# III. The sovereign-bank nexus in the euro area: financial and real channels

by Mario Bellia, Ludovic Cales, Lorenzo Frattarolo, Andreea Maerean, Daniel Monteiro, Marco Petracco Giudici and Lukas Vogel

*The sovereign-bank nexus played a key role in the 2010-2012 European debt crisis by enabling pernicious dynamics whereby governments and domestic banking sectors mutually weakened each other. This article reviews the direct (financial) and indirect (real) channels through which banks and sovereigns interact, and which can give rise to feedback loops between them. While significant progress has been achieved in recent years in mitigating the direct channel, its indirect mechanisms have remained largely intact. Policy options for improving the financial stability of euro area banks and sovereigns continue to be discussed in policy circles, including measures to diversify banks' sovereign debt holdings. While a review of the literature and model-based simulations do not demonstrate that diversification in itself has a clear impact on systemic risk, where it does reduce (or at least cap) total risks it can help significantly in absorbing shocks in crisis periods. Similarly, simulations show that greater cross-border integration in banking can dilute the impact of asymmetric shocks across regions in a monetary union.* ([153])

## III.1. Introduction

The 2008 financial crisis and the ensuing sovereign debt crisis exposed a gradual intertwining of risks between euro area sovereigns and their domestic banking sectors. While various theoretical mechanisms may underlie this phenomenon (see below), we can register upfront a number of empirical facts that characterised the crisis:

- Bank failures led to government intervention in the financial sectors in several euro area countries, putting significant pressure on public finances (Graph III.1);

- Banks' sovereign credit risk exposures have remained biased towards their domestic sovereign across the euro area (Graph III.2); and

- Euro area sovereigns saw hikes in their default risk (Graph III.3) that correlated with hikes in the default risk of domestic banks.

Academics, economists and policymakers have come to refer to this mutual reinforcement of weak bank balance sheets and sovereign fragility as 'diabolic loops' ([154]) and to see it as a key feature of the euro area crisis.

Graph III.1: **General government liabilities due to interventions to support financial institutions**
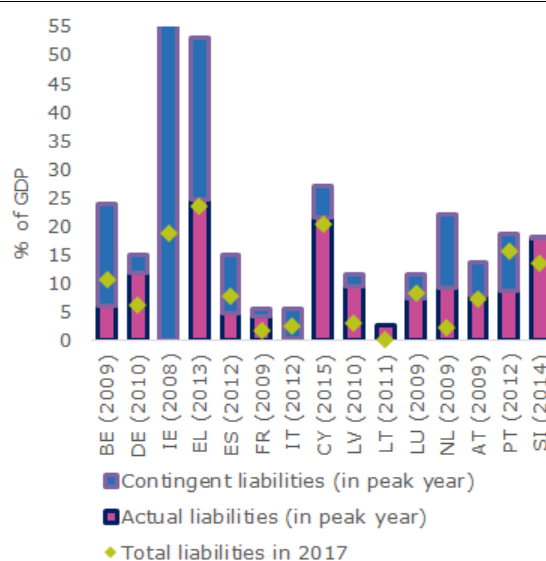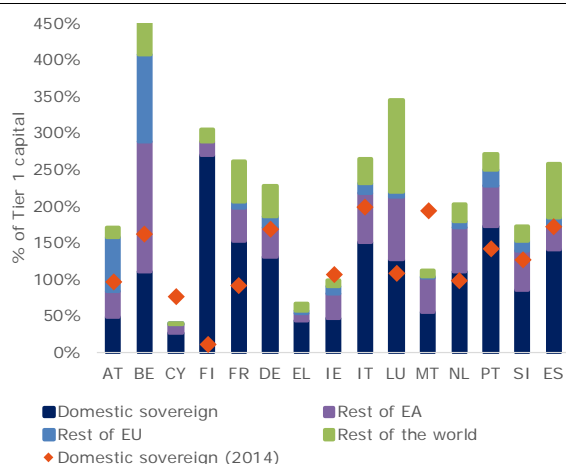


(1) Total liabilities are the sum of actual and contingent liabilities; contingent liabilities relate mainly to the provision of government guarantees on assets and liabilities of financial institutions and special purpose vehicles; actual liabilities are those having an immediate impact on government debt. Each country's peak year for total liabilities is indicated on the x axis; EE, MT, SK and FI are not plotted, as they have no government liabilities linked to the support of financial institutions.
*Source:* own calculations based on Eurostat data.

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([153]) The authors would like to thank Gabriele Giudice, Davide Lombardo and an anonymous reviewer for their useful comments.

([154]) The term was coined in 2011 by the Euro-nomics group of academic economists from various euro area countries.

Graph III.2: **Geographical breakdown of sovereign exposures of euro area banking sectors (June 2018)**

The situation in the euro area has improved significantly since the peak of the crisis, thanks to a better institutional framework and a more favourable economic environment. Sovereign risk has receded markedly (although it remains well above pre-crisis benchmarks in most countries) and government liabilities linked to financial sector intervention are unwinding (Graphs III.1 and III.3).

While it appears to have dropped in some countries in recent years, home bias in banks' sovereign debt holdings remains high (Graph III.2). [155] Many of the financial and real channels that drive the sovereign-bank nexus remain in place and could re-ignite harmful dynamics in some form or other.

Graph III.3: **5-year sovereign credit default swap (CDS) spreads**
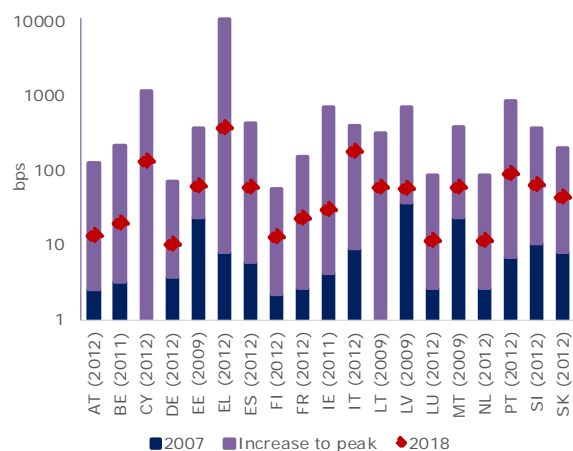


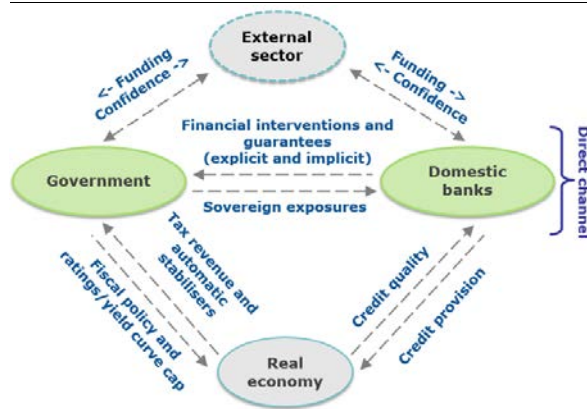(1) Non-linear scale; the year in the x axis refers to the peak year for CDS spreads; no 2007 data for CY and LT.
*Source:* Bloomberg, own calculations.

The remainder of this article is structured as follows. Section III.2 reviews the direct and indirect channels of the sovereign-bank loop, with references to the literature. Section III.3 considers the progress achieved as regards the institutional set-up in the euro area, discusses remaining challenges and explores possible policy responses. Section III.4 assesses the sovereign-bank loop using the Commission's SYMBOL and QUEST models. It considers baseline simulations and counterfactual scenarios involving the diversification of banks' debt holdings and greater cross-border integration in banking sectors; and conclusions are set out in Section III.5.

## III.2.    The sovereign-bank loop

Governments and banking interact through various channels. Graph III.4 provides a visual reference for the following subsections on direct channels (which operate via financial exposures between banks and sovereigns) and indirect channels (which operate via real economy mechanisms).

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[155] The large increase in the degree of home bias in Finland is driven by a very large increase in the domestic sovereign exposures of one institution and the inclusion of a new institution in the sample, which itself is highly exposed to the domestic sovereign. The choice of 2014 in Graph III.2 to illustrate the evolution of the exposures to the domestic sovereign is driven by comparability considerations regarding the EBA sample.

Graph III.4: **Sovereign-bank loops**



**Source:** adapted from the sovereign-bank loop literature (e.g. Schnabel, I. and Véron, N. (2018), Completing Europe's banking union means breaking the bank-sovereign vicious circle, VoxEU.org)

## Direct (financial) channels

The direct channels of the sovereign-bank loop (whereby banks and their domestic sovereigns weaken each other) are essentially based on:

- banks' financial exposures to domestic sovereign debt; and

- (the possibility of) governments' financial intervention in the domestic banking system through: (i) nationalisation; (ii) bail-outs; (iii) capital injections; [156] (iv) the provision of guarantees (including on deposits); [157] (v) the purchase of toxic assets; and (vi) taking on other forms of contingent liability.

Other measures by public authorities for dealing with banking crises include liquidity support from the central bank and deposit. [158]

The loop can occur via a direct channel where bank losses lead a government to sponsor recapitalisations, provide guarantees or otherwise increase its contingent liabilities, in actual or

expected value terms. This leads to a rise in actual or expected government debt levels, which depresses sovereign bond prices. As banks have holdings of domestic sovereign debt, this further weakens their balance sheets (in market value terms), thus iterating the loop. [159] In addition, since sovereign bonds serve as collateral for financial transactions, the banks' ability to secure funding can decline if the sovereign experiences financial difficulties. [160]

The direct channel can also originate on the side of the sovereign, as when unsound fiscal policies can lead to higher government debt and sovereign risk, which transmit to domestic banks via valuation losses on sovereign debt. [161]

Government guarantees and the possibility of intervention can generate moral hazard by encouraging banks to take on more risk on their balance sheets and lowering their financing costs. Moral hazard can arise, for example, through rescue packages that transfer credit risk from the banking sector to the government. Evidence from credit default swap (CDS) spreads for the euro area countries and banks shows that the introduction of bank bailouts around October 2008 caused bank CDS premia to fall, while sovereign risk spreads surged. [162] Such risk-shifting has led to EU policy action to break this direct channel by requiring the 'bail-in' of creditors in the event of bank failure as a pre-condition for public intervention. [163]

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[156] A capital injection may not constitute a bail-out in the strict sense, if it serves to reinforce the capital base of a bank that already satisfies the minimum capital requirements in the banking regulations.

[157] Given the seniority of deposits over other bank liabilities and the existence of deposit guarantee schemes that are funded *ex ante* to protect deposits of up to €100,000 in the event of a bank failure, any implicit governmental guarantee on deposits is only partial.

[158] For details of different countries' support measures in 1970-2011, see Laeven, L. and Valencia, F. (2012), 'Systemic banking crises database: an update', *IMF Working Paper No 12/163*.

[159] See, for example, Schnabel, I. and Schüwer, U. (2016), 'What drives the relationship between bank and sovereign credit risk?', *German Council of Economic Experts Working Paper 07/2016*. The authors confirm a positive correlation between the strength of the sovereign-bank nexus and factors such as a high degree of home bias, low bank capital ratios and high sovereign debt ratios.

[160] See Bank for International Settlements (2011), 'The impact of sovereign credit risk on bank funding conditions', *CGFS Papers No 4*.

[161] See, for example., Stournaras, Y. (2016), 'The impact of the Greek sovereign crisis on the banking sector — challenges to financial stability and policy responses by the Bank of Greece', speech at the American School of Classical Studies, Athens, 8 June 2016.

[162] Ejsing, J. and Lemke, W. (2011), 'The janus-headed salvation: sovereign and bank credit risk premia during 2008–2009', *Economics Letters 110*.

[163] Bail-in is a resolution tool whereby bank creditor positions are converted into equity positions in the event of a bank failure. See also Subsection 0.

### Indirect (real) channels

The indirect channel consists of real economy linkages and operates even in the absence of government intervention or banks' direct financial exposures to sovereigns. A loop via the indirect channel can occur when a shock leads to constraints in banks' supply of credit, which then harm private investment, consumption and the broader economy. In turn, an economic slowdown increases the government deficit through lower tax revenues and the operation of automatic stabilisers. Experience shows that government debt can rise dramatically following banking crises and that these surges are not necessarily due to bailout costs, but can be driven by a combination of collapsing tax revenues in the wake of output contractions and countercyclical fiscal policies aimed at mitigating the downturn. [164]

In the face of such a downturn, government may see its debt increase (which can trigger the direct channel) or embark on a course of fiscal consolidation (e.g. to avoid losing market access), further slowing down the economy by withdrawing stimulus. As economic activity is further depressed, banks' balance sheets suffer valuation and loan losses. This further lowers their capital ratios and lending ability, [165] iterating the loop.

The loop can also start on the government side, or simultaneously on both sides, e.g. when an adverse macroeconomic shock affects both government revenues and banks' assets.

The indirect channels also include other mechanisms, e.g. empirical evidence indicates that increases in government risk premia spill over to risk premia in the domestic private sector, [166]

while sovereign ratings act as a *de facto* cap on domestic companies' ratings. [167] External financing may disappear in a banking crisis, due to a fall in confidence among foreign investors. As a result, governments will be less able to roll over and service their external debt, [168] with sudden stops in capital flows often generating sovereign defaults.

Finally, the real economy also mediates the loop through its effect on the sustainability of public finances (e.g. weak or negative growth leads to less favourable government debt-to-GDP ratios, which in turn tend to depress sovereign bond valuations).

### Modelling the feedback loop

We have explored how the sovereign-bank loop can be transmitted through direct and indirect channels. We now look at how the loop has been modelled in the literature.

Most empirical papers explore the relationship between sovereigns and banks by measuring their credit risk through CDS spreads.

Acharya *et al.* (2014) [169] construct a theoretical model whereby bailouts and sovereign bond holdings link financial sector and sovereign default risk. Using CDS data in an empirical application, they show that:

- bailouts have lowered banks' default risk while sovereigns' risk increased; and

- changes in sovereign CDS spreads have driven changes in banks' CDS spreads in the post-bailout period (i.e. sovereign stress is transmitted to the financial sector) in the post bail-out period.

[164] See Reinhart, C. M. and Rogoff, K. S. (2009), 'The aftermath of financial crises', *American Economic Review* vol. 99(2) and Baldacci, E. and Gupta, S. (2009), 'Fiscal expansions: what works', *IMF Finance & Development 46*.

[165] For an analysis of how the need to improve capital ratios may constrain bank lending see, for example, Monteiro, D. and Priftis, R. (2017), 'Bank lending constraints in the euro area', *European Economy*, Discussion Paper 43.

[166] See, for example, Theobald, T. and Tober, S. (2019), 'Euro area sovereign yield spreads as determinants of private sector borrowing costs', *Economic Modelling* and Augustin, P., Boustanifar, H., Breckenfelder, J. and Schnitzler, J. (2016), 'Sovereign to corporate risk spillovers', ECB, *Working Paper Series no 1878*. For the role of country risk in driving the risk premia of non-financial companies, see also Horny, G., Manganelli, S. and Mojon, B. (2016), 'Measuring financial fragmentation in the euro area corporate bond market', *Banque de France Working Paper 582*.

[167] Bank for International Settlements (2011) *op cit* shows that sovereign downgrades often translate into lower ratings for domestic banks, which in turn can worsen their access to foreign financing and affect their borrowing conditions.

[168] Reinhart, C. M. and Rogoff, K. S. (2009), 'This time is different — eight centuries of financial folly', Princeton University Press.

[169] Acharya, V., Drechsler, I. and Schnabl, P. (2014), 'A pyrrhic victory? Bank bailouts and sovereign credit risk', *The Journal of Finance 69* (6).

Alter and Schüler (2012) [170] use CDS data to show how bank default risk affected their host sovereign's at the beginning of the crisis, and confirm that bailouts strengthen the reverse causal relationship.

Mody and Sandri (2012) [171] proxy sovereign default risk through bond spreads and banks' fragility through the relative equity index of the financial sector. Their modelling of sovereign risk can be combined with the Commission's SYMBOL model to obtain another empirical tool to assess the loop (see Subsection III.4.1).

As regards the theoretical literature, Brunnermeier *et al.* (2016) [172] use a model to show how such loops can be avoided by restricting banks' domestic sovereign exposures, in particular by shifting them to the senior tranche of a diversified sovereign bond portfolio (i.e. 'ESBies'). In Brunnermeier *et al.* (2017), [173] they extend their theoretical model to study the equilibrium effects of different ESBie portfolios. Farhi and Tirole (2018) [174] contribute to the theoretical literature with a comprehensive model of the feedback loop that covers the supervisory function and explores the mechanisms behind domestic bailouts of the banking system and sovereign debt forgiveness by international creditors, or solidarity by other countries. Cooper and Nikolov (2018) [175] highlight the role of banks' decisions on equity issuance in preventing or enabling the loop. Finally, dynamic stochastic general equilibrium (DSGE) models with a banking sector can generally capture at least some elements of the sovereign-bank nexus. For instance,

Gourinchas *et al.* (2016) [176] examine the Greek crisis of 2010 through the lens of such a model to examine the role of various drivers, including sovereign risk, credit costs and non-performing loans. A model from the same DSGE class – the Commission's QUEST model – is employed in Subsection III.4.2.

## III.3. Policy challenges and achievements

In Subsection III.3.1, we summarise institutional progress in the euro area on weakening the sovereign-bank loop; in subsection III.3.2, we look at remaining challenges.

### III.3.1. The new institutional setup of the euro area

In general, safety buffers in the euro area banking system have increased, thus reducing the need for public interventions such as those that have added to debt levels in several Member States in the past decade (Graph III.5). Despite profitability challenges and still-high levels of non-performing loans in some jurisdictions, euro area banks are now much more capitalised, owing to the introduction of more stringent capital requirements. At the same time, the crisis took a toll on public finances and government debt ratios remain high in some Member States.

A decisive improvement compared with the pre-crisis period has been the introduction of single bank supervisory and resolution mechanisms at EU level. The single supervisory mechanism has promoted the convergence and effectiveness of supervisory practices across the EU, thereby helping to reduce insolvency risks *ex ante*. The new bank resolution framework gives authorities the wherewithal to restructure failing banks while avoiding, or limiting, the use of public money and impacts on the broader financial system. [177] The entry into force of the Bank Recovery and Resolution Directive [178] and of the main operational aspects of the single resolution

[170] Alter, A. and Schüler, Y. S. (2012), 'Credit spread interdependencies of European states and banks during the financial crisis', *Journal of Banking & Finance 36* (12).

[171] Mody, A. and Sandri, D. (2012), 'The eurozone crisis: how banks and sovereigns came to be joined at the hip', *Economic Policy 27* (70).

[172] Brunnermeier, M. K., Garicano, L., Lane, P. R., Pagano, M., Reis, R., Santos, T., Thesmar, D., Van Nieuwerburgh, S. and Vayanos, D. (2016), 'The sovereign-bank diabolic loop and ESBies', *The American Economic Review Papers and Proceedings 106* (5).

[173] Brunnermeier, M. K., Langfield, S., Pagano, M., Reis, R., van Nieuwerburgh, S. and Vayanos, D. (2017), 'ESBies: safety in the tranches', *Economic Policy 32* (90).

[174] Farhi, E. and Tirole, J. (2018), 'Deadly embrace: sovereign and financial balance sheets doom loops', *Review of Economic Studies* vol. 85.

[175] Cooper, R. and Nikolov, K. (2018), 'Government debt and banking fragility: the spreading of strategic uncertainty', *International Economic Review* (forthcoming).

[176] Gourinchas, P., Philippon, T. and Vayanos, D. (2016), 'The analytics of the Greek crisis', *NBER Working Paper No 22370*.

[177] For the strategic importance of having a good resolution 'technology' available, see DeYoung, R., Kowalik, M. and Reidhill, J. (2013), 'A theory of failed bank resolution: technological change and political economics', *Journal of Financial Stability*, vol.9, issue 4.

[178] Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014.

mechanism (SRM) in January 2016 provided a bank resolution toolbox: bail-in, asset separation, sale of business and bridge institution. Bail-in, in particular, allows for a clear shifting of risk from governments to bank creditors through the conversion of certain creditor positions into equity positions if the need arises to recapitalise a failing bank. Linked to the entry into force of the bail-in tool, banks must now comply with minimum requirements for own funds and eligible liabilities (MREL) to ensure the issuance of sufficient 'bail-in-able' instruments. In addition, the banking industry is in the process of capitalising a single resolution fund (SRF) that can be tapped to finance the restructuring of failing systemic banks when other options (such as bail-in) have been exhausted.

Graph III.5: **Banks' tier 1 capital ratio and government debt, by EA Member State**
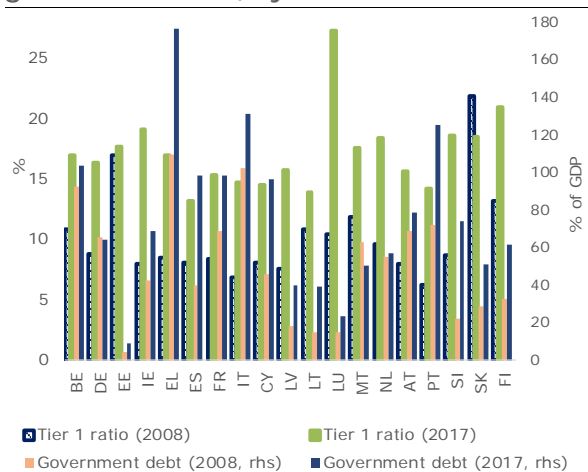


(1) The calculation of tier 1 capital is subject to a statistical break, with the 2017 figure based on the Basel III concept.
*Source:* ECB, Eurostat, own calculations

Together with improved supervisory practices, the new resolution tools carry the potential to break the direct channel from distressed banks to the domestic sovereign. The Commission's 2018 *Fiscal sustainability report* ([179]) uses SYMBOL ([180]) to assess the bank-originating risks to public finances of a systemic event of a magnitude comparable to the 2008-2012 crisis. It finds that, given banks' improved capitalisation levels, the possibility of bail-in and the existence of an SRF, such risks are

minor for most Member States, and exist essentially only over the short term.

Other improvements to the institutional framework in the euro area include:

• the establishment of a European Stability Mechanism (ESM), which can grant loans to euro area governments in need of financial assistance;

• the deployment of new monetary policy tools that can provide the market with ample liquidity, such as asset purchase programmes, targeted long-term refinancing operations and outright monetary transactions; and

• enhancement of macroeconomic surveillance mechanisms through the introduction of a macroeconomic imbalance procedure, the reform of fiscal rules and the institutionalisation of the European Semester, an annual economic policy coordination exercise.

These improvements should also hinder the operation of the indirect channels of the loop.

### III.3.2. Remaining challenges and possible policy responses

Notwithstanding the progress achieved in severing the sovereign-bank loop, a number of challenges remain:

• deposit insurance is still compartmentalised along national lines;

• banks are still building up their MREL capacity;

• supervisory practices and rules are not yet fully aligned (particularly as regards less significant institutions); and

• the SRF is still being capitalised, with a view to reaching the equivalent of at least 1% of euro area deposits by year-end 2023.

It has been agreed in principle that the ESM will provide a common backstop to double the firepower of the SRF, but this is not yet operational.

Also, while the new resolution framework carries evident potential, not all available resolution tools

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([179]) European Commission (2019), 'Fiscal sustainability report 2018 — volume 1', *European Economy Institutional Paper* 94.

([180]) The sample and assumptions differ from those underpinning the stylised simulations in Subsection III.4.1.

have been tested in actual bank failure cases. For instance:

- the failure of Spain's Banco Popular in 2017 was dealt with by selling the bank at no cost to Santander, another Spanish bank. It was a resolution with write-down of own funds but without a proper bail-in, and which relied on the liquidity and solvency of the acquiring bank.

- also in 2017, the failures of Italy's *Banca Popolare di Vicenza* and *Veneto Banca* were managed through normal insolvency proceedings; [181] and

- *Monte dei Paschi di Siena* underwent a precautionary recapitalisation.

State aid was used in the last three cases.

In 2015, the Commission proposed a European deposit insurance scheme (EDIS) as the third pillar of the banking union. EDIS would ultimately ensure that the euro area banking system funds a common scheme providing guarantees on deposits of up to €100,000, thus severing the link between national deposit guarantees and the domestic banking system. Negotiations between Member States on the adoption of EDIS have not yet started.

Another issue relates to the high degree of home bias in banks' holdings of sovereign debt, which is seen as having delayed progress on EDIS. [182] It has been argued that this is facilitated by the current regulatory exemption of banks' exposures to the sovereign debt of euro area Member States from capital charges or quantitative limits. [183] These exemptions, together with liquidity requirements and Eurosystem collateral policy, create a specific regulatory environment for bank holdings of sovereign debt. At the same time, since the integration of sovereign bond markets was

reversed during the financial crisis, these holdings have become more strongly skewed towards the domestic sovereign in some countries. This has been explained both as a kind of 'carry trade', whereby banks resort to easily available funding to load up on high-yielding bonds, and as the result of moral suasion, whereby governments put pressure on banks to absorb their debt issuance in periods of distress. [184] It has also been claimed that greater sovereign home bias in the crisis period reallocated credit from the private to the public sector, displacing productive investment. [185] On a more positive note, domestic banks' absorption of sovereign debt in times of distress can have a stabilising effect by containing interest-rate volatility and facilitating the smooth conduct of fiscal policy. [186] It could also act as a commitment device for governments, [187] as a sovereign default in the context of strong home bias is particularly damaging for the domestic banking sector and for the domestic economy as a whole. As a result, greater home bias in times of stress tends to increase the tail risks confronting the economy.

Discussion in recent years has centred on several options for incentivising banks to reduce their home bias. Some focus on adjusting bank regulations, e.g. through capital charges to sovereign exposures (based on assessed risk or degree of concentration), or quantity-based

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[181] Normal insolvency proceedings also applied to ABLV, a small bank under the remit of the SRM that failed in 2018.

[182] Véron, N. (2017), 'Sovereign concentration charges — a new regime for banks' sovereign exposures', study submitted to the European Parliament at the request of the Economic and Monetary Affairs Committee.

[183] This contrasts with the capital requirements for credit risk and the large exposures limit that generally apply to other forms of bank lending. In particular, given a large exposures limit, banks may not hold claims worth more than 25% of their tier 1 capital with respect to a single counterparty.

[184] See, for example, Altavilla, C., Pagano, M. and Simonelli, S. (2016), 'Bank exposures and sovereign stress transmission', *ECB Working Paper 1969* and Acharya, V. V. and Steffen, S. (2013), 'The 'greatest' carry trade ever? Understanding eurozone bank risks', *Journal of Financial Economics* vol. 115, issue 2. Also, for how the ownership structure of euro area banks may render them prone to political interference, see Véron, N. (2017), 'The governance and ownership of significant euro-area banks', *Bruegel Policy Contribution*, 30 May.

[185] See, for example, Broner, F., Erce, A., Martin, A. and Ventura, J. (2014), 'Sovereign debt markets in turbulent times: creditor discrimination and crowding-out effects', *Journal of Monetary Economics*, vol. 61 and Altavilla, C., Pagano, M. and Simonelli, S. (2012), 'Bank exposures and sovereign stress transmission', *Review of Finance*.

[186] Tabellini, G. (2018), 'Risk sharing and market discipline: finding the right mix', *VoxEU.org*, argues that domestic banks may have an incentive to perform this stabilisation function, as their own survival may be at risk in the event of a sovereign default.

[187] See, for example, Asonuma, T., Bakhache, S. and Hesse, H. (2015), 'Is banks' home bias good or bad for public debt sustainability?', *VoxEU.org*. For a rationalisation of home biases in capital markets, see also Coeurdacier, N. and Rey, H. (2013), 'Home bias in open economy financial macroeconomics', *Journal of Economic Literature*, American Economic Association, vol. 51(1).

limits. [188] However, regulatory diversification incentives have to address at least four challenges:

- They may result in pro-cyclical effects, i.e. impose harsher conditions on banks and issuing sovereigns in crisis periods;

- Uncertainty as to banks' behaviour under different regulatory arrangements makes it difficult to assess the likely impact of such reforms;

- In some circumstances, diversification may make banks' sovereign bond portfolios more risky and more vulnerable to cross-border spillovers; [189] and

- Less concentration in banks' exposures should not lead to excessive concentration in other financial institutions, which may also be subject to a sovereign risk nexus.

Besides other possible benefits, a common European safe asset could help to weaken sovereign-bank loops by reducing the scale and riskiness of (domestic) national exposures in banks' balance sheets. In particular, it could resolve the fundamental tension in simultaneously reducing concentration and sovereign risk in banks' portfolios. [190] Various options for such an instrument have been discussed, including sovereign bond-backed securities [191] and senior sovereign debt issuance by a common European institution. [192] In both cases, one important aim is to increase the supply of safe assets, which would then partially replace national sovereign bonds in banks' balance sheets. Given their intrinsic diversification and low sovereign risk, research suggests that portfolio reallocation towards safe assets could break the direct channel of the loop. [193] A common safe asset could, in addition, help to overcome the fracturing of sovereign debt markets along national lines, which may be detrimental for the functioning of the European economy. Indeed, such fracturing appears to have been driven in crisis times by divergent market sensitivities or other factors unrelated to economic fundamentals. [194]

While the direct channels of the loop have been the focus of policy measures and discussion to date, the indirect channels remain essentially intact. To address them, stronger cross-border integration of banking and financial markets is needed, to make economies less dependent on the health of the domestic banking sector, and *vice versa.* Banks' home biases as regards private-sector lending appear to be a key obstacle to improving private-sector risk-sharing in the euro area, which seems to lag behind that in the United States. [195]

### III.4.  Financial and real channels: a model-based assessment

This section presents stylised simulations that illustrate the workings of the direct and indirect channels of the loop using the Commission's SYMBOL and QUEST models. The benefits of

[188] See European Systemic Risk Board (2015), 'ESRB report on the regulatory treatment of sovereign exposures', Basel Committee on Banking Supervision (2017), 'The regulatory treatment of sovereign exposures' and Véron, N. (2017), *op cit.*

[189] Research suggests that, depending on the combination of specific factors (such as banks' diversification patterns, their capitalisation levels and the severity of shocks), diversification can increase systemic risk and render financial institutions more vulnerable by exposing them to foreign shocks in addition to domestic ones. See, for example, Bolton, P. and Jeanne, O. (2011), 'Sovereign default risk and bank fragility in financially integrated economies', *IMF Economic Review* 2011, vol. 59, issue 2, Wagner W. (2010), 'Diversification at financial institutions and systemic crises', *Journal of Financial Intermediation*, Vol 19, Issue 3 and Acemoglu, D., Ozdaglar, A. and Tahbaz-Salehi, A. (2015), 'Systemic risk and stability in financial networks', *American Economic Review* 2015, 105(2). In addition, if low-risk sovereign bonds are scarcely available, the sovereign debt portfolio of some banks can see an increase in their credit risk as a result of diversification, given that banks with initially low-risk exposures may have little option but to diversify into higher-risk assets. See Alogoskoufis, S. and Langfield, S. (2018), 'Regulating the doom loop', *ESRB Working Paper Series no 74* and Craig, B., Giuzio, M. and Paterlini, S. (2019), 'The effect of possible EU diversification requirements on the risk of banks' sovereign bond portfolios', *ESRB Working Paper Series no 89.*

[190] See Alogoskoufis, S. and Langfield, S. (2018), *op cit.*

[191] See, for example, ESRB High-Level Task Force on Safe Assets (2018), 'Sovereign bond-backed securities: a feasibility study'.

[192] See, Monti, M. (2010), 'Supporting the single market and financial integration, through the issuance of E-bonds' in *A new strategy for the Single Market: at the service of Europe's economy and society* (report to the President of the European Commission, José Manuel Barroso), Leandro, Á. and Zettelmeyer, J. (2018), 'The search for a euro area safe asset', *Peterson Institute for International Economics Working Paper 18-3* and Giudice, G., De Manuel, M., Kontolemis, Z. and Monteiro, D. (2019), 'A European safe asset to complement national government bonds'.

[193] See Brunnermeier *et al.* (2016), *op cit.*

[194] See Monteiro, D. and Vašíček, B. (2019), 'A retrospective look at sovereign bond dynamics in the euro area', *Quarterly report on the euro area*, Vol 17, No 4.

[195] See Nikolov, P. (2016), 'Cross-border risk sharing after asymmetric shocks: evidence from the euro area and the United States', *Quarterly report on the euro area,* Vol 15, No 2.

weakening domestic banks' and sovereigns' embrace are illustrated in counterfactual scenarios that show the effects of:

- greater diversification in banks' sovereign debt holdings; and

- the cross-border diversification of bank ownership (in the case of QUEST).

These counterfactuals quantify the risk-reduction and risk-sharing potential of reducing banks' home bias and increasing cross-border integration in banking sectors.

### III.4.1. Direct channel loops: SYMBOL assessment

SYMBOL is a micro-simulation credit portfolio model designed, *inter alia*, to assess the risks to public finances emanating from the banking sector. It is particularly suitable for assessing loops via the direct (financial) channel, based on detailed banking sector data and a fine geographical breakdown. The inputs include variables capturing the (initial) riskiness of banks and sovereigns, and the formers' exposures to the latter. By considering shocks to banks' assets and sovereign bond prices, the model estimates 'excess losses' corresponding to the possible impact on public finances via recapitalisation needs (see Box III.1).

Here, the model covers a sample of euro area banks from eight Member States participating in the 2018 transparency exercise organised by the European Banking Authority (EBA). Together, these banks' sovereign exposures represent roughly 70% of the exposures involved in the transparency exercise. For the sake of clarity, the simulation results in this subsection are:

- scaled up to reflect the size of the domestic banking sector in each Member State; and

- grouped from bank-level results into three blocs: (i) countries that were more severely affected by the crisis (Ireland, Spain, Italy and Portugal); (ii) countries less severely affected (Belgium, Germany, France and the Netherlands); and (iii) an EA-8 bloc (i.e. the sum of the above).

The bank-level data refer to year-end 2017, unless noted otherwise.

Graph III.6 compares 'excess losses' (divided by total bank assets) arising from a severe systemic shock to EA-8 banking sectors. Here and elsewhere, excess losses are defined as the losses incurred by banks bringing the tier 1 capital ratio below a threshold of 10.5%. They are therefore the losses to be covered by government-sponsored recapitalisation if a bank is to continue to operate under a minimum required capital ratio of 10.5%. They include losses from an initial shock to banks'

assets and additional losses resulting from the sovereign-bank loop. Here and elsewhere, a severe shock is based on a loss percentile reflecting the order of magnitude of the 2008 financial crisis. In other words, the shock is set to a very high magnitude, corresponding to losses beyond the 99.95th percentile of the loss probability distribution function under the Basel credit risk model. [196] For presentational purposes, and taking account of the stylised and illustrative nature of the simulations, excess losses are presented in relative terms, with the maximum in-sample losses set at 100 in the following graphs. Thus, the region and scenario with the highest loss were normalised to 100, with the results for the other regions and scenarios expressed in relation to that maximum. [197]

As can be observed, excess losses (and related governmental capital injections) can be significantly reduced through the bail-in of bank creditors and the use of a euro area-wide SRF. [198] Both measures are denoted hereafter as the 'safety net'. While all three scenarios in Graph III.6 are merely illustrative and should not be taken as precise estimates, the 'no safety net' scenario is entirely theoretical given the new resolution framework (see Section III.3). The drivers of excess losses correlate with initial levels of bank capitalisation and sovereign risk (e.g. Graph III.6 shows that three of the countries in the group with the biggest relative losses are also those with the highest sovereign CDS spreads and lowest tier 1 ratios).

Graph III.6: **Excess losses (relative to total bank assets) from a severe systemic shock vs risk characteristics**
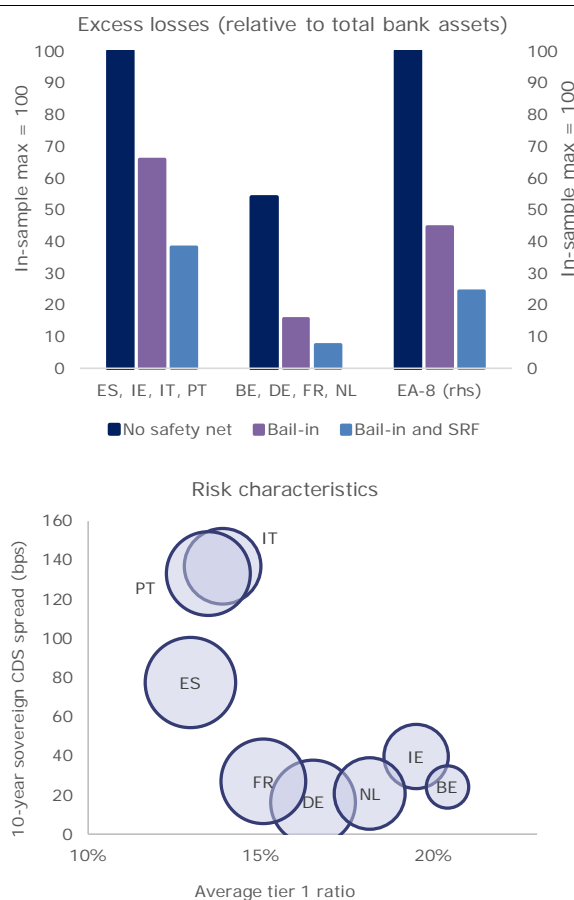


(1) Excess losses relative to total bank assets correspond to losses incurred by banks bringing the tier 1 capital ratio below 10.5% divided by the banks' total assets; the maximum figure was normalised to 100. The severe systemic shock reflects a loss beyond the 99.95th percentile in the Basel credit-risk framework. In the second chart, the bubble diameter represents the degree of home bias.
*Source:* EBA, Bloomberg, SYMBOL simulations and own calculations

Graph III.7 shows the progress achieved in recent years in reducing risk levels in sovereign and banking sectors, and in mitigating the feedback loop between them. In particular, it compares banks' excess losses based on 2017 and 2012 data for the same systemic shock seen earlier. [199]

Overall, the results suggest that the new regulatory framework, other policy action and changes in the economic environment have worked to reduce

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[196] The 99.95th loss percentile is a theoretical one, chosen to make model results agree with observed losses during the crisis. It should not be taken as an actual probability. In particular, SYMBOL is consistent with probabilities of default under the Basel credit risk model, which is understood to underestimate actual bank default probabilities. The Basel model (and therefore SYMBOL) puts the probability of failure for a bank holding its minimum capital requirement at 0.1% in a given year.

[197] Due to differences in scale, the EA-8 aggregate is represented on the secondary axis independently of the constituent regions, with its maximum across scenarios also set to 100.

[198] Bail-in is a resolution tool whereby bank creditor positions are converted into equity positions in the event of a bank failure. Resolution funds are capitalised by the banking sector and can be tapped to finance the restructuring of failing systemic banks. See also Subsection 0. In the present simulations, bail-in was modelled as a worst-case scenario, where total loss absorbing capacity (bail-in capacity plus regulatory capital) is set at 8% of total assets. The SRF is assumed to have been phased in to 40% of its target level and to contribute to resolution by absorbing losses of up to 5% of the insolvent bank's total assets, provided that bail-in has already occurred.

[199] Data for year-end 2012 are based on the results from the EBA's 2013 transparency exercise. Given that the bank samples in the 2017 and 2012 vintages do not fully overlap, caution should be exercised in drawing comparisons. Also, given the lower capital requirements in 2012, the minimum tier 1 capital ratio is set at 8% for that year.

potential losses to a very small fraction of those in 2012. This is especially clear when comparing the results for 2017 under bail-in and an SRF to the 'no safety net' scenario in 2012. We also see large reductions when we remove the effects of the bail-in tool and the SRF, which were not available in 2012 (see blue bars). The same holds true when assuming bail-in and an SRF at both points in time (yellow bars). Overall, the remarkable improvement owes much to the new 'safety net', the higher capitalisation of euro area banks, the lower perceived sovereign credit risk, a lower degree of home bias and, in some cases, the lower implied risk in banks' portfolios.

Graph III.7: **Total excess losses from a severe systemic shock, 2017 vs 2012**
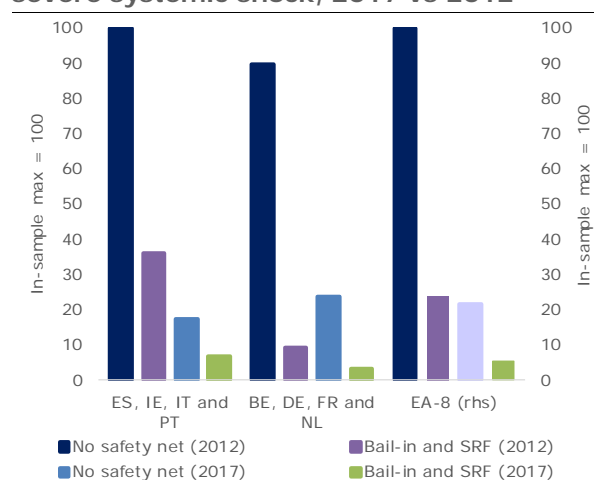


(1) Excess losses correspond to the losses incurred by banks bringing the tier 1 capital ratio below 10.5% (2017) or 8% (2012). The severe systemic shock reflects a loss beyond the 99.95th percentile in the Basel credit-risk framework.
*Source:* SYMBOL simulations

Graph III.8 shows total excess losses caused by shocks to banks and sovereigns in different regional blocs. The results are based on actual sovereign exposures and counterfactual scenarios where the exposures have been perfectly diversified (i.e. sovereign portfolio shares are the same for all banks and equal to that sovereign's share in total sovereign exposures). This can be regarded as an extreme case where home bias has been eliminated across the euro area.

*Box III.1:* **The SYMBOL model**

The systemic model of banking-originated losses (SYMBOL) is a tool developed by the European Commission's Joint Research Centre, in collaboration with academics and other experts, to simulate banking crises. The model is flexible and allows for the inclusion of modules to incorporate the effects of interbank contagion and the direct channel of the sovereign-bank loop. [1] As input, it takes a rich dataset covering actual balance-sheet data of banks in many euro area countries. Coupled with data on sovereign exposures, it can be used to explore how losses originating in banks' balance sheets or hikes in sovereign risk premia can be mutually reinforcing, potentially driving increases in government debt due to interventions to recapitalise banks. [2]

The sovereign side of SYMBOL is based on the Mody-Sandri model, [3] which calculates a non-arbitrage sovereign credit risk spread based on a country's debt level $D$, the GDP level $G$, the risk-free rate $r^f$, a long-term average GDP growth rate $g$ and standard deviation $\sigma$, a recovery rate in the event of sovereign default $R$, the debt-to-GDP ratio at which the country is inferred to default $\overline{DY}$ and the current CDS spread $C$. As $G$, $r^f$, $g$, $\sigma$, $R$ and $\overline{DY}$ are assumed to remain constant in the simulations, the Mody-Sandri function $MS$ returns a new credit-risk spread $C'$ as a function of the initial spread and the new debt level $D'$:

$$C' = MS(D', C | G, r^f, g, \sigma, R, \overline{DY}).$$

The haircut $H_i$ is the percentage loss on bank i's holdings of sovereign debt induced by changes in its market value. [4] It is a function of the risk-free rate $r^f$, the CDS spread $C$ and the change in the spread $\varDelta C$:

$$H_i = Haircut(r^f, C, \Delta C).$$

Bank-level losses on sovereign debt holdings are obtained from the set of all bank-level haircuts $H$, and the matrix of banks' exposures to different sovereigns, $E$. Together with banks' actual and minimum required capital ratios, $CR$ and $CR^{min}$ respectively, [5] one can determine the amount of losses $L$ incurred by the domestic sovereign through recapitalisations aimed at raising the capital ratio of domestic banks to their regulatory minimum following a change in the valuation of existing sovereign exposures: [6]

$$L = Loss(H, E, CR, CR^{min}).$$

The simulation procedure starts with the calibration of $G$, $r^f$, $g$, $\sigma$, $R$ and initial $D$. Subsequently, $\overline{DY}$ is calibrated as the only remaining unknown in the $MS$ function given the current sovereign CDS spreads $C$.

An initial shock may occur on the side of the sovereign, via an increase in the sovereign risk spread $\varDelta C$, or the banks, via losses on their assets (see below). Such losses may then translate into a sovereign loss $L$ through recapitalisation needs. This increases government debt, so that $D' = D + L$, which in turn increases the sovereign risk spread, $\varDelta C$, via the $MS$ equation. From this point onward, the iterations are the same whether the initial shock was on the side of the sovereign or of the bank. In particular, $\varDelta C$ implies a haircut $H$, which increases $L$, which increases $D$, which further increases $C$. This loop is iterated until convergence to final levels of government debt, spreads and bank losses is achieved.

[1] For full details, see De Lisa, R., Zedda, S., Vallascas, F., Campolongo, F. and Marchesi, M. (2008), 'Modelling deposit insurance scheme losses in a Basel 2 framework', *Journal of Financial Services Research*, Vol 40 and Fontana, A. and Langedijk, S. (2019), 'The bank-sovereign loop and financial stability in the euro area', *JRC Working Papers in Economics and Finance 2019/10*. The interbank contagion channel is not considered in the present implementation of the model.

[2] Sovereign interventions are regulated at EU level. In the present exercise, we avoid a discussion of the conditions and limits imposed on such interventions, and focus on abstract 'worst case' scenarios.

[3] Mody, A. and Sandri, D. (2012), 'The eurozone crisis: how banks and sovereigns came to be joined at the hip', *Economic Policy 27*.

[4] SYMBOL assumes that losses on assets that are not mark-to-market impact investors' perceptions of banks' capitalisation levels and may lead to *de facto* recapitalisation needs through market discipline mechanisms.

[5] In the present exercise, the minimum required tier 1 capital ratio is set at 10.5%, which includes requirements linked to the capital conservation buffer.

[6] The model assumes that investors consider banks' balance sheets in market-value terms in their risk assessments, so that market pressure renders all sovereign exposures *de facto* mark-to-market for recapitalisation purposes.

*Box (continued)*

In order to simulate initial bank losses, the average implied probability of default on a bank's asset portfolio is first derived on the basis of the Basel asymptotic single risk factor (ASRF) model using bank balance-sheet data. (⁷) Starting from this probability of default, SYMBOL uses Monte Carlo simulations, the ASRF loss distribution and assumptions for cross-bank asset correlation to produce loss realisations at bank and national level. After taking account of actual capitalisation levels in excess of minimum requirements and the presence of safety nets (e.g. bail-in and resolution funds), some of these losses may then be passed on to the government sector.

For the purposes of the present exercise, the main input data were taken from the EBA (risk-weighted assets, total capital and sovereign exposures), Bloomberg (10-year sovereign CDS spreads), AMECO (GDP and government debt levels), Orbis BankFocus and SNL (total bank assets, capital and risk-weighted assets) and the ECB data warehouse (total assets of national banking sectors, used to scale up losses derived from the available subsamples).

(⁷) In particular, data on 'fully loaded' effective capital and risk-weighted assets, taking into account the full application of Basel III/CRD IV rules.

As we can see, perfect diversification can have a significant risk-sharing effect and different risk-reduction implications depending on the regional bloc affected by the asymmetric shock. The results suggest that, in the case of a severe shock to the banks and sovereigns in countries more affected by the crisis, diversification makes it possible to mitigate losses in the affected region and share some of them with the unaffected region, while reducing total losses for the euro area aggregate (see top part of Graph III.8). There is a similar distribution of impact in the case of an asymmetric shock to less affected countries (see lower part of Graph III.8). However, in that case, total euro area aggregate losses increase marginally. This is because stronger diversification and risk distribution can foster sovereign-bank loops and debt valuation losses in the more vulnerable region (generated by losses in less vulnerable countries). (²⁰⁰)

In some cases, the risk-reduction potential of diversification appears uncertain. While perfect diversification of banks' sovereign debt holdings should frequently lead to a reduction in total losses, it can also increase them in certain cases. Graph III.9 shows the simulated risk-reduction potential of perfect diversification in different shock scenarios. The impact of diversification on total losses appears largely neutral in the case of a symmetrical shock to all euro area banks or sovereigns. Diversification allows for risk reduction in the case of an asymmetric shock to the banks and sovereigns of the most vulnerable bloc. To the extent that idiosyncratic shocks are more likely to affect the more vulnerable regions, diversification should often lead to overall risk reduction. However, it can also increase total losses somewhat in the (arguably less likely) case of a severe asymmetric shock to the banks and sovereigns of the 'core' economies, by triggering loops in the more vulnerable Member States. This result is in line with other findings in the literature, according to which diversification of debt holdings has an ambiguous effect on systemic and bank-level risk (see Subsection III.3.2). It also highlights the possible limitations of diversification as a policy measure carried out in isolation.

(²⁰⁰) This qualitative result persists when sovereign shocks are excluded from the simulations and only bank-level shocks are retained.

Graph III.8: **Total excess losses from severe asymmetric shocks to both banks and sovereigns**

Shock to the banks and sovereigns of ES, IE, IT, and PT



Shock to the banks and sovereigns of BE, DE, FR and NL
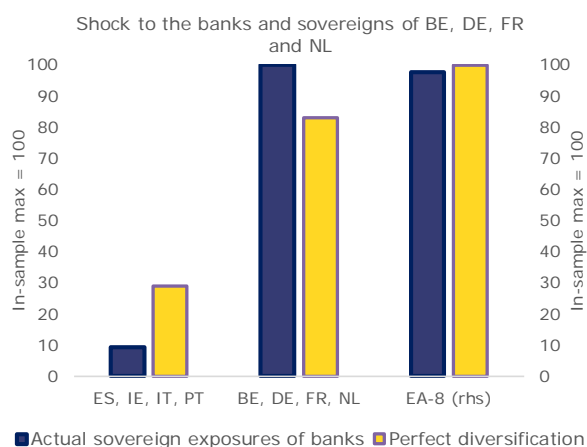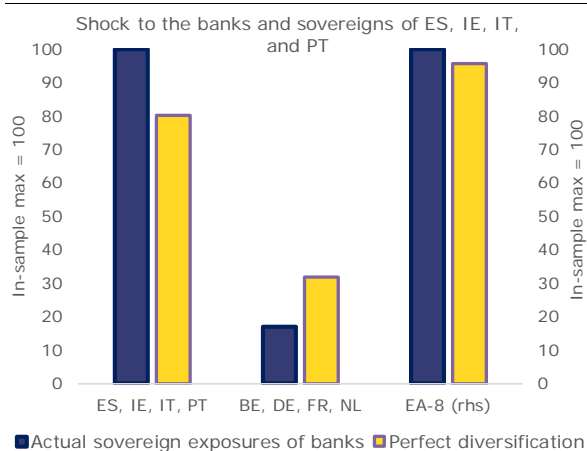


(1) Excess losses correspond to losses incurred by banks bringing the tier 1 capital ratio below 10.5%. The bank-level shock reflects a loss falling beyond the 99.95th percentile under the Basel credit risk framework. The sovereign shock reflects an initial increase of 200 bps in risk premia. In each graph, the initial shocks are imposed in one region only. Assuming a safety net (bail-in and SRF).
*Source:* SYMBOL simulations

Graph III.9: **Change in total excess losses due to perfect diversification**
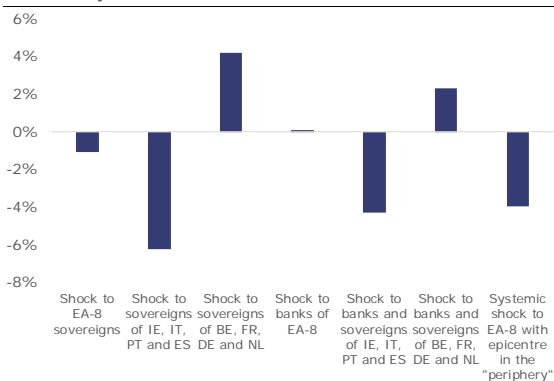


(1) Shocks to banks reflect a loss beyond the 99.95th percentile under the Basel credit risk framework; shocks to sovereigns represent an increase of 200 bps in their risk premia; in the last scenario (systemic shock with epicentre in the 'periphery'), the banks and sovereigns of IE, IT, PT and ES suffer a shock beyond the 99.95th percentile and of 300 bps, respectively, while those of BE, FR, DE and NL suffer smaller shocks (beyond the 99.9th percentile for banks and of 100 bps for sovereigns); total excess losses are from all banks in the sample; assuming a safety net (bail-in and SRF) for bank-originated losses
*Source:* SYMBOL simulations

### III.4.2. General equilibrium dynamics: QUEST assessment

The QUEST model, with a banking sector extension, has been used as a complementary tool to analyse the bank-sovereign feedback loop and the macroeconomic effects of bond valuation and loan losses. Starting from a baseline in which euro area banks retain a largely domestic footprint, implying powerful indirect linkages via the domestic economy, this section discusses the effects of stronger geographical integration in banking sectors. This can take three main forms:

- cross-border lending and other banking activities;

- cross-border funding, including deposit-taking; and

- cross-border ownership of bank equity.

This subsection considers versions of the first and third main form, namely stronger diversification of banks' sovereign bond portfolios and stronger

diversification of bank ownership across countries or regions. ([201])

QUEST uses a higher level of institutional and geographical aggregation than SYMBOL. Here, we use a two-region version of the monetary union, with one representative (or aggregate) bank and one fiscal authority in each region (see Box III.2 and Graph III.10).

Graph III.10: **Overview of the QUEST model with a banking sector**
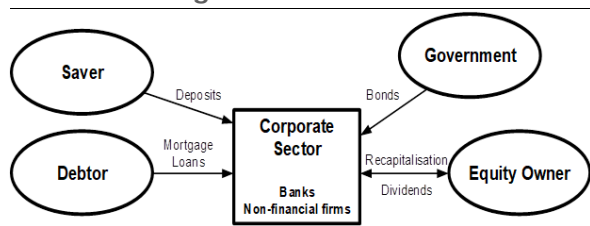


*Source:* own presentation

In principle, the model's general-equilibrium approach can capture both the direct and indirect channels (see Section III.2), i.e. those involving recapitalisation by the government, and a deterioration of the economic situation, leading to lower tax revenue and higher government spending.

However, the simulations presented below do not consider the possibility of bank recapitalisation by the government. This is in line with the objectives of the Bank Recovery and Resolution Directive, ([202]) which seeks to avoid the use of public money when managing bank failures. Rather, recapitalisation comes from equity owners in the form of lower dividend payments (or capital injections, in more extreme cases). Recapitalisation by shareholders over time can be taken as reflecting the existence of an SRF that can ensure banks' continued activity by immediately recapitalising them to the minimum required ratio, in return for lower dividends and higher bank contributions over time to the SRF.

Ruling out government bail-outs excludes the possibility of loops starting via the direct channel. Therefore, diversification measures tend to act as risk-sharing mechanisms without affecting aggregate losses. To the extent that risk sharing acts as an insurance mechanism for risk-averse households in both regions, it is in itself welfare-increasing.

Graph III.11 presents simulation results for the level of real GDP for shocks starting on the government or the bank side. The trigger of the sovereign-induced loop ('gov risk shock') is a temporary 10 pp (annualised) rise in the sovereign credit risk premium (a shock of the order of magnitude of risk premia in the 'periphery' at the height of the euro area crisis), with a half-life of 1 year. The bank-induced loop ('loan loss shock') is triggered by frontloaded loan defaults that cumulate to 10% of outstanding mortgage debt over 3 years. This is broadly consistent with peak ratios for non-performing loans in 'periphery' countries during the crisis. ([203]) The shock occurs in the 'home' region, which is calibrated to account for around a quarter of euro area GDP. Underlying the scenarios in Graph III.11 is an assumption of full home bias in banking, i.e. banks hold only domestic sovereign debt, receive deposits from and lend to domestic households only, and are exclusively owned by domestic equity investors. We add a second variant of the sovereign risk scenario, in which 20% of the government risk premium shock spills over to private-sector financing costs, as discussed in Section III.2. ([204])
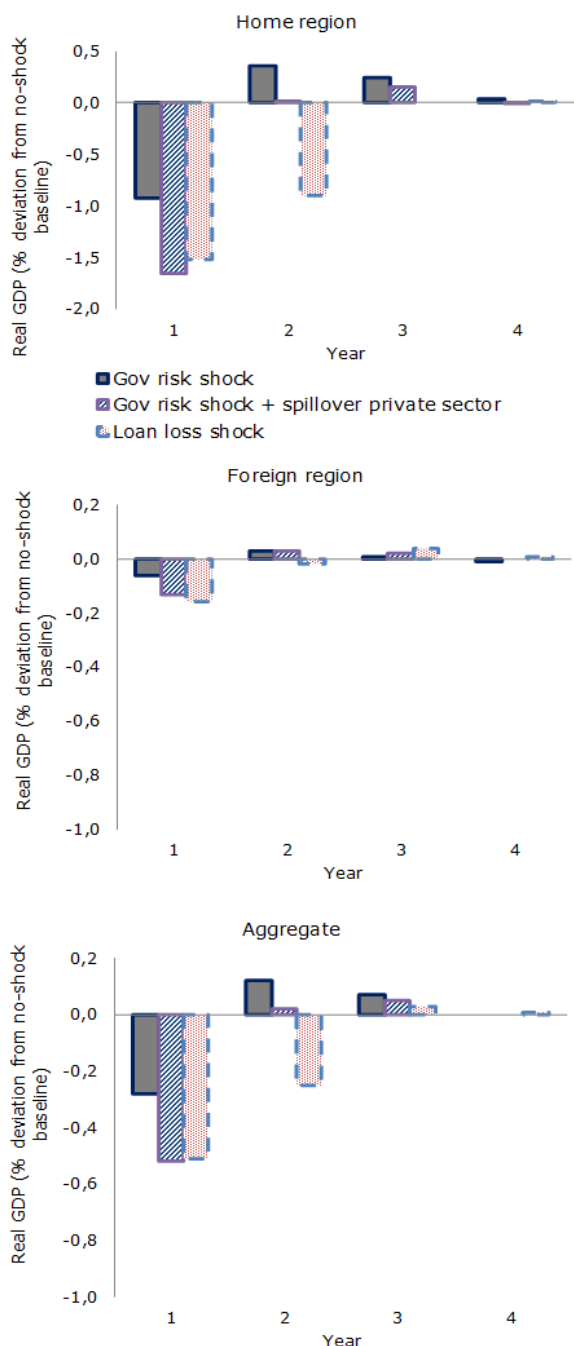
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([201]) While cross-border private-sector lending constitutes an important element of cross-border risk-sharing (see Nikolov, P. (2016), *op cit.*), simulating this aspect of integration requires further assumptions as to banks' investment decisions, which we leave for future research. Cross-border ownership of bank equity, as discussed in this subsection, is expected to mimic to some extent the effects from cross-border bank lending.

([202]) Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 establishing a framework for the recovery and resolution of credit institutions and investment firms (OJ L 173, 12.6.2014, p. 190).

([203]) The stock of non-performing loans reached some 15% of total loans in Portugal and Italy, close to 10% in Spain and some 40% in Cyprus and Greece. Taking into account that a part of non-performing loans is recoverable, this suggests an upper bound for the magnitude of the loan loss shock.

([204]) The strength of assumed spillover from domestic sovereign to domestic private-sector financing costs is in line with the evidence in Augustin, P., Boustanifar, H., Breckenfelder, J. and Schnitzler, J. (2016), *op cit.*

## Graph III.11: **Real GDP under full home bias in the banking sector**

**Home region**



Real GDP (% deviation from no-shock baseline)

- ■ Gov risk shock
- ▨ Gov risk shock + spillover private sector
- ▨ Loan loss shock

**Foreign region**



Real GDP (% deviation from no-shock baseline)

**Aggregate**



Real GDP (% deviation from no-shock baseline)

(1) 'gov risk shock' corresponds to a 10 pp increase in the sovereign risk premium; the spill-over to the private sector corresponds to a 2 pp increase in its financing costs; the 'loan loss shock' corresponds to 10% losses of 10% on loans, cumulated over 3 years.
***Source:*** QUEST simulations

Sovereign-induced and loan-induced bank losses require recapitalisation by domestic equity owners, which reduces private sector consumption and investment demand. As the sovereign risk shock is large but relatively short-lived, negative demand and GDP effects are stronger on impact, but less persistent than in the loan-loss scenario. GDP is seen to bounce back in the 2nd and 3rd years in the sovereign shock scenario, mainly because the fading-away of the shock produces valuation gains on banks' balance sheets. As the recapitalisation efforts are concentrated in the 1st year, subsequent valuation gains allow for additional dividend pay-outs, which temporarily boost equity-owners' consumption and investment. The spillover of sovereign risk to private-sector financing costs in the domestic economy amplifies the contraction of domestic demand and activity.

In the case of full home bias in banking, spillovers to the foreign region in response to financial-sector shocks in the domestic region are small and restricted to the trade channel (i.e. lower import demand and real effective exchange-rate depreciation in the domestic region).

Graphs III.12 and III.13 illustrate how cross-border diversification in banking mitigates the sovereign-bank loop and its macroeconomic implications. Graph III.12 shows a scenario in which the shocks underlying Graph III.11 hit banks with geographically diversified sovereign exposures. The scenario assumes perfect diversification of government bond holdings, i.e. the domestic banking sector's holdings of domestic and foreign government bonds reflect their respective shares in aggregate euro area government debt. Given the smaller calibrated size of the home economy, home banks hold predominantly foreign sovereign bonds in this scenario.
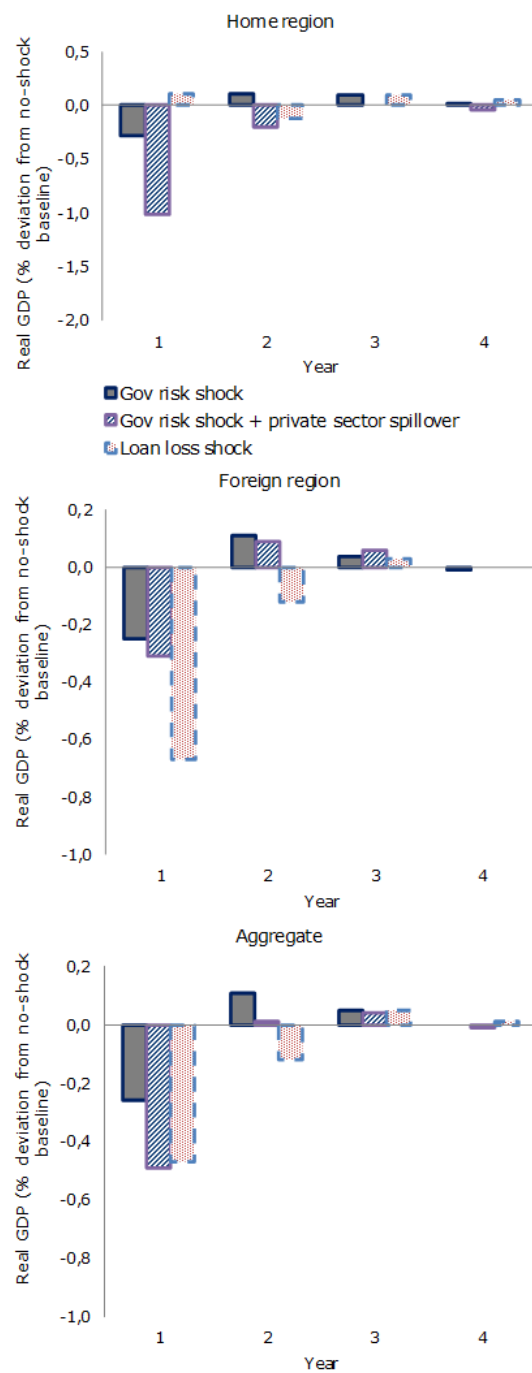
Graph III.12: **Real GDP under no home bias in bank holdings of sovereign debt**
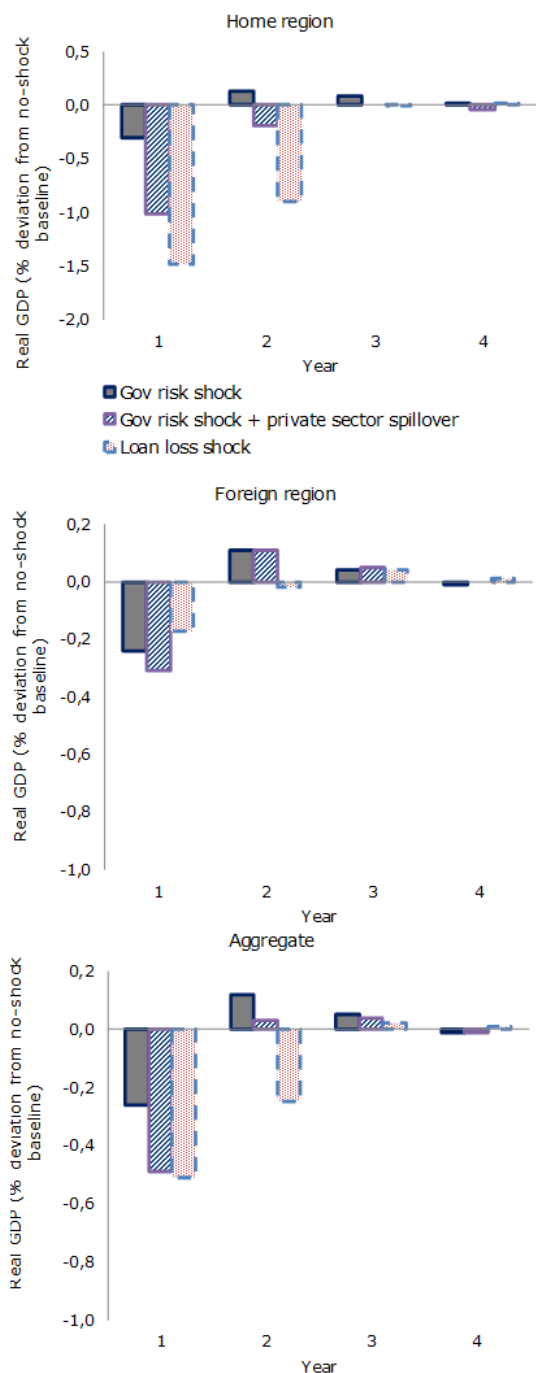


Graph III.13: **Real GDP under no home bias in bank equity ownership**



(1) 'gov risk shock' corresponds to a 10 pp increase in the sovereign risk premium; the spillover to the private sector corresponds to a 2 pp increase in its financing costs; the 'loan loss shock' corresponds to 10% losses on loans, cumulated over 3 years.
*Source:* Quest simulations

(1) 'gov risk shock' corresponds to a 10 pp increase in the sovereign risk premium; the spillover to the private sector corresponds to a 2 pp increase in its financing costs; the loan loss shock corresponds to 10% losses on loans, cumulated over 3 years.
*Source:* Quest simulations

The GDP effects in Graph III.12 show that balance-sheet diversification can have a powerful effect in mitigating the impact of higher government risk premia on the domestic economy. In particular, valuation losses have less of an impact on the balance sheet of domestic banks, so their recapitalisation needs are lower. The initial real GDP contraction is reduced by around two thirds, from 0.9% to 0.3%. The contraction in activity is larger when higher sovereign risk spills over into private-sector financing costs. Diversification of bond holdings makes it possible to reduce the impact by about a third in this case, from -1.7% to -1.0% on impact. As expected, diversification strengthens international risk-sharing mechanisms through greater spillovers to foreign banks, which now hold the majority of risky 'home region' sovereign bonds and are thus subject to capital losses via this channel.

Diversification does not materially change results in the loan loss scenario, because there are no government bail-outs in this version of the model and banks can continue to operate (well) below target capital ratios. This differs from the assumptions underlying the SYMBOL model, where diversification can change overall losses. As mentioned, the model used in this subsection is akin to the existence of a large SRF that can immediately recapitalise banks in return for higher bank contributions to the SRF.

Bank equity can also be subject to diversification. Even with full home bias in bank portfolios, a distribution of bank losses between equity owners across the monetary union can dampen the contractionary impact on economic activity in the region in which the shocks occur.

The private recapitalisation of the domestic banking sector in this case involves lower dividend payments to home and foreign equity owners alike, whereas the former still receive dividends from their ownership of part of the foreign banking sector that is not hit by shocks. An alternative institutional interpretation relates cross-border bank ownership to the existence of a monetary union-wide SRF that immediately recapitalises the ailing bank and is itself recapitalised by both regional banking sectors over time.

Graph III.13 shows a scenario with the same shocks that underlie Graph III.12, but with bank equity fully diversified across the two regions. This means that domestic equity owners' holdings of domestic and foreign bank equity reflect home and foreign banks' respective shares in aggregate euro area bank equity. Given the limited size of the home economy's banking sector, domestic equity owners hold predominantly foreign bank equity.

Graph III.13 shows that the diversification of bank equity and bank losses is an effective shock absorption tool, whether the loop is triggered by the sovereign (sovereign debt valuation loss) or the private sector (loan losses). The stabilisation gains in the sovereign risk shock scenario (with or without contagion to private financing costs) are practically identical to those with bank portfolio diversification in Graph III.12.

Bank equity diversification also distributes the losses from loan default more evenly. The initial 1.5% decline of real GDP in the home region in Graphs III.11 and III.12 is fully offset in Graph III.13. Instead, we observe a small positive home GDP effect in the 1st year, as default means that domestic households benefit from a lower debt burden. At the same time, the costs of default fall mainly on bank shareholders in the foreign region, given its larger size. An expansionary monetary policy, i.e. reduction of policy (risk-free) rates by the common central bank, stimulates interest-sensitive demand in both regions. To the extent that diversification helps to synchronise business cycles across regions, it should also allow for a more effective monetary policy with a more symmetrical impact.

Bank equity diversification amplifies spillovers to the foreign region, where real GDP falls by 0.7% on impact (Graph III.13), compared to 0.2% in Graphs III.11 and III.12. Stronger regional spillovers flow from a contraction in domestic demand in the foreign economy (where households bear some of the bank losses), in addition to (now reduced) spillovers from lower import demand in the home region.

The bank portfolio or bank loss diversification in Graphs III.12 and III.13 leaves GDP effects in the monetary union aggregate of the model practically unchanged. As mentioned, this is due to the assumption of no government bail-outs, which breaks the direct channel of the loop. It is also a consequence of the assumed linear response of government risk premia to the government debt ratio. Finally, the mechanism achieves a distribution of losses and associated negative demand effects across the two regions that would

also occur if the initial shocks were applied to the foreign region.

Given standard risk-aversion assumptions in households' utility functions, a sequence of smaller losses tends to be preferred to fewer large losses of the same aggregate size, so that a broader distribution of losses through diversification can increase welfare even in the absence of aggregate risk reduction. (205)

## III.5.  Conclusion

In this article, we have reviewed the sovereign-bank nexus in the euro area, partly in the light of its past crisis experience. Salient empirical observations from this period include the following:

- government-sponsored financial sector interventions put strong pressure on the public finances of several euro area Member States in the form of actual and contingent liabilities;

- there is evidence of a clear home bias in banks' sovereign debt holdings and this tended to increase during the crisis; and

- hikes in government risk premia correlated with similar hikes in the domestic corporate sector, both financial and non-financial.

Banks and sovereigns interact via:

- direct channels – these relate to banks' holdings of domestic sovereign debt and possible public intervention to bail out, or otherwise safeguard, the financial sector; these carry fiscal implications for the sovereign; and

- indirect channels – these capture real economy dynamics, including the possibilities of (i) the mutual reinforcement of credit constraints and restrictive fiscal policies; and (ii) private-sector funding costs experiencing contagion from rises in sovereign funding costs.

A review of the literature and analysis using the SYMBOL and QUEST models shows how adverse loops may emerge through both types of channel.

When it comes to mitigating the sovereign-bank loop, we can conclude that significant progress has been achieved as regards the direct channel. While government debt levels are higher than in the pre-crisis period, the banking sector is more strongly capitalised and the institutional framework in the euro area has seen major improvements. Chief among these are a single supervisory mechanism and a new resolution framework, including the creditor bail-in tool and a fledgling SRF. SYMBOL simulations show a marked reduction in risks to the government sector from a banking crisis when comparing the current situation with the crisis year of 2012. This is particularly true when one factors in the bail-in tool and the SRF, which suggests that policy action has helped to reduce potential losses to a small fraction of those previously possible.

While the new institutional framework carries many real and potential benefits, it still lacks a European deposit insurance scheme that could further weaken the direct channel between banks and sovereigns. Other policy options include regulatory action to reduce concentration and other risks in banks' sovereign debt portfolios. However, regulatory options promoting pure diversification should be approached with caution, as the literature and SYMBOL simulations suggest that this can have an ambiguous effect on systemic- and bank-level risk in some cases. However, the diversification of banks' sovereign debt holdings can help significantly to distribute the impact of shocks, as also confirmed in QUEST simulations. These positive results could also be achieved through the further cross-border integration of banking sectors. QUEST simulations assuming a particular form of integration (cross-border bank equity ownership) show how asymmetric shocks can be diluted across regional blocs.

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(205) Other non-linearities, not considered in the simulated model, could also mean that losses that are more frequent, but smaller, are preferable from a welfare viewpoint.

QUEST is a neoclassical–Keynesian synthesis ('new Keynesian') dynamic general-equilibrium macroeconomic model, combining a neoclassical growth model with nominal rigidities (price and wage stickiness) and real rigidities (including capital and employment adjustment frictions). Its equations characterising the aggregate dynamics of the economy are derived from microeconomic theory of household and firm behaviour. Like other macroeconomic models, QUEST offers a stylised and simplified representation of economic agents (households, firms and government) and their interactions in goods and factor markets. [1]

The version of QUEST used in this paper covers two regions in a monetary union. The same parameters determining the speed of price, wage, employment and investment adjustment are set for each. Baseline (steady state) values of the variables are calibrated to available data, so in the steady state the regions differ with respect to (bilateral) trade openness, fiscal policy variables, employment rates and bank assets and liabilities. Each regions has a representative (or, consolidated) bank, which collects deposits from risk-averse saver households, invests in government and foreign bonds, and provides loans to the private sector. The banks maximise their profits, i.e. the difference between the return on their asset portfolios (loan rates and return on government bonds) and the interest they pay on deposits (plus some operating costs). They pay the profits to equity-owner households. The equity owners use the profit income for consumption and investment in productive corporate capital. [2]

Bank assets are risky. In particular, government bonds are subject to valuation and (partial) default risk, and loans to the private sector face the risk of loan losses (i.e. defaults by debtors). In the event of valuation or loan losses, banks need recapitalisation in order to re-converge on a target capital ratio; this can take the form of:

(i)  recapitalisation by the government; or

(ii) recapitalisation via retained earnings, where banks increase their capital base by making lower dividend payments to their equity owners.

Recapitalisation by the government triggers the direct channel of the feedback loop (see Section II.2), because the value of government bonds depends (*inter alia*) on the level of public debt, so that rising government debt in response to bank rescues increases government financing costs and depreciates the value of government bonds held by banks, which then require further recapitalisation.

Recapitalisation by bank equity holders triggers the indirect feedback loop by lowering consumption and productive investment in the economy, which in turn reduces aggregate demand, activity and the economy's productive potential. Contracting economic activity deteriorates the government's fiscal position (through lower tax revenues, increased spending on automatic stabilisers and adverse denominator effects), which lowers the value of government debt and feeds back adversely to the asset side of the bank balance sheet.

In the baseline version of the model, we assume full home bias in the banking sector, i.e. domestic banks:

(i)   hold only domestic government bonds;

(ii)  are owned exclusively by domestic households; and

(iii) provide loans only to the domestic private sector.

The assumption will be relaxed in the counterfactual scenarios, by geographical diversifications of:

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[1]  See Ratto, M., Roeger, W. and in 't Veld, J. (2009), 'QUEST III: an estimated open-economy DSGE model of the euro area with fiscal and monetary policy', *Economic Modelling*, vol. 26(1), pp. 222-233, for a presentation of the basic QUEST model. The model extension with tradable goods, non-tradable goods and a housing sector is described in Roeger, W. and in 't Veld, J. (2009), 'Fiscal policy with credit constrained households', *European Economy Economic Papers* 357.

[2]  Breuss, F., Roeger, W. and in 't Veld, J. (2015), 'The stabilising properties of a European banking union in case of financial shocks in the euro area', *European Economy Economic Paper*s 550, provides a detailed presentation of the version with a banking sector.

*(Continued on the next page)*

*Box (continued)*

(i) banks' government bond portfolios, i.e. domestic banks will hold bonds of domestic and foreign governments, so bond valuation losses will be diversified across domestic and foreign banks; and

(ii) bank ownership, i.e. domestic banks' equity is held by domestic and foreign households, so bank losses will be diversified across domestic and foreign owners of bank equity.