish between two episodes: a recession and subsequent recovery period. During the first period (2008) income was on average well below trend income across the euro area countries. During the second period (2012-2019) income was on average in sync or above trend income.

I.5.1. Recession

Graph I.4 shows how several factors affected private consumption growth across the euro area ⁽⁶⁹⁾ over 2008-2012. Making a distinction between effects stemming from income fluctuations, residential real estate price fluctuations and other factors, the simulation results should be interpreted as follows.

Each period households earn current income that is equal to permanent income adjusted for a transitory component. While they both affect current income, they have a different impact on consumption.

⁽⁶⁴⁾ By contrast, as expected the elasticity of the domestic bank channel in cases where a country is under a financial assistance programme (third column) is positive, which indicates that the countercyclical effect of the domestic bank channel weakens.

⁽⁶⁵⁾ Assuming a scenario in which all types of bank integration would have been at their weakest level (observed over the sample period) and a scenario in which they would have been at their highest level. It is worth noting that the different types of bank integration recorded different developments with direct cross-border bank integration reaching its peak at the end of the sample and its low at the beginning of the sample. Indirect cross-border bank integration peaked in the second quarter of 2007 and reached its lowest at the beginning of the sample period. See Box I.1

⁽⁶⁶⁾ The sum of the variable elasticities (broken down in sub-parts) with regard to transitory income.

⁽⁶⁷⁾ The difference between two elasticities 1-0.42.

⁽⁶⁸⁾ By calculating the fitted value on the basis of the point estimates of variant V4 in Table A of Box I.3 and the observed values of the explanatory variables for the period under investigation.

⁽⁶⁹⁾ Covering 11 euro area countries for which all data are available: Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland.

Illustrative case: Spain

During this period permanent income decreased in Spain by almost 2% per year. If this would have been the only shock, disposable income would have decreased by the same amount and consumption would have fallen by almost 1% per year on average (purple bar).

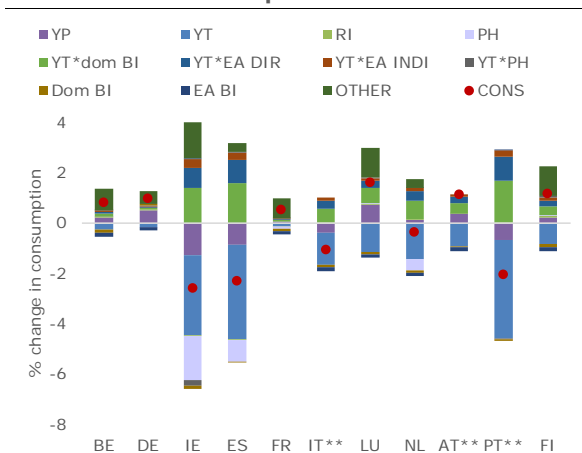
However, current income fell below permanent income, causing consumption growth to fall by 3.8% per year on average (light blue bar).

The effects of this temporary income drop was nonetheless tempered by bank credit. More specifically, domestic bank credit reduced the fall in consumption associated with the negative transitory component by 1.6% on average (light green bar), and direct cross-border credit by 0.9% on average (dark blue bar). The tempering effect of cross-border indirect credit was negligible.

Residential real estate prices also affected consumption. Their sharp fall (relative to consumer prices) induced a strong negative wealth effect, reducing consumption by an additional 0.9% per year on average (light purple bar). However, the impact of the residential real estate price fall on households' propensity to spend less from their transitory income⁽⁷⁰⁾ was negligible (dark grey bar)⁽⁷¹⁾.

All in all, the net effect of all factors combined lowered consumption by around 2% per year on average (red bullet).

Graph I.4: Factors affecting private household consumption –2008Q1-2012Q1



(1) CONS: private consumption, YP: permanent income component, YT: transitory income component, RI: real interest rate, PH: price of residential real estate relative to the harmonised index of consumer prices, DOM BI: domestic credit channel; EA DIR: direct cross border credit channel, EA INDI: indirect cross-border credit channel, EA BI aggregate of direct and indirect cross-border credit channel.

(2) Member States marked with ** to denote that the effect of residential real estate price changes is not shown explicitly but included in the term others (due to missing data for that specific period).

(3) While Table I.1 shows elasticities evaluated for specific periods in time (i.e. lowest, highest and average level of bank integration), the bars in the graphs show the elasticities measured for the specified period multiplied by the changes in the explanatory variables over that period.

Source: Authors' estimates.

General empirical findings

In summary, the simulation results in Graph I.4 show that

- trend income declined in several Member States, especially in Ireland and Spain, triggering a fall in consumption by 1.3% per year on average in Ireland, 0.9% in Spain and 0.7% in Portugal;
- current income fell below trend income in all Member States, with the sharpest fall in Ireland, Spain and Portugal, triggering an additional drop in consumption in these three Member States, by 3.2%, 3.8% and 3.9% respectively per year on average;
- residential real estate prices decreased sharply in Ireland and Spain and to a lesser extent in the Netherlands, triggering a further fall in consumption, in these three member States, by

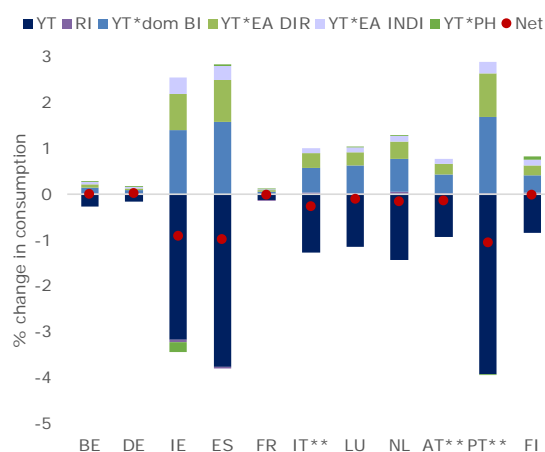
⁽⁷⁰⁾ The precautionary wealth effect discussed in sub-section I.1.4.

⁽⁷¹⁾ Across the sample, this channel only had a significant impact in Ireland.

1.7% in Ireland and 0.9% in Spain ⁽⁷²⁾ on average; and

- falling interest rates and inflation provided only limited stimulus ⁽⁷³⁾.

Graph I.5: **Impact of bank sector on transitory income fluctuations –2008Q1-2012Q1**



(1) See notes in Graph I.4.

Source: Authors' estimates.

At the same time, bank credit allowed households to absorb a sizeable part of the fall in private consumption that was triggered by temporary income fluctuations ⁽⁷⁴⁾. However, this stabilisation occurred with a varying degree of effectiveness between the three bank credit channels ⁽⁷⁵⁾ as well as over time ⁽⁷⁶⁾. More specifically, Graphs I.4 and I.5 suggest that:

- The domestic banking sector had the strongest impact in tempering the temporary income fluctuations in all euro area countries (included in the sample), offsetting 40-50% of the income shock. For instance, the domestic banking channel raised consumption by 1.8% in

Portugal, 1.7% in Spain and 1.5% in Ireland, partially offsetting the large transitory income shocks in these countries;

- The *direct cross-border channel* also helped to stabilise consumption, but its impact was around half of that from the domestic banking system, offsetting around 25% of the income shock. For instance direct cross-border banking boosted consumption by 1.0% in Portugal, 0.9% in Spain and 0.8 % in Ireland on average ⁽⁷⁷⁾;
- However, the *indirect cross-border channel* does not seem to have provided much stabilisation ⁽⁷⁸⁾.

These are sizeable effects. However, it is worth pointing t out that in the event of an idiosyncratic shock affecting one country, the domestic credit channel is likely to be somewhat muted. The potency of this **direct cross-border channel** is therefore key in helping smooth consumption.

I.5.2. Recovery and growth

The recovery period was characterised by an overall increase in economic activity which in turn brought current income closer to permanent income, and gave also rise to permanent income.

Illustrative case: Germany

Once again, the simulation results make it possible to distinguish the impact of the various factors. For instance, the simulation results suggest that in Germany, the increase in permanent income would have increased consumption, on average, by around 1% per year (purple bar) - if other factors would not have changed.

However, at the same time, a positive transitory income shock raised consumption even further, i.e., on average, by almost 0.5 percentage points (ppt) per year (light blue bar), while the increase in

⁽⁷²⁾ No data on residential real estate prices available for Portugal for that period.

⁽⁷³⁾ Robustness tests do not show a significant difference when using a short-term interest rate (less than 1 year).

⁽⁷⁴⁾ Here it is worth remembering that credit markets are unsuited to absorbing persistent idiosyncratic shocks such as a shock to permanent income. Such shocks have to be absorbed via capital markets (by holding a diversified portfolio of domestic and foreign assets) or by (permanent) cross-border labour mobility.

⁽⁷⁵⁾ The domestic channel as well as direct and indirect cross-border credit channel.

⁽⁷⁶⁾ As discussed in sub-section 2, the level of bank integration changed over time, i.e. a deterioration during the crisis years and a gradual recovery in recent years, so that part of the stabilisation capacity of cross-border integration was lost at the height of the crisis.

⁽⁷⁷⁾ The robustness check (variant V9 in Box I.3) suggests that the direct and indirect cross-border banking channels had a consistently smaller countercyclical impact on consumption in countries like Spain, Portugal and Ireland (that had financial assistance programmes) than in other countries - although the point estimates are only significant in the case of Portugal for the direct channel and Spain for the indirect channel. In other words, these estimates should be interpreted as upper-limits.

⁽⁷⁸⁾ No significant point estimate for the indirect cross-border channel. As argued above, this insignificance may be partly associated with the ECB's Asset Purchase Programme and the interaction between domestic bank lending and interbank lending.

residential real estate prices raised consumption, on average, by around 0.35 ppt (light purple bar) ⁽⁷⁹⁾.

At the same time, as current income grew at a stronger pace than permanent income, part of this increase was used to increase deposits by domestic and foreign banks, thereby tempering consumption growth, on average, by respectively, 0.18 ppt (dark blue bar) and 0.15 ppt (red bar). Again, residential real estate price developments had a negligible impact on households' propensity to spend less from their transitory income (dark grey bar) ⁽⁸⁰⁾.

General empirical findings

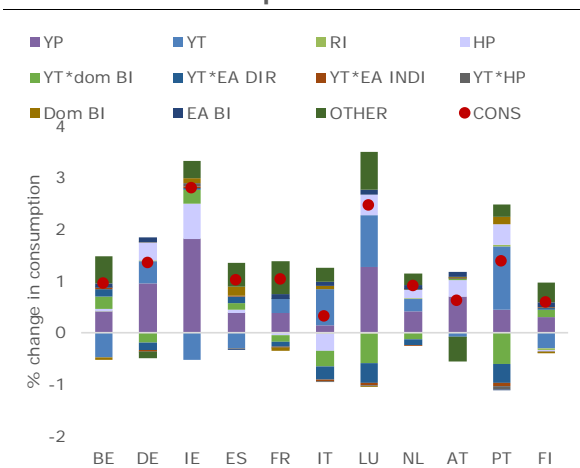
Graph I.6 shows the results for a period characterised by recovery and growth (in this section referring to the period from 2012 until early 2019). During this period:

- increased trend income was an important driver of consumption growth, especially in Ireland (raising consumption by 1.8% per year on average), Germany (by 1.0%) and Luxembourg (by 1.3%);
- residential real estate price developments ⁽⁸¹⁾ had a further positive impact on private consumption in most euro area countries, except Italy (inducing a 0.3% drop in private consumption on average);
- growth of the transitory disposable income component recorded in several Member States, especially in Luxembourg, Italy and Portugal giving rise to an increase in private consumption by 1.0%, 0.7% and 1.2% respectively per year on average;
- however, in several other Member States disposable income fell below trend income, putting downward pressure on private consumption, this was especially the case in Belgium (by 0.5% per year on average), Ireland (by 0.5%), Spain (by 0.3%) and Austria (by 0.1%) ⁽⁸²⁾.

Overall, the credit channel provided a countercyclical smoothing, with the strongest contribution stemming from the domestic credit channel, lowering private consumption (as some of the excess income was saved in deposits) by 0.2% on average in Germany and 0.6% in Luxembourg ⁽⁸³⁾. See graphs I.6 and I.7.

The same channel (but then in the opposite direction as income underperformed relative to trend income) increased consumption in Belgium (by 0.2%) Ireland (0.3%), Spain (0.1%) and Finland (0.1%).

Graph I.6: Factors affecting private household consumption –2012Q1-2019Q1



(1) See notes in Graph I.4.

Source: Authors' estimates.

All in all, despite the (gradual) improvement in cross-border bank integration, the cross-border effects have been rather modest – mainly reflecting the fact that in this period, temporary income was closer to trend income than during the crisis years.

⁽⁷⁹⁾ The residential real estate price effect discussed in sub-section I.4.1.

⁽⁸⁰⁾ The precautionary wealth effect discussed in sub-section I.4.1.

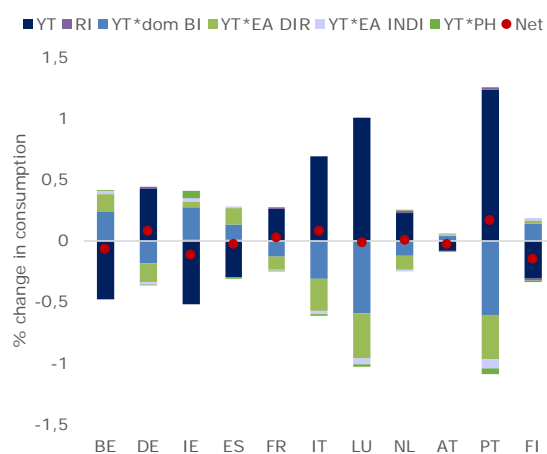
⁽⁸¹⁾ The residential real estate price effect as discussed in sub-section 4.

⁽⁸²⁾ Current income is equal to permanent income plus the transitory income component, which can be negative or

positive. In the former case, it gives rise to bank credit or the drawing down of existing deposits, while in the latter case it gives rise to bank deposits or paying off credit early. See equation (2) in Box I.2.

⁽⁸³⁾ Bank credits are only provided to bridge the gap between current and potential income. They do not cover falls in permanent income, which are of a more structural nature and can not be remedied by credit flow.

Graph I.7: **Impact of bank sector on transitory income fluctuations – 2012Q1-2019Q1**



(1) See notes in Graph I.4.

Source: Authors' estimates.

I.6. Conclusions

The 2008-2012 crisis in the euro area and available literature highlight the importance of cross-border risk-sharing in a monetary union with a single monetary policy that cannot directly address idiosyncratic shocks in specific Member States.

This section provided an econometric analysis of the effects of income shocks on private consumption in open economies and the degree to which foreign banks provide financial services (via lending or deposits) to domestic households to help them smooth the impact of these shocks.

The empirical analysis points out the important countercyclical impact of credit on consumption and suggests that cross-border bank integration plays a particularly important role in that respect.

However, this impulse depends on the type and level of bank integration. Direct cross-border bank integration appears to offset around a quarter of the transitory income shock on consumption. This contributed, on average, to around half of the

stabilisation seen during 2008-2012, while indirect cross-border credit channels provided only limited stabilisation. The significant countercyclical impact of direct cross-border banking is notable because the level of direct bank integration in the euro area was still quite limited in 2007 prior to the global financial crisis. By contrast, indirect bank integration was quite developed in 2007, although much of its countercyclical or smoothing properties were more volatile and continue to be so over time.

Completing the Banking Union can help deliver stable, cross-border bank intermediation over time, particularly through the direct channel (bank to household) ⁽⁸⁴⁾. Key reforms are being pursued, including common deposit insurance, improving the resolution framework and addressing the 'home-host' supervisory regimes, notably with regard to the restrictions on intra-group liquidity and capital ⁽⁸⁵⁾. Well-coordinated macro-prudential policy can also be a useful tool to prevent contagion across borders.

At the same time, completing the capital markets union may improve risk diversification and optimal allocation of investments. This is key to enabling conditions to boost M&A banking activity and increase cross-border banking investments.

Although the analysis in this section suggests that further bank integration strengthens consumption stability, there is still a need to complement it with other risk-sharing mechanisms. These include a well-designed common fiscal stabilisation scheme and the development of Europe-wide capital markets that strengthen private sector risk sharing.

Moreover, well-designed regulation is also needed to address possible risks associated with further bank integration, such as larger systemic or contagion risks and the reduction in competition in the sector. These could lead to an increase in financial service prices, which would also affect consumption.

⁽⁸⁴⁾ A mechanical extrapolation of the estimates deriving from the analysis suggests that a complete direct Banking Union would smooth around 50% of a transitory income shock. However, such extrapolation is only by way of an example as these estimates pertain specifically to the sample analysed during a specific period.

⁽⁸⁵⁾ "Deepening Europe's Economic and Monetary Union: Taking stock four years after the Five Presidents' Report- European Commission's contribution to the Euro Summit" 21 June 2019

Box 1.2: Household consumption, financing gap and bank credit/deposit

The analysis makes the following assumptions: i) households maximise an intertemporal utility function that depends on current and future consumption, ii) the present discounted value of consumption expenditures must equal the present discounted value of income, iii) each period the representative household earns an income that has a permanent and transitory component, iv) consumption is financed from current income and bank credit/deposits.

The intertemporal utility function U reads as

$$(1) U = \log c_1 + \beta \log c_2$$

with c_i consumption in period $i=1,2$ and β the discount rate. The current nominal income Y in period 1 is ⁽¹⁾

$$(2) Y_1 = YP P_1 + YT$$

while in period 2

$$(3) Y_2 = YP P_2$$

with YP the real permanent income component earned in periods 1 and 2, YT the nominal transitory income component earned in period 1, P_i the consumer price in period $i=1,2$.

Optimising behaviour implies that in the absence of frictions, the propensity to spend

permanent income on consumption is $\sigma = \frac{1 + \frac{1}{(1+r)\left(\frac{P_1}{P_2}\right)}}{1+\beta}$ with r the nominal interest rate.

In this section, we assume that bank credit/deposits are needed to cover the financing gap, FG , between current income, Y_1 , and desired consumption (based on permanent income), $\sigma P_1 YP$, i.e.

$$(4) FG = Y_1 - \sigma P_1 YP$$

or on making use of (2)

$$(5) FG = YT - (\sigma - 1)P_1 YP$$

if $\sigma = 1$ ⁽²⁾, the financing gap is equal to the transitory income, i.e.

$$(6) FG = YT.$$

The financing gap is (partly) closed with bank credit BC ,

$$(7) BC = BI FG$$

with $0 \leq BI \leq 1$ measuring the fraction of the financing gap that can be borrowed or deposited ⁽³⁾, and with an interest rate r paid on the credit. $BI=0$ when the household does not have access to credit and $BI=1$ when all its credit needs are met.

⁽¹⁾ For analytical simplicity it is assumed that there is no shock in period 2.

⁽²⁾ This is the case if the real interest rate equals the discount rate, i.e. $\beta = \frac{1}{(1+r)\frac{P_1}{P_2}}$.

⁽³⁾ In the empirical analysis, where a distinction is made between domestic, as well as direct and indirect cross-border lending, this 'access' parameter varies over time and is measured by an ECB indicator.

(Continued on the next page)

Box (continued)

With access to credit markets, the intertemporal budget constraint reads as

$$(8) P_1 C_1 + \frac{P_2 C_2}{1+r} = [Y_1 + BC] + \left[\frac{Y_2}{1+r} - (1+r)BC \right]$$

with the first bracket on the right-hand side the cash flow in period 1, and the second bracket the cash flow in period 2.

Equation (8) can be written as

$$(9) P_1 C_1 + \frac{P_2 C_2}{1+r} = Y_1 + \frac{Y_2}{1+r} - r BC$$

Inserting (2), (3) and (6) into (9) and rearranging terms, the intertemporal budget constraint reads as

$$(10) P_1 C_1 + \frac{P_2 C_2}{1+r} = \left(1 + \frac{\left(\frac{P_2}{P_1}\right)}{1+r} \right) P_1 YP + (1-r BI) YT$$

Maximising (1) subject to (10) provides an Euler equation

$$(11) C_2 = \beta (1+r) \frac{P_1}{P_2} C_1$$

inserting (11) in (10) yields

$$(12) C_1 = \frac{1}{(1+\beta)} \left(1 + \frac{\left(\frac{P_2}{P_1}\right)}{1+r} \right) YP + \frac{1}{(1+\beta)} \frac{YT}{P_1} - \frac{r}{(1+\beta)} BI \frac{YT}{P_1}$$

i.e. private consumption is equal to its desired level (in the absence of a shock) adjusted for a temporary deviation of income from permanent income and the availability of credit.

Taking first differences of equation (12), dividing both sides by C and remembering that $d \ln(x) = 1/x dx$,

$$(13) d \ln(C_1) = \rho_1 d \ln(YP) + \rho_2 d \ln\left(\frac{YT}{P_1}\right) - \rho_3 \left[BI d \ln\left(\frac{YT}{P_1}\right) \right] - \rho_4 dr - \rho_5 dBI$$

with the values of the parameters $\rho_i > 0$ for $i=1, \dots, 5$ set by the structural parameters of the model and point of linearization. Equation (13) shows how contemporary consumption growth is conditioned by the permanent and transitional component of current income, as well as the bank credit flowing to households.

Box 1.3: A reduced form regression analysis

A. Specification

With the difference operator Δ measuring the change between a quarter and the same quarter in the previous year, the error correction mechanism is specified as:

$$\begin{aligned}(1) \Delta \ln(C_{it}) = & \alpha_i + \beta_1 \Delta \ln(YP_{it}) + \beta_2 \Delta \ln(YT_{it}) + \gamma_1 \Delta(LI_{it}) + \gamma_2 \Delta(INFL_{it}) \\ & + \gamma_3 \Delta \ln(PH_{it}/HICP_{it}) + \rho_1 DB_t \Delta \ln(YT_{it}) + \rho_2 BI_DIR_t \Delta \ln(YT_{it}) + \rho_3 BI_INDIR_t \Delta \ln(YT_{it}) \\ & + \rho_4 \ln(PH_{it}/\overline{PH_{it}}) \Delta \ln(YT_{it}) + \theta_1 \Delta(DB_{it}) + \theta_2 \Delta(BI_DIR_t) + \theta_3 \Delta(BI_INDIR_t) \\ & + \mu ECT_{it-4} + u_{it}\end{aligned}$$

with ECT referring to the error correction term measuring disequilibrium in the past, u referring to a stochastic term, and parameter α_i capturing country fixed effects⁽²⁾. The indices i and t refer to the country and the period respectively ⁽³⁾.

The parameters related to the variables other than the bank sector are expected to have the following signs: $\beta_1, \beta_2, \gamma_2, \gamma_3 > 0$ and $\gamma_1 < 0$. For the bank sector channels it is expected that $\rho_1, \rho_2, \rho_3 < 0$, indicating that when access to the bank sector (i.e. credit and deposits) improves, the negative (positive) impact of a deviation in actual income is tempered. The parameters $\theta_1, \theta_2, \theta_3 > 0$ indicate that on their own the improvements in cross-border banking have a positive impact on private consumption.

B. Data

The unbalanced data set covers quarterly data for 11 Member States⁽⁴⁾ from the first quarter of 2006 to the first quarter of 2019. The data have been retrieved from various sources, including Eurostat, the (ECB) and the Bank for International Settlements (BIS).

As harmonised quarterly data on disposable household income is not available in the Eurostat database, this variable has been approximated by using the wage bill. The temporary deviation from permanent income is estimated by regressing the total wage bill (per employed person) on trend price level, trend productivity, trend unemployment rate and a deterministic trend, whereby the trend values are obtained by applying a Hodrick-Prescott filter (with $\lambda=1600$). Permanent income is the fitted value of this regression.

The data for the direct and indirect cross-border bank sector integration are presented in Box 1. At the domestic level, the banks' capacity and willingness to lend and borrow is proxied by the Hodrick-Prescott filtered BIS series. 'Credit to private non-financial sector from all sectors

⁽²⁾ Capturing all time-invariant institutional and economic features that affect consumption.

⁽³⁾ Underpinning such reduced form specification is an intertemporal utility maximisation problem as described in Box I.2.

⁽⁴⁾ Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland.

(Continued on the next page)

Box (continued)

at market value - Percentage of GDP - Adjusted for breaks' is used to approximate the stance of this domestic bank channel ⁽⁵⁾.

C. Estimation results

The estimation of equation (1) is based on the two-step Engle-Grange procedure. Variant V0 in Table A shows the estimation results for the long-run consumption (co-integration) relationship after pooling the data for the Member States for which data are available. The point estimates have the expected sign, with an increase (decrease) in consumption when permanent income and inflation increase (decrease) and a decrease (increase) when the interest rate increases (decreases) ⁽⁶⁾.

Focusing on the short to medium run, various variants of the error correction mechanism have been estimated with generalised least squares ⁽⁷⁾ using a pool of demeaned variables ⁽⁸⁾. Variant V1 shows the estimation results for the error correction mechanism without the banking sector. All point estimates of the macro-economic variables have the expected sign and are significant. The next three variants show the estimation results for alternative specifications for the bank sector interaction ⁽⁹⁾.

Variant V2 presents estimation results of the interaction of the temporary income deviation with the domestic banking sector capacity as well as an aggregate indicator of cross-border bank sector integration ⁽¹⁰⁾. Both interactions show a negative point estimate and are significant; this suggests a countercyclical effect, i.e. a fall (rise) in actual income below permanent income, putting downward (upward) pressure on consumption, is tempered by bank credit (deposits). However, the countercyclical effect of the domestic bank interaction channel appears weaker during the periods when the country was under a programme ⁽¹¹⁾.

Variants V3 and V4 show estimation results after disaggregation of the aggregate indicator of cross-border bank sector integration into its direct and indirect channel. In both variants the domestic and direct cross-border channel interacting with temporary income deviation have the expected negative sign. However, the indirect channel is insignificant.

⁽⁵⁾ Other variables included in the regression analysis are the ECB MFI interest rate statistics (the interest rate over one year to households), Eurostat's house price index (tipsho40), Eurostat National Accounts the final consumption expenditure of households (namq_10_gdp), wages and salaries (namq_10_gdp) and HICP (prc_hicp_midx). Data are seasonally and calendar adjusted data.

⁽⁶⁾ These estimates allow us to estimate the error correction term used in variants 1 to 4.

⁽⁷⁾ This allows for correlation between the random components across Member States.

⁽⁸⁾ For each Member State the variables have been demeaned by subtracting the Member State's sample mean from the observed value. When the data are centred, the addition of interaction terms does not affect the point estimates of the main effects. Centring also reduces collinearity between explanatory variables. See for instance Aiken, L. and S. West (1991), *Multiple Regression: Testing and Interpreting Interactions*.

⁽⁹⁾ Comparing the R-squared diagnostic statistics – which is a measure of how much variation of a dependent variable is explained by the independent variables – it is worth remembering that the variants V2, V3 and V4 differ from each other in terms of the specific type of interaction variable, i.e. the aggregate, a disaggregate in direct and indirect effect – which are strongly correlated with each other.

⁽¹⁰⁾ Capturing direct and indirect channel in one indicator as is the case for the ECB price-based financial integration composite sub-indicator for the banking market. For more details on this ECB indicator, see https://www.ecb.europa.eu/stats/financial_markets_and_interest_rates/financial_integration/html/index.en.html

⁽¹¹⁾ In the regression captured by the term interacting with the programme dummy, which is equal to 1 if the Member States is under a programme and 0 if not under a programme.

(Continued on the next page)

Box (continued)

Variant V3 and V4 differ from each other as to how the stand-alone impact of cross-border bank integration is specified. Variant 3 uses the direct and indirect indicators, while variant V4 makes a distinction between the Member States that were under programme during the sample period and those that were not ⁽¹²⁾. The point estimates of variant V4 are used to assess the effectiveness of cross-border bank integration in tempering fluctuations in private consumption.

Comparing variant V4 with variants V5 (i.e. V4 with short-term interest rate instead of long-term interest rate), V6 (i.e. V4 with residential real estate prices instrumentalised using lagged and trend residential real estate prices to deal with possible simultaneously bias), V7 (i.e. V4 with income tax rate ⁽¹³⁾ as additional explanatory variable), V8 (i.e. V4 with permanent income instrumentalised to deal with possible “measurement problems”) ⁽¹⁴⁾, V9 (i.e. V4 with the direct and the indirect cross-border bank integration variables also interacting with a dummy for each of the programme countries in the sample) and V10 (i.e. V4 with an autoregressive error term) suggests that point estimates of baseline V4 are fairly stable.

Table A: Private consumption – estimation results

| Dependent: Growth in household consumption at constant prices | | | | | | | | | | | |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | V0 | V1 | V2 | V3 | V4 | V5 | V6 | V7 | V8 | V9 | V10 |
| Permanent income | 0.64*** (26.12) | 0.39*** (14.15) | 0.41*** (11.26) | 0.39*** (13.54) | 0.39*** (12.97) | 0.39*** (13.03) | 0.40*** (11.39) | 0.39*** (13.35) | 0.38*** (8.48) | 0.40*** (13.40) | 0.43*** (17.72) |
| House price /HICP | 0.00 (0.08) | 0.10*** (9.61) | 0.08*** (6.97) | 0.09*** (8.72) | 0.09*** (8.63) | 0.09*** (8.49) | 0.09*** (5.71) | 0.10*** (9.11) | 0.12*** (10.70) | 0.08*** (7.39) | 0.07*** (6.54) |
| Interest rate | -0.91*** (-7.82) | -0.16** (-2.46) | -0.10 (-1.27) | -0.09 (-1.30) | -0.10 (-1.42) | -0.05 (-0.74) | -0.09 (-1.26) | -0.14** (-1.98) | -0.04 (-0.61) | -0.18** (-2.40) | -0.31*** (-4.48) |
| Inflation | 0.19** (1.67) | 0.15*** (4.83) | 0.16*** (4.71) | 0.13*** (3.75) | 0.14*** (4.03) | 0.14*** (3.94) | 0.13*** (3.51) | 0.14*** (4.32) | 0.20*** (5.95) | 0.14*** (3.81) | 0.13*** (3.72) |
| Transitory income | 0.32*** (14.61) | 1.32*** (5.01) | 1.70*** (4.72) | 1.94*** (5.27) | 1.96*** (5.39) | 1.98*** (4.31) | 1.85*** (5.02) | 1.64*** (4.45) | 2.10*** (4.25) | 2.06*** (5.34) | 0.30*** (2.34) |
| Temporary income*House price | 0.79*** (2.32) | 1.29*** (3.54) | 1.04*** (2.50) | 1.16*** (2.78) | 1.17*** (2.72) | 1.20 (1.18) | 1.16*** (2.81) | 1.94*** (4.39) | 0.57 (1.05) | 0.65 (1.40) | |
| Average income tax rate | | | | | | | 0.06*** (3.55) | | | | |
| Autoregressive error term | | | | | | | | | | | -0.29*** (-6.64) |
| Error correction term | -0.33*** (-14.41) | -0.39*** (-11.95) | -0.33*** (-14.93) | -0.32*** (-13.74) | -0.32*** (-13.69) | -0.32*** (-13.11) | -0.33*** (-14.24) | -0.29*** (-13.01) | -0.32*** (-13.15) | -0.32*** (-15.23) | -0.30*** (-15.23) |
| Transitory income interacting with | | | | | | | | | | | |
| Domestic BI | -0.96*** (-3.29) | -0.98*** (-3.27) | -1.09*** (-3.61) | -1.11*** (-3.69) | -1.10*** (-3.64) | -1.05*** (-3.48) | -0.99*** (-3.76) | -1.19*** (-3.31) | -0.90*** (-2.80) | | |
| Domestic BI * programme | 0.07** (2.09) | 0.07** (2.07) | 0.09** (2.49) | 0.08** (2.13) | 0.09** (2.37) | 0.10*** (2.69) | 0.11** (1.72) | 0.12** (1.44) | 0.04 (1.08) | | |
| EA BI aggregate | -0.37** (-2.26) | | | | | | | | | | |
| EA BI DIRECT | -0.86*** (-2.80) | -1.03*** (-3.19) | -1.02*** (-3.17) | -1.05*** (-2.64) | -0.92*** (-2.87) | -0.92*** (-2.60) | -1.16*** (-2.94) | -1.52*** (-4.76) | | | |
| EA BI DIRECT* programme IE | | | | | | | 0.18 (0.72) | | | | |
| EA BI DIRECT* programme ES | | | | | | | 0.03 (0.43) | | | | |
| EA BI DIRECT* programme PT | | | | | | | 0.34*** (2.83) | | | | |
| EA BI INDIRECT | -0.14 (-0.68) | -0.26 (-1.25) | -0.26 (-1.21) | -0.26 (-0.84) | -0.25 (-1.23) | -0.23 (-1.00) | -0.23 (-0.89) | -0.13 (-0.64) | | | |
| EA BI INDIRECT* programme IE | | | | | | | 0.05 (0.22) | | | | |
| EA BI INDIRECT* programme ES | | | | | | | 0.18** (2.14) | | | | |
| EA BI INDIRECT* programme PT | | | | | | | 0.15 (0.80) | | | | |
| Stand-alone effects | | | | | | | | | | | |
| Domestic BI | -0.20** (-2.15) | -0.11 (1.44) | -0.16 (-1.52) | -0.14 (-1.37) | -0.16 (-1.46) | -0.15 (-1.43) | 0.01 (0.05) | -0.03 (-0.40) | -0.14 (-1.39) | | |
| EA BI Direct | 0.00 (0.37) | | | | | | | | | | |
| EA BI Indirect | -0.00 (-0.59) | | | | | | | | | | |
| EA BI no program MS | | | 0.02** (2.38) | 0.02** (2.50) | 0.02** (2.33) | 0.02** (2.28) | 0.02** (1.34) | 0.01 (2.68) | 0.02*** (5.62) | 0.03*** (5.62) | |
| EA BI program MS | | | -0.00 (-0.23) | 0.00 (0.04) | -0.00 (-0.14) | -0.01 (-0.31) | 0.03 (1.57) | 0.04 (0.85) | -0.01 (-0.42) | | |
| Adjusted R-squared | 0.721976 | 0.733239 | 0.736960 | 0.740438 | 0.739616 | 0.740163 | 0.739769 | 0.721638 | 0.745376 | 0.749145 | |
| Number of observations | 573 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 509 | 476 | |
| Number of explanatory variables | 15 | 7 | 22 | 14 | 14 | 14 | 15 | 14 | 20 | 15 | |

Note: Permanent and actual income, house price relative to HICP in first differences of natural logarithm in variants V1 to V4; in log levels for variant V5 showing the long-run equilibrium relation. Note: sample size 2000Q1-2019Q4; * indicates between brackets; **p<0.05; ***p<0.01. Dependent and explanatory variables demeaned.
Note: BI short for bank integration, EA BI aggregates. DIRECT and INDIRECT cross-border credit channel.
Note: V5, V4 with short-term interest rate instead of long-term interest rate, V6, V4 with house price instrumentalised, V7, V4 with income tax rate, V8, V4 with permanent income instrumentalised, V9, V4 with additional interaction dummies, V10, V4 with autoregressive error term.

⁽¹²⁾ Multiplying the ECB price-based financial integration composite sub-indicator for the banking market with a dummy that is equal to 1 if the Member State was under a programme during the sample period, and equal to 0 otherwise.

⁽¹³⁾ Annual data retrieved from the OECD database, and interpolated to quarterly data.

⁽¹⁴⁾ Permanent income YP cannot be observed directly and had to be estimated – which may entail a random measurement error. Instrumental variables provide consistent point estimates of parameters in linear regression models with independent additive measurement errors. See for instance Chen, X., H. Hong and D. Nekipelov (2007), ‘Measurement Error Models’. The instruments used are the Hodrick-Prescott filtered series of the total wage bill (per employed person), which is subject to a measurement error not correlated with the measurement error of the original YP variable or random component of equation (1).