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Monetary policy and bank stability: the analytical toolbox reviewed

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Technical papers

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Abstract

The response of major central banks to the global financial crisis has revived the debate around the interactions between monetary policy (MP) and bank stability. This technical paper sheds light, quantitatively, on the different mechanisms underlying the relationship between MP and bank stability. It does so by reviewing microeconomic studies from the academic literature as well as those conducted internally at the ECB. The paper proceeds chronologically, using the recent crisis as a touchstone. First, it provides a brief overview of the main theoretical channels linking bank stability and the transmission of MP. It then analyses the evidence from the pre-crisis period in the light of the structural trends leading up to the crisis. As the crisis erupted, unconventional monetary policy (UMP) measures were deployed, and the paper suggests that these were essential to buttress bank stability and halt a systemic crisis. At the same time, these measures involved trade-offs, and the adverse spillovers on banks' intermediation capacity and risk-taking require close monitoring. The paper ends by offering a critical review of the methodologies employed and suggestions for the areas where analytical efforts should be focussed in the future.

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Contents

Non-technical summary	4
Key takeaways	6
1 Monetary policy transmission and spillovers on banks	7
1.1 The money versus credit view	7
1.2 The bank lending channel	8
1.3 Conclusions	12
2 Before the crisis	13
2.1 The bank lending channel: Before the storm	13
2.2 Low interest rates and bank risk-taking	18
Box 1: The real impact of the bank lending channel	19
2.3 Key structural trends prior to the crisis	21
Box 2: The global capital flows cycle	24
2.4 Conclusions	28
3 Monetary policy during crisis times: Impaired transmission and unconventional monetary policy tools	29
3.1 Measures adopted to overcome impairments in the transmission mechanism	31
3.2 Measures adopted to overcome the zero lower bound	41
3.3 Conclusions	53
Box 3: Assessing the excessiveness of banks' risk-taking	55
4 Banks and the transmission of monetary policy after the crisis	58
4.1 The analytical toolkit: Strengths and weaknesses	58
4.2 Changes to transmission imparted by non-bank intermediaries and regulatory reform	62
4.3 Monetary policy, financial stability and the recovery: Historical experiences	66
4.4 Conclusions	69
Box 4: The sovereign-bank nexus	71
5 Conclusions	74
References	76
Abbreviations	93

Non-technical summary

This technical paper reviews monetary policy (MP) spillovers to bank stability and draws a number of key takeaways. It concentrates on the financial stability implications for the banking sector, as the majority of financial crises causing macroeconomic instability have been due to problems in the banking system. The focus is **empirical**. The paper delves into the large body of empirical work drawing on extensive granular datasets, an approach that has been found to be particularly fruitful in tracing out the implications of policies. It draws on the academic literature, as well as on the internal analyses and tools available at the ECB. In doing so, it also provides a critical account of the toolbox available to conduct such an assessment.¹ A companion paper analyses theoretical macroeconomic models offering a more structural perspective.²

We proceed **chronologically**. After reviewing the main channels linking MP and bank stability (Section 1), in Section 2 we show that prior to the crisis most of the empirical work in the euro area found weak evidence that banks' balance sheet conditions played a significant role in the transmission of MP. This was considered evidence of MP having no significant spillovers on the stability of banks. At the same time, the overall picture emerging indicates that prior to the crisis MP stimulated risk-taking by banks, which contributed to the unusually long duration of the upswing in the credit cycle. However, other structural developments had a larger impact on the pre-crisis build-up of risk. An unprecedented process of financial deregulation, globalisation and innovation all led to an expansion of the supply of credit, augmenting underlying vulnerabilities to a larger extent than accommodative MP.

The 2007-12 financial crisis brought the importance of spillovers between MP and bank stability back to the fore. As the crisis erupted, all banks were forced to reduce lending. This effect was unevenly distributed across banks as certain characteristics became major determinants of the transmission of MP. Smaller, weakly capitalized banks, as well as those more dependent on unstable sources of funding, cut loan supply more abruptly.

As the crisis got worse, central banks were forced to adopt unprecedented **unconventional monetary policy (UMP) measures** (Section 3). In this paper, UMPs are grouped according to the financial friction they aim to tackle. The first block targets dislocations in sovereign bond markets. It includes asset market purchases seeking to narrow the wedge between the intended and the actual MP stance. The second consists of measures aimed at facilitating the provision of liquidity to banks and targeting dysfunctions in banks' funding markets. The third block is designed to provide additional accommodation when the policy rate reaches the zero lower bound. It includes negative interest rates, forward guidance and additional asset purchases.

The use of UMP measures led to concerns over **broader adverse spillovers**. There were fears that UMPs would be reflected in spiralling inflation, or that private borrowers would take advantage of low interest rates to build up excessive leverage. However, inflation remained subdued and private debt-to-GDP ratios stabilized. More generally, there were

¹ The scope of this paper is broader than a review of the bank lending channel. It also includes MP implications for banks' risk-bearing capacity and risk appetite. Both of these affect banks' stability and, in turn, the transmission of MP. This paper does not examine whether MP should take financial stability considerations into account, or whether macroprudential policies or financial regulation have an impact on the spillovers between banking stability and MP.

² Cozzi, Darracq-Paries, Karadi, Koerner, Kok, Mazelis, Nikolov, Rancoita, Van der Ghote, and Weber (2019).

concerns that UMPs might lead governments to delay reforms, although it can be argued that in the absence of UMPs the output losses would have been much greater.³

The **overall impact of spillovers from UMPs on banks' stability is clearly positive**. The deployment of such measures was prompted by challenges to macroeconomic stability of historic proportions, so any evaluation of the measures has to be confronted with a counterfactual of a major systemic disruption. While some adverse spillovers can be identified, they tend to be counterbalanced by a number of positive effects supporting banks' stability and the economy at large. Some of the UMPs contributed to compressing the yield curve, damaging banks' interest margins and revenues. The evidence indicates that these adverse effects have been offset by their positive impact: the economic stimulus provided by these measures supported banks' profits due to less provisioning needs, higher business volumes and improvements in assets values. UMPs also raised risk appetite, although there is scant evidence that such risk-taking has been, on balance, excessive. Pockets of vulnerabilities following UMPs have been detected for some institutions and sectors. At the same time, the design of UMPs has been adjusted over time to cope with possible moral hazard problems. This was the case with long-term refinancing operations for banks, which progressively embedded incentives to convey stimulus to the real economy rather than to investing in domestic sovereign bonds. While the impact varied across measures, the overall conclusion is that UMPs acted as a decisive circuit breaker that sustained financial stability. This prevented a major economic meltdown driven by adverse macro-financial feedback loops. Certain UMPs guided economic agents towards benign equilibria, at a time when disruptive equilibria were emerging as plausible outcomes. **Looking forward, this benign assessment could be challenged**, suggesting that there is a need to combine UMPs with counterbalancing policy measures that often go beyond monetary policy (see key takeaways below).

From a methodological standpoint, there has been a massive improvement in the profession's ability to model and quantify the spillovers between monetary policy and bank stability, but the paper also identifies important limitations in our existing toolbox. In the wake of the global financial crisis, macro models have made significant progress in providing a structural assessment of how various macroeconomic variables responded to MP. Although they became progressively richer, these models still fail to give a sufficiently realistic account of the financial sector, and this limits their ability to provide policy advice. Difference-in-difference analyses based on micro data are very apt in identifying the local effects of certain policies but encounter limitations when it comes to predicting and quantifying aggregate effects. This limitation holds in particular in the case of some UMPs for which there is no univocal theoretical prediction on the sign of their impact. In this case, indeed, the comparison between banks more and less favourably affected cannot provide useful indications on the sign of the average (aggregate) effect. Finally, a major limitation still besetting both micro and macro models, is their inability to assess the impact of monetary policy vis-à-vis a scenario entailing a systemic collapse of the banking sector. This is because such collapses are tail events that are rarely observed precisely because of endogenous central bank interventions to prevent them.

³ Eichengreen (2019).

Key takeaways

The following **takeaways** can be drawn from this technical paper. First, **UMPs exert side effects on bank stability in many dimensions, which require incisive and early identification and close monitoring**. Decisive action on the UMP side has proved to be essential not only to unblock the transmission mechanism so that MP stimulus can reach the real economy, but also to support bank stability, representing the ultimate backstop against the realization of potentially systemic runs.

Second, **the precise design features of the UMP measures deployed are key for their effectiveness as well as for their potential spillovers**. For instance, composition effects matter significantly. In the United States the decision to purchase mortgage-backed securities increased mortgage refinancing activity, boosting consumption. In the euro area, asset purchases of corporate bonds encouraged new issuances, also in the case of first-time borrowers. Enhancing the design of liquidity injections with appropriate incentive schemes has proved to be useful in boosting effectiveness, while reducing adverse effects.

A third key takeaway is that a better understanding of the **underlying factors driving credit** is of paramount importance. The modelling of the credit cycle should include not only conjunctural but also structural elements such as competition, regulation, financial innovation and the rise of non-bank intermediaries. For instance, the advent of fintech is likely to lead to further contestability in the banking sector. Increased use of market sources of funding can make banks' funding more dependent on the perceptions of financial markets, heightening the probability of herding.

Fourth, the **right institutional setting** is required to minimize some of the undesired aspects of the nexus between bank stability and MP. This suggests strengthening the effective supervision and prompt resolution of banks, particularly following the implementation of UMPs. The establishment of the Single Supervisory Mechanism in the euro area was a historically important improvement in this direction, raising and homogenising supervisory standards. At the same time, completing the banking union, including a wider range of macroprudential tools, is critical to counterbalance some of the adverse unintended effects from UMPs.

Fifth, it is useful to take a perspective that looks beyond current economic conditions. A **careful review and understanding of evidence from previous crises** provides a useful compass for understanding effects and formulating policies. As illustrated throughout the paper, evidence of the connection between monetary policy and bank stability is characterized by extreme cyclicity usually linked to the stage of the credit cycle. It is, therefore, crucial to look beyond the contemporary situation of the economy, and draw from analogous past experiences. For instance, results from previous crises showed how banks tend to undercapitalize during credit booms.⁴

Finally, **macro- and micro-analytical models have fundamental strengths and should be used jointly for a credible assessment of the bank lending channel**. Micro models have limitations as they provide local effects, although they have improved our ability to make causal statements about the impacts of policies. Looking forward, the analytical tools will have to improve their ability to assess the role of monetary policy interventions in avoiding the materialisation of systemic events.

⁴ See Peek and Rosengreen (1995) or Laeven and Majnoni (1995).

1 Monetary policy transmission and spillovers on banks

The recent (2007-2012) global financial crisis brought the connection between MP and bank stability back to the fore. The crisis showed, vividly, how the banking sector is critical to the transmission of the monetary policy to the real economy. This connection between bank stability and MP is particularly relevant in the euro area, owing to the size of its banking sector. This section starts by briefly reviewing the bank lending channel from a relatively broad perspective: In particular, it argues that MP has an impact on the loan supply also by affecting banks' balance sheet conditions. The spillovers from MP and bank risk-taking are complex, and can be more or less desirable from a financial stability standpoint. While these wider connections between MP and bank stability are generally neglected in most reviews of the bank lending channel, their identification and quantification represent a major component of this study.

1.1 The money versus credit view

In the traditional money view, a key transmission mechanism of MP is the interest rate channel. The central bank steers very short-term nominal interest rates in order to affect long-term *real* interest rates. The latter, in turn, affect investment and consumption. For instance, a contractionary MP would increase real interest rates and, therefore, the cost of capital for actual and potential borrowers. This would cause a drop in investment, leading to a decline in aggregate demand and output.⁵

The speed of transmission of MP hinges on the financial structure. Contractual features of credit markets, often shaped by a country's institutional settings or history, can dramatically alter the pace of the pass-through of MP rates to borrowers. For instance, mortgages rates can be "fixed" or "adjustable". Adjustable rates are "floating", in that they charge an interest rate tied to a short-term benchmark, such as the one-year EURIBOR, which varies over time. In contrast, for fixed-rate mortgages the interest rate charged does not change during the life of the loan (e.g. 10 to 20 years). The transmission of MP is therefore far quicker (Campbell and Cocco, 2003) for households selecting adjustable rates.

A striking feature of the euro area is the high degree of heterogeneity across countries in terms of the use of fixed or adjustable-rate mortgages. Fixed-rate mortgages are dominant in Belgium, France, Germany and the Netherlands, while adjustable-rate mortgages prevail in Austria, Greece, Italy, Portugal and Spain (ECB, 2009; Campbell, 2012). As a result, the transmission of MP is heterogeneous across countries and, since mortgages are a major liability on most households' balance sheets, they play a

⁵ A key ingredient for the transmission from nominal short-term to real long-term rates is "price stickiness". Following a change in the nominal short-term interest rate, it takes some time for the aggregate price level to adjust, so that an expansionary monetary policy shock lowers not only the nominal, but also the real long-term interest rate.

key role in the transmission of MP to the real economy (Di Maggio et al., 2017). This also depends on other factors such as prevailing household leverage (Beraja et al., 2018).

The workings of credit markets can lead to MP having substantial real effects on aggregate demand. Aggregate demand tends to exhibit large fluctuations that are difficult to reconcile with those of nominal as well as real interest rates. In fact, an influential stream of literature, models how imperfections in credit markets play a large role explaining these relatively large real effects associated with relatively small MP impulses (Gertler and Gilchrist, 1993; Bernanke and Gertler, 1995; Cecchetti, 1995 and Hubbard, 1998).

The credit view of MP can operate via two channels: The borrower balance sheet channel and the bank lending channel, both of which build on insights from information economics.⁶ The balance sheet channel, also called the “broad credit channel” or “financial accelerator”, works via borrowers’ balance sheets. A decline in short-term rates positively impacts borrowers’ net worth, thus making debt cheaper and increasing asset prices. This lowers the external cost of finance, which is inversely related to a borrower’s financial position. A decrease in the external finance premium increases interest-sensitive spending and investment (Bernanke and Gertler, 1995). Our starting point is the “traditional” bank lending, or narrow credit channel, which argues that an expansionary MP increases banks’ loan supply. For borrowers dependent on bank loans, the increase in loan supply will lead to increases in investment and consumption (Boivin et al., 2010).

1.2 The bank lending channel

1.2.1 Traditional view

The traditional view of the bank lending channel assumes that an increase in reserve requirements raises the cost of issuing deposits, so banks reduce lending owing to the relative decrease in funding sources. In other words, a monetary tightening leads to a decline in bank lending if the drop in reservable bank deposits cannot be completely offset by issuances of non-reservable liabilities (or liquidating some assets). Since the market for bank debt is not frictionless and non-reservable bank liabilities are typically not insured, a “lemons premium” must be paid to investors.

The traditional view of the bank lending channel hinges heavily on central banks’ control over the level of deposits via reserve requirements and the money multiplier. According to this formulation, if banks were not subject to reserve requirements, the mechanism would not be effective.⁷ Nowadays, however, MP implementation predominantly

⁶ See Stiglitz (2017) for a review.

targets a level of short-term interest rates, and the traditional bank lending channel has ceased to be a valid representation of a MP transmission mechanism via banks.⁸

This would not mean that bank conditions, in general, are not active in the transmission of MP. For instance, following an increase in short-term interest rates, depositors, in an attempt to seize higher rates, would tend to shift out of bank deposits towards less liquid instruments. A tightening in MP leads to a disproportionate increase in the cost of uninsured funding (over and above the increase in the short-term rate), which can then be passed on to bank borrowers.

The bank lending channel, both in its traditional and its newer representations, often hinges on the presence of spillovers of MP on banks' funding position. Bank-specific characteristics determine the sensitivity of banks' cost of external financing to changes in MP and, accordingly, the response of loan supply to MP changes (Disyatat, 2011). In empirical studies, this heterogeneity in the exposure to the MP shock is often exploited by comparing patterns of lending supply across different intermediaries. Our focus is broader, and Section 4 will also consider the impact (or spillovers) of monetary actions onto banks' balance sheets; be it in terms of funding, profitability, or capitalisation. These changes on banks' balance sheets are, in turn, expected to impact banks' intermediation capacity and risk-taking.

1.2.2 Additional channels of transmission through banks

Recent studies find evidence for a “risk-taking channel”.⁹ The question is whether MP has an impact on banks' “risk tolerance”, which would represent an obvious MP spillover that can affect the stability of the banking sector. **There are at least two main ways in which low interest rates may affect bank risk.** First, low short-term funding costs for banks, coupled with low returns on government bonds, may increase banks' incentives to “search for yield”, for behavioural or institutional reasons (Rajan, 2005). Search for yield may also depend on the “sticky” rate of (nominal) return targets in certain contracts which are prevalent in banks, pension funds and insurance companies. This would bring about a disproportionate increase in banks' demand for riskier assets with higher expected returns. This effect could change across countries and over time, as it would depend on initial capitalization and the degree of bank competition (Dell’Ariccia et al., 2014).

Another way in which low interest rates could make banks take on more risk is through their impact on valuations, incomes and cash flows. A reduction in the policy rate boosts asset and collateral values, which in turn modify banks' estimates of probabilities of default, loss-given default and volatility. This would lead to an expansion of banks' balance sheets owing to an increase in their risk tolerance (Borio and Zhu, 2008; Adrian and Shin, 2008, 2010).

⁸ For instance, following the collapse of Lehman Brothers, the ECB provided the reserves demanded by solvent banks, subject to their posting sufficient acceptable collateral.

⁹ See, for instance, Dell’Ariccia et al. (2017), Altunbas et al. (2014), Maddaloni and Peydró (2011) for the United States; Jiménez et al. (2012, 2014) for Europe.

A further transmission channel works via banks' capitalization. Tighter MP can have a negative impact on banks' cash flows, for example due to declines in asset valuations, which are reflected in negative changes in banks' capital (Disyatat, 2011). Banks' capital changes affect their external ratings, also providing investors with an indication of their perceived soundness. Lower capital signals higher risks to providers of uninsured funding, for which they demand a higher external finance premium. Well-capitalized banks can better shield their lending from MP shocks, as they have easier access to uninsured funds. Capital also influences the way banks react to shocks in the real economy: Well-capitalized banks can better absorb temporary financial difficulties and preserve long-term lending relationships (Gambacorta and Mistrulli, 2004).

The bank capital channel requires two conditions to be in place. The first is that breaking the minimum capital requirement should be costly, so that banks limit their risk of capital inadequacy (Van den Heuvel, 2002). As capital requirements are linked to credit outstanding, the latter would determine an immediate adjustment in lending. By contrast, if banks have an excess of capital, the drop in capital could be absorbed without any consequences for the lending portfolio. As equity funding is relatively costly compared with other forms of funding, banks tend to economize on units of capital and minimize the amount of capital in excess of what regulators (or the markets) require. The second is an imperfect market for bank equity: Banks cannot easily issue new equity, particularly in periods of crisis, because of tax disadvantages, adverse selection and agency costs. Empirical evidence has shown that these two conditions typically hold and that bank capital is important in the propagation of credit shocks (Kishan and Opiela, 2000; Gambacorta and Mistrulli, 2004; Altunbas et al., 2010), particularly during periods of financial stress.

1.2.3 New models and structural trends

Changes in the banking system are enhancing banks' importance from the perspective of MP transmission and are altering the MP spillovers on banks.

Structural changes in bank funding have been observed in the run up to the financial crisis. For instance, banks have been relying more on market sources of funding (see Section 2). As a result, banks' incentives and ability to lend are likely to be more sensitive to financial market conditions than they were when banks were mostly funded via deposits. In turn, market funding flows are more sensitive to banks' financial health than deposits and are associated with a greater cyclicity of loan supply (He and Krishnamurthy, 2013). There is, in fact, strong evidence to show that banks with more deposit funding or that are less reliant on wholesale funding reduced supply less than other banks and were less adversely affected by the recent banking crisis (Ivashina and Sharfstein, 2010; Gambacorta and Marques-Ibanez, 2011; Kapan and Minoiu, 2018; Dagher and Kazimov, 2015). This is the opposite of the view held prior to the crisis, whereby banks relying on wholesale funding were seen as capable to easily replace deposits and therefore as less exposed to MOP shocks.

This trend has partly reversed with the financial crisis, since which banks increased their insured deposits together with their funding from central banks. From the perspective of MP, these changes mean that the impact of a given level of interest rate on

bank loan supply and loan pricing could change over time, depending on banks' funding structure and conditions (Hale and Santos, 2010; Disyatat, 2011). Importantly, from the perspective of this paper, this complicates the analysis of the spillovers of MP on banks, as these will depend on the specific funding structure, on the conditions prevailing in the different funding market segments and, as we will see in the following chapters where we extensively describe all the main conventional and unconventional MP instruments, on the type of MP tool activated. This is also why this paper will adopt an extensive approach and analyse single MP instruments and episodes.

From a borrower's perspective, during the global financial crisis non-financial corporations were able to raise substantial amounts of funding via the corporate bond market. Therefore, many very large firms were able to bypass supply constraints in the banking sector by tapping into the corporate bond market directly. This casts some doubt on the imperfect substitutability between bank lending and bonds for very large borrowers. The bank lending channel is therefore also evolving over time as a result of the development of alternative forms of market funding for firms (De Bondt and Marques-Ibanez, 2005).

A “deposit channel” has also been recently put forward, working via banks' market power over deposits. In line with the traditional view of the bank-lending channel, it has been argued that in the United States, as the Fed funds rate increases the spread between the deposit and the Fed funds rate declines. Households respond to the decline in the spread (the opportunity cost of holding deposits) by reducing their deposit holdings and investing in bonds. The deposits channel predicts that banks increase wholesale funding to partly offset deposit outflows (Drechsler et al., 2016).

Stringency of supervision may also have a major impact on the transmission of MP via banks and on the bank stability spillovers . Undercapitalized banks may tend to roll over unprofitable loans to riskier borrowers, thereby affecting the bank lending channel. These banks tend to delay the recognition of losses on their credit portfolio in order not to further undermine their reported capital, a phenomenon known as “evergreening”. As lending flows to insolvent borrowers, bank capital is locked, obstructing the transmission of MP to new borrowers. In the extreme, banks continue to maintain preferential lending relationships with certain borrowers, rather than shifting to more profitable opportunities (“connected lending”). Some papers provide evidence of evergreening in parts of the euro area during the crisis (Blattner et al., 2018), while others some argue that it is quantitatively not relevant (Albertazzi and Marchetti, 2010, Schivardi, Sette and Tabellini, 2018).¹⁰

Some of the new mechanisms of the bank lending channel blur the distinction between banks and non-banks. Non-bank financial intermediaries that rely completely on market funding are also sensitive to MP changes. As with banks, their funding cost is dependent on their perceived riskiness. MP also influences their balance sheets, cash flows and capital, thus conditioning their loan supply (Brinkmeyer, 2014).

¹⁰ These links have been extensively documented for other economies (see Morck and Nakamura, 1999; Peek and Rosengren, 2005; Caballero et al., 2008; Kihwan, 2006; La Porta et al., 2003; Sapienza, 2004; Cufiat and Garicano, 2010; Illueca Muñoz et al., 2011; Jassaud, 2014; Koetter and Popov, 2018).

Factors such as regulatory gaps and access to central bank liquidity affect the different lending reactions of banks and non-banks. For instance, non-banks can step in and replace bank lending when the latter is constrained by regulatory requirements.

The overall result of the growing impact of non-bank financial intermediaries on monetary policy transmission is unclear. In the light of new entrants, traditional banks might try to dampen the effect of interest rate changes on lending, in order to preserve long-term relationships (Bolton et al., 2016). There is tentative international evidence suggesting that non-bank intermediaries' balance sheets contract (expand) more strongly in response to monetary tightening (easing) than bank balance sheets (IMF, 2016). There are also US results suggesting that shadow banks are able to charge higher spreads than banks, especially when the Fed funds rates are high (Xiao, 2018).¹¹

1.3 Conclusions

This section reviews the main channels through which banks shape the transmission of MP. While traditional ways of looking at the bank lending channel have been questioned, the role of banks in shaping the transmission mechanism of MP has increased in recent decades. The global financial crisis has brought about a deeper understanding of the different channels which now incorporate factors such as market sources of funding, financial innovation and non-bank financial intermediaries. Along the way, a stronger emphasis on the role of banks in the MP transmission has been accompanied by a greater awareness of the spillovers of MP on banks.

¹¹ In this regard there is macroeconomic modelling of how MP tightening induces a rise in lending by shadow banks (Mazelis, 2015; Mazelis, 2016).

2 Before the crisis

Most pre-crisis evidence was weak with regard to banks' conditions having an impact on the transmission of monetary policy. At that time, central banks regularly analyzed developments in borrowers' funding conditions, but there were no major concerns over banks' affecting the supply of credit in any meaningful way. With few exceptions there was also scant analysis of the possible spillovers from monetary policy to bank stability. This section reviews the main results from that period, and how benign conditions were driving those pre-crisis results. It also shows how underlying structural changes in the banking sector underpinned the burgeoning vulnerabilities created in the run-up to the crisis and were tightening the connection between FS and MP.

2.1 The bank lending channel: Before the storm

In the years leading up to the financial crisis most of the literature tended to omit banks as a major source of friction in the transmission of MP. Likewise, most central banks around the world rarely included the banking sector in their macroeconomic models and, instead, conducted conjunctural monitoring of borrowers' funding conditions. There were several reasons for the limited interest in banks shown by central bankers and academics. Technically, it is very difficult to incorporate banks into Dynamic Stochastic General Equilibrium (DSGE) models. It is only recently that initial steps have been taken in this direction, incorporating certain features of banks which have been shown to impair the transmission of MP during crises.¹²

From a macroeconomic perspective a relatively long upswing in the credit cycle also contributed to a false sense of security prior to the crisis. On the real side, a smoothing of the business cycle, as suggested by the structural decline in the volatility of GDP which began in the early 1980s, also contributed to complacency.¹³ The aforementioned strong credit expansion, characterized by low default rates and robust credit growth had, since the early 1990s, assuaged concerns over the potentially disruptive impact of tensions in credit markets on the real economy.

In the run-up to the global financial crisis, lending conditions in most developed economies, including the euro area, were relatively loose. An environment characterized by accommodative MP was demonstrated by the persistent downward deviations of central bank interest rates from the Taylor rule. Low rates were transmitted to the economy as lenders eased credit standards for corporations and households (blue and yellow line respectively). Consistent with the risk-taking channel,¹⁴ lending standards were moving in line with risk perception (see Chart 1).

¹² Gertler and Kiyotaki (2010) and Cozzi, Darracq-Paries, Karadi, Koerner, Kok, Mazelis, Nikolov, Rancoita, Van der Gote and Weber (2019).

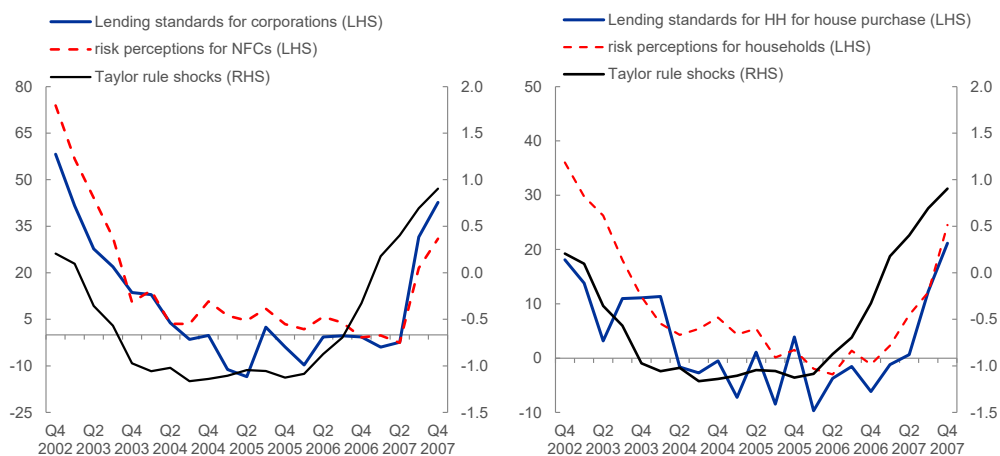
¹³ McConnell and Perez-Quiros (2000).

¹⁴ Rather than a bank lending channel.

Chart 1

The euro area's lending standards, risk perceptions and deviations from the Taylor rule prior to the crisis

(net percentage of banks; percentage points)

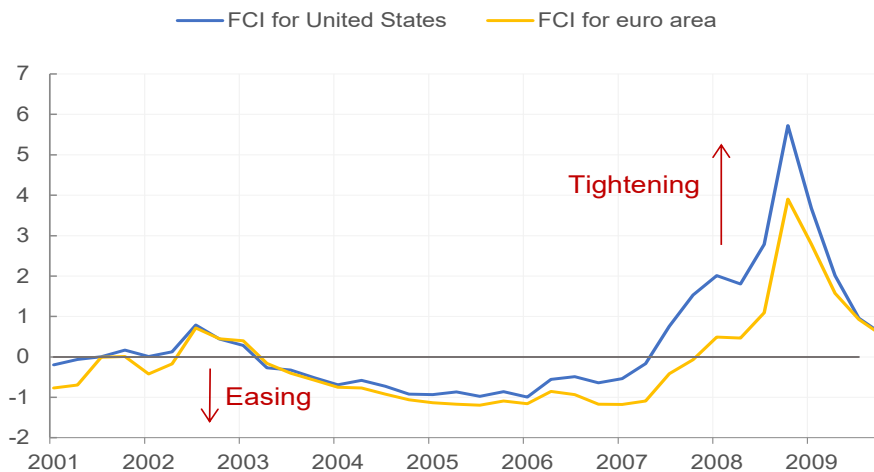


Sources: Maddaloni and Peydró (2011) and euro area bank lending survey.

Notes: Lending standards measured as net percentage of banks reporting a tightening (change) of credit standards (risk perceptions) for loans to enterprises and households. Taylor-rule shocks are obtained by taking the residuals of the regression of the quarterly average of overnight interest rates, the EONIA rate, on GDP growth and inflation. Both measures are weighted according to the outstanding amount of loans in each of the 12 countries in the sample.

Chart 2

Financial Conditions Index prior to the crisis



Source: IMF.

Notes: For the euro area the index is given by the median across countries. The index is calculated by aggregating, on a time-varying weighted basis, a set of variables collectively proxying the conditions prevailing in financial markets. Besides the real short-term interest rate, a series of interest rate spreads are included, as well as equity-related measures, the exchange rate and real estate prices.

Accommodative credit conditions were also illustrated by developments in the Financial Conditions Index (FCI), (see Chart 2 above). This shows that US and euro area firms benefited from an enduring period of financial softening prior to the crisis. The trend reversed in late 2007 with the start of the financial crisis, as lenders tightened credit conditions, and the FCI had reached an all-time high by end-2008.

2.1.1 Bank characteristics and the transmission of MP

In the run-up to the global financial crisis, bank heterogeneity was not found to be relevant for the transmission of MP. Most empirical studies analyzing the bank lending channel yielded insignificant or mild results for Europe and the United States. These papers sought to disentangle the demand and supply factors driving credit growth, using large panels of banks' balance sheet information over time. They therefore used cross-sectional differences under the hypothesis that certain bank-specific characteristics (e.g. size, liquidity and capitalization) influence only banks' loan supply, while demand is largely independent of these characteristics.¹⁵

As suggested in Section 2, this approach assumes that, after a monetary tightening, the drop in bank funding (which affects banks' ability to make new loans) and banks' ability to shield loan portfolios, differ from bank to bank. In particular, smaller and less strongly capitalized banks, which suffer more from information frictions, face higher costs when raising non-secured deposits and are more strongly compelled to reduce their lending. Illiquid banks are less able to shield themselves from the effect of a monetary tightening on lending by simply drawing down cash and securities.

Evidence of a bank lending channel operating in Europe was, overall, very weak prior to the crisis. Chart 3 summarizes the main study results, and shows that MP did not have a major impact on the lending of small or less-capitalized banks compared with other institutions. However, banks holding more liquid assets showed weaker loan adjustment. This finding can be explained by country-specific characteristics, suggesting that a good understanding of institutional features across countries is important.¹⁶

There is more evidence of a bank lending channel operating via liquidity differences across banks in the United States than in Europe, although it is still not macroeconomically meaningful. It shows that banks might be obliged to restrain lending following an MP tightening if they face liquidity constraints (Kashyap and Stein, 1995). As is the case in Europe, this evidence is probably linked to problems faced by US banking institutions in the early 1990s.

There was also no evidence of a strong bank lending channel operating via bank capital before the crisis, either in the United States or in Europe. Studies from different European countries suggest that differences in bank capital had no material impact on the transmission of MP across banks (see Chart 4). The exceptions are Italy and the United Kingdom, which show some evidence, probably linked to banking problems in the early 1990s in these countries (Gambacorta and Mistrulli, 2004; Kishan and Opiela, 2000).¹⁷

¹⁵ Overall, identification issues and endogeneity problems remain among the most challenging aspects this literature is obliged to tackle (Peek and Rosengren, 2009).

¹⁶ Some examples are the importance of banks' networks, state guarantees and public ownership (Angeloni et al., 2003; Ehrmann et al., 2003; Ehrmann and Worms, 2004).

¹⁷ Other studies show that the lending behavior of less-capitalized banks in France was also more responsive to a change in monetary policy (Altunbas, De Bondt and Marques-Ibanez, 2004).

Chart 3

Loan supply: Responses to monetary policy before the crisis

	Size	Capital	Liquidity	Holding affiliation
Europe	No	No (only during crisis periods)	Slightly	Slightly
United States	Slightly	Slightly	Slightly	Slightly

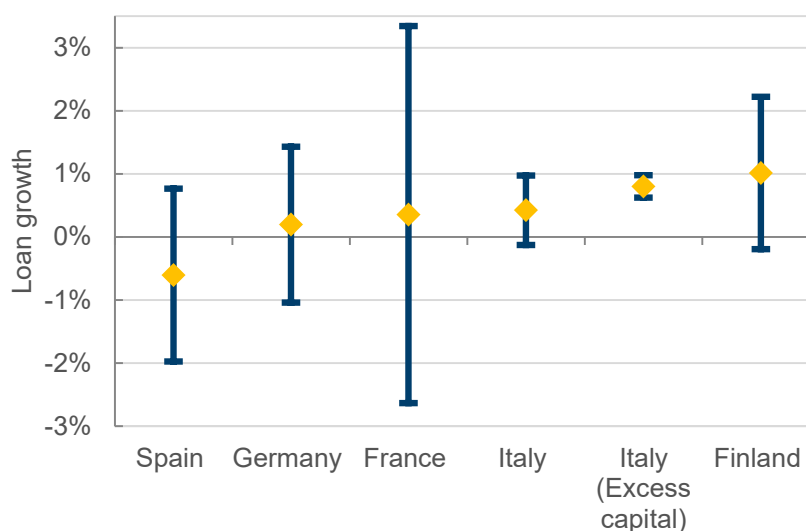
Sources: Altunbas, Fazylov and Molyneux (2002); Altunbas, Gambacorta and Marques-Ibanez (2009); Dell’Ariccia, Laeven and Suarez (2017); Ehrmann, Gambacorta, Martínez-Pagès, Sevestre and Worms (2001); Gambacorta (2005); Gambacorta and Mistrulli (2004); Jiménez, Ongena, Peydró and Saurina (2012); Kashyap and Stein (1995); Kashyap and Stein (2000); Kishan and Opiela (2000).

Chart 4

Loan supply: Bank capital and the transmission of monetary policy before the crisis

(percentages)

◆ Additional loan growth for banks having lower than 10% capital...



Sources: Angeloni et al. (2003) and Gambacorta (2005).

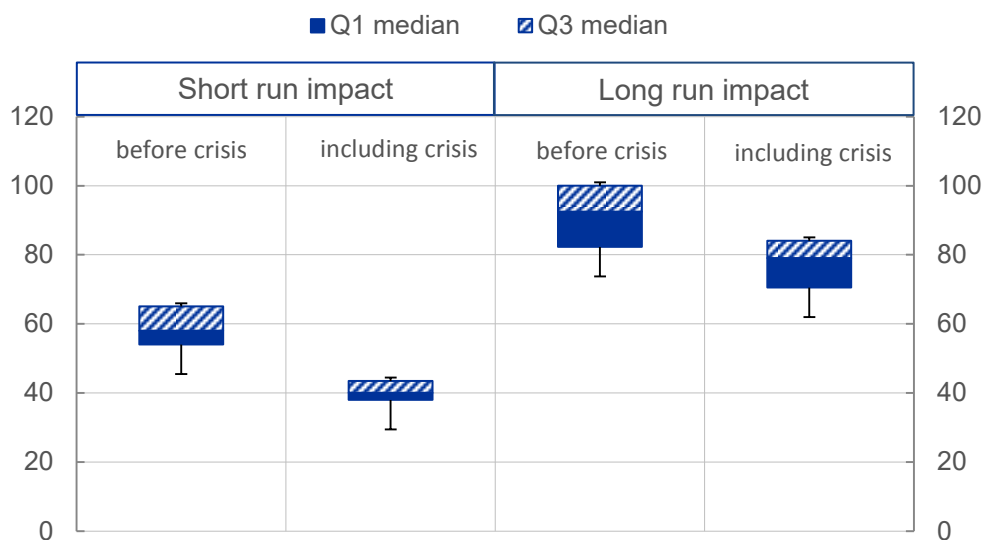
Notes: This chart shows the additional impact of a monetary policy easing on the loan supply of banks with low capital compared with better-capitalised banks. The estimation period runs from the first quarter of 1991 to the fourth quarter of 1998 for Spain, the first quarter of 1994 to the fourth quarter of 1998 for Germany, the third quarter of 1994 to the third quarter of 2000 for France, the first quarter of 1988 to the fourth quarter of 1998 for Italy, the fourth quarter of 1986 to the fourth quarter of 1998 for Italy (excess capital) and the first quarter of 1995 to the fourth quarter of 2000 for Finland. Results for loan growth are usually estimated via the GMM estimator suggested by Arellano and Bond (1991).

As the crisis erupted, the deterioration in bank conditions suddenly became a major stumbling block for the transmission of monetary policy. As banking problems spread, the majority of banks drastically restricted the loan supply and tightened lending standards (see Chart 1). For those borrowers that were able to get a loan, the pass-through of (declining) policy rates to borrowers slowed considerably (see Chart 5).

Chart 5

Pass-through of money market rates to lending rates: before and after the crisis

(changes in basis points due to a 100 basis point change in money market rates)



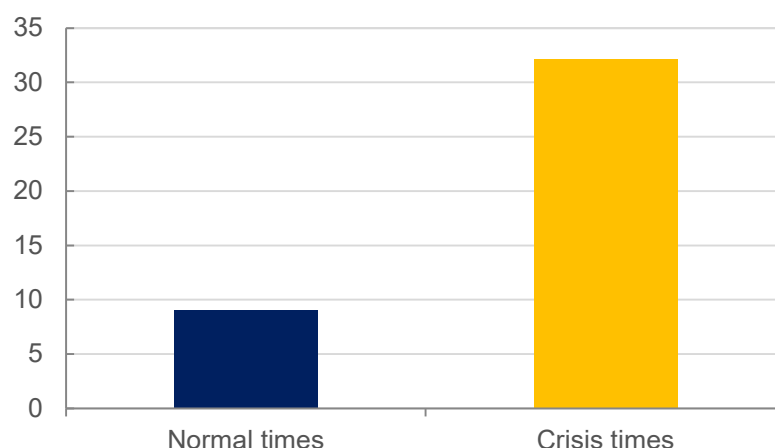
Sources: Based on Albertazzi, Nobili and Signoretti (2019); Borio and Fritz (1995); Bank for International Settlements (1994); Cottarelli and Kourelis (1994); De Haan et al. (2001); Donnay and Degryse (2001); Hofmann and Mizzen (2004); Holton and Rodriguez d'Acri (2015); Kleiemeier and Sander (2004); Mojon (2000).

In addition, during the crisis bank heterogeneity reappeared as a major factor shaping the transmission of monetary policy. There is consistent evidence that capital suddenly becomes an important driver of banks' credit supply (particularly) in periods of acute financial stress. During such periods raising capital becomes extraordinarily expensive, or even unfeasible, and many banks are forced to limit their lending even more. Smaller banks also react by restricting lending more aggressively than larger institutions. This restriction in loan supply has, in turn, an impact economic activity (see Box 1).

In short, smaller and less-capitalized banks are less able to shelter their borrowers during episodes of financial distress and are forced to restrict loan supply more aggressively. As MP seeks to counterbalance the effects of the crisis, smaller and less-capitalized banks are also less responsive to changes in MP, which then becomes less effective for these institutions (see Chart 6 below). While size and capital are important, the most important characteristic obstructing the loan supply is bank funding, which will be considered in detail in Section 2.3.

Chart 6 Share of loan growth explained by Tier 1 capital

(quarterly percentages growth)



Source: Gambacorta and Marques-Ibanez (2011).

Notes: *Heterogeneity in loan growth explained by the level of capital across banks. The results are based on data from 15 countries (the United States and 14 major EU economies). The results on the left-hand side bar refer to the period from 1999q4 to 2007q2, while the results on the right-hand side bar refer to the period from 2007q3 to 2009q4.*

2.2 Low interest rates and bank risk-taking

There is also mounting evidence from the pre-crisis period of a risk-taking channel at work. The evidence shows a relationship between low real interest rates and bank risk-taking that is consistent with a risk-taking channel. Low interest rates have been linked with the granting of riskier loans in both advanced and emerging economies.¹⁸ They are also linked with risk-taking by institutional investors and mutual funds (Di Maggio and Kacperczyk, 2017; Hau and Lai, 2016).

Quantitative evidence that the risk-taking channel was operating before the crisis is provided in Chart 7. Chart 7A shows that, in Spain, a 1% decline in the monetary policy rate during the pre-crisis period led to a higher probability of a loan application being granted to riskier, compared with safer, firms. Chart 7B shows that the effect of a US monetary policy easing on corporate loan spreads (i.e. more aggressive lending) is far greater for risky than for safer firms (Paligorova and Santos, 2017). Overall, this literature suggests that loose monetary policy has a significant impact on banks' lending standards, particularly during the upswings of a credit cycle or as credit conditions become frothy. Quantitatively, however, it is most likely that other factors contribute far more to bank risk-taking than monetary policy. The next section briefly considers these underlying structural factors, with a focus on financial factors,¹⁹ as these structural factors have significantly affected banks' incentives and the way financial institutions convey monetary policy.

¹⁸ Ioannidou, Ongena and Peydró (2014); Maddaloni and Peydró (2011); Jimenez et al. (2014); Altunbas, Gambacorta and Marques-Ibanez (2014); Popov (2016); Dell'Ariccia et al. (2017); Claessens, Coleman and Donnelly (2017).

¹⁹ Other structural factors on the real side such as the decline in productivity or slower secular economic growth, which might also have contributed to banking vulnerabilities, are not considered here.

Box 1: The real impact of the bank lending channel: Evidence from micro studies on the real effect of banking crises.

(by Luisa Carpinelli)

The reduction in lending associated with the bank lending channel is likely to produce real effects by altering the investment decisions of households and firms and, ultimately, affecting output and employment. The extent to which the contraction in economic activity observed during the Great Recession can be traced back to the credit crunch has recently been explored. Identifying a causal impact of the financial shock on real activity poses serious empirical challenges, in that it requires the singling out of the supply from the demand components of credit and the isolation of the share of output dynamics connected to the financial shock. A number of papers have tried to address these issues through the use of innovative identification strategies relying on detailed granular data.

The variation in results depends mainly on the country under analysis and the type of borrowers that are included in the study sample. Also, the magnitude of the impact hinges on the financial structure of the economy and the overall loss-absorption capacity of corporates and households. The impact of the financial shock seems relatively limited for the US corporate sector. Based on a sample of about 2,000 medium-sized and large firms that tap the syndicated loan market, Chodorow-Reich (2014) finds that, during the 2007-09 crisis, employment seemed to respond to the health of lenders: employment for firms at the 10th percentile of bank health fell by 4 to 5 percentage points more than for clients at the 90th percentile.

Nevertheless, **the impact of bank health is far greater for small than it is for large firms**. Using a different approach, Greenstone et al. (2014) offer evidence that lending shocks led to declines in both small firm and overall employment during the Great Recession, although the effect was economically small. Even if the entire reduction in lending could be attributed to a decline in credit supply, this would still account for no more than 5% of the fall in employment.

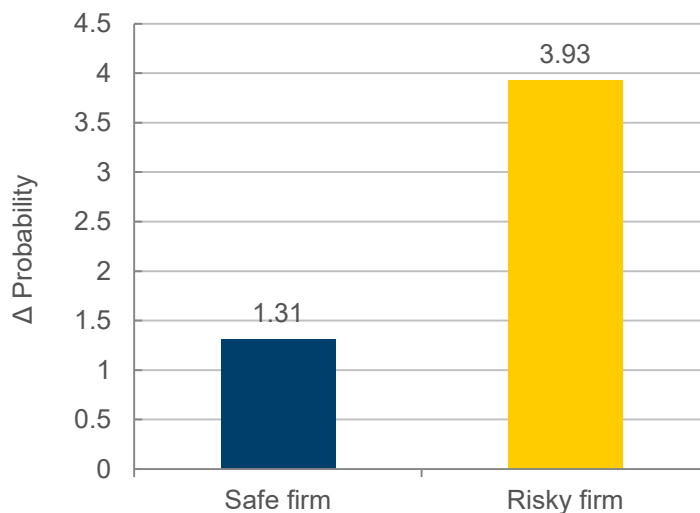
Gilchrist (2018) finds that **during booms credit supply shocks do not have any significant effect on economic outcomes**, although he finds a significant impact during busts. Over the period 2007-10, when mortgage credit contracted further declines in house prices, in the employment-population ratio and in average wages per capita, as well as increases in the unemployment rate, were all large and significant.

In Europe, Bentolila et al. (2017) and Cingano et al. (2016) find that the Lehman crisis had a significant impact on the Spanish and Italian economies respectively. By identifying weak banks as those that had been bailed out by the Spanish government, based on a sample of about 150,000 Spanish non-financial firms, Bentolila et al. (2017) showed that weak banks reduced credit supply more and that firms borrowing more intensively from these banks suffered significantly larger employment losses. These credit-related losses accounted for 7% of total job losses. Losses were larger for financially vulnerable firms and were concentrated among workers with temporary contracts. In Cingano et al. (2016) the source of heterogeneous exposure to the shock was lenders' reliance on interbank funding before the crisis. They find that without the collapse of the interbank market investment expenditure would have been more than 20% higher. Reduced access to credit induced declines in investment and in employment: firms facing a 10% fall in credit growth between 2006 and 2010 lowered employment growth by around 2%. Finally, there is evidence from Germany showing that following a bank funding shock, firms that are dependent on credit from affected banks experience significant effects, both on employment and on wages (Popov and Rocholl, 2018).

Chart 7

(A) The impact of monetary policy easing on loan granting

(percentage points)

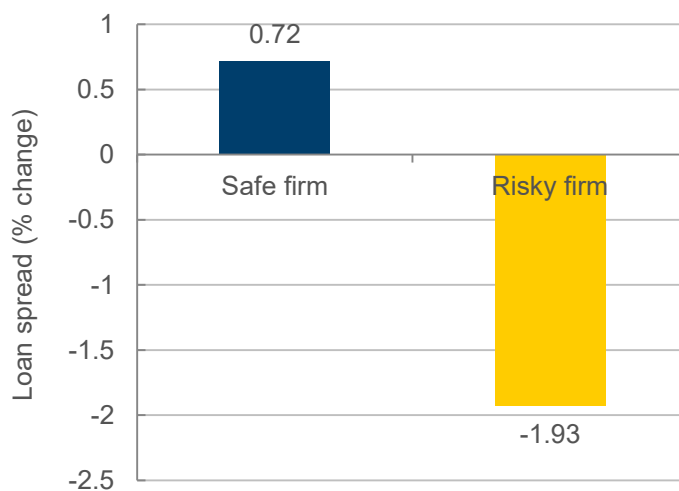


Sources: Jimenez et al. (2012), Jimenez et al. (2014);

Notes: The chart shows the effect of a 1% decrease in the monetary policy rate on the probability of a loan application being granted in Spain from 2002 to 2008. The average probability before the rate reduction was 36%. A firm is classified as risky if it had nonperforming loans outstanding in the previous four years.

(B) The impact of monetary policy easing on corporate loan spreads

(percentage points)



Source: Paligorova, Santos (2017).

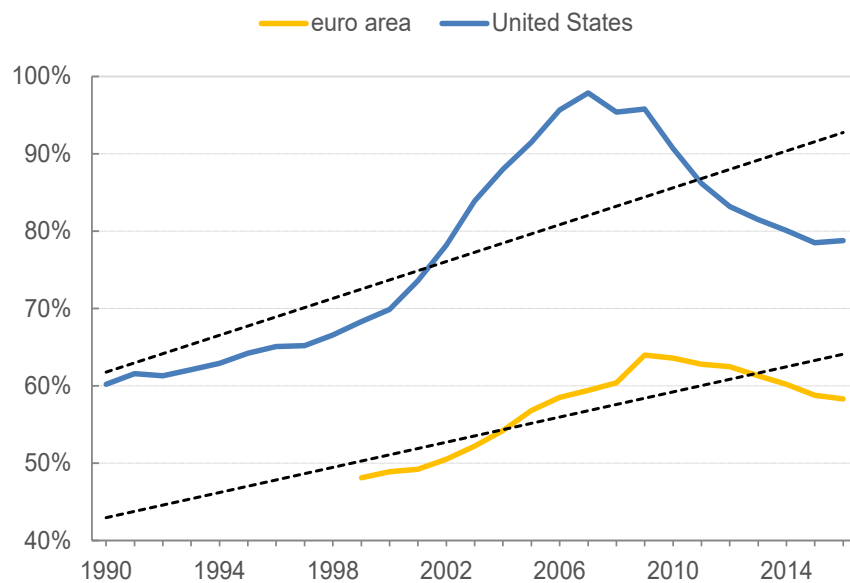
Notes: The chart shows the impact (percentage change) of a monetary policy easing on corporate loan spreads for a "safe" firm (defined as having one standard deviation lower probability of default than the average) and for a "risky" firm (one standard deviation higher probability of default). The sample includes loans to US publicly traded companies from 1990 to 2008.

2.3 Key structural trends prior to the crisis

Several structural changes in the run-up to the financial crisis had a major impact on the banking industry, and thus on the transmission of monetary policy. This subsection revisits three major structural changes that affected banks prior to the crisis: The unprecedented process of financial deregulation, globalization, and the increased use of market sources of funding. One important effect was that these trends augmented the amount of credit available in most developed economies (see Chart 8) and contributed to making the credit cycle longer and smoother, although also deeper. This is, of course, relevant as most financial crises, including the global financial crisis, are ultimately triggered by an excessive supply of credit normally linked to rising housing prices.

Chart 8
Total credit outstanding

(percentages of GDP)



Source: Organisation for Economic Co-operation and Development.

To provide an image, the loan supply operated like a rubber band. During the good times, for a given level of interest rates, it further increased the credit available, which was granted under more favourable conditions. Financial innovation contributed to smoothing the credit cycle, as smaller shocks were hedged and diversified away more easily. These trends also led to the system becoming more leveraged and vulnerable to systemic shocks when the credit cycle turned. This was the case during the global financial crisis, during which the loan supply declined drastically and many worthy borrowers were not able to access credit. On top of this, heterogeneity in the transmission of monetary policy across banks resulted in the restriction in credit being even more extreme for borrowers receiving credit from weaker banks.

2.3.1 Financial deregulation

In the decades leading up to the crisis the banking industry experienced an intense period of financial deregulation. Owing to its potential for large negative externalities in the form of financial crises, the banking industry had been traditionally one of the most regulated sectors. In the two decades prior to the global financial crisis, however, an unprecedented process of financial deregulation took place both in the United States and in Europe, aimed at making the banking sector more competitive. These cycles in regulation intensity have been common throughout history – the amount of regulation tends to increase in the aftermath of crises only to decline during periods of financial stability (Dagher, 2018). In the late 1990s, it was expected that deregulation would increase competition in the banking industry owing to new entrants and the geographical expansion of existing players. Efficiency gains from competition were also expected to increase the amount of credit available to borrowers.

In practice, most of the conduct and structural regulations limiting banks' activities were progressively lifted (see Chart 9 below). Deregulation applied to a wide spectrum of banking regulations that covered, inter alia, the possibility of banks expanding geographically or widening the range of products they could offer to customers. Deregulation led to a significant expansion in the size of the banking industry, which accelerated in Europe after the introduction of the euro.

Chart 9

Regulation developments in the decades prior to the global financial crisis

<i>Structural regulation</i>	<i>Conduct regulation</i>	<i>Prudential regulation</i>	
Functional separation of institutions	↓ Regulation of banks deposit and lending rates	↓ Deposit insurance	= ↓ ↑
Entry restrictions	↓ Regulation of fees and commissions	↓ Discount window (lender of last resort)	= ↑
Discriminatory rules against foreign banks (and investors)	↓ Credit quotas	↓ Ownership restrictions	↓
	Branching limitations	↓ Restriction on asset concentrations (large exposures)	= ↓
	Limits on maturity transformation	↓ Solvency ratios CRR CRD IV Macro Prudential	= ↑
		Information disclosure requirements	↑

Sources: Constructed from Diamond and Dybvig (1986); Gual and Neven (1992); The Oxford Handbook of Banking (2014). Blue arrows are used for prudential regulation and red for other of regulations. Blue arrows are used for prudential regulation and red for other of regulations.

According to several observers, intense deregulation led to more competition, although it also augmented underlying systemic vulnerabilities.²⁰ Historically, periods of deregulation in the banking sector have tended to coincide with bouts of financial instability (Vives, 2016; Vives 2019). The economic mechanism suggests that deregulation lowers banks' market power, thereby depressing their charter value. This, coupled with banks' limited liability and the existence of "quasi" flat-rate deposit insurance, also encouraged banks to expand their lending to riskier borrowers.²¹ In short, the idea is that a more competitive banking sector will bring about efficiency gains, although if this is not regulated appropriately then extreme competitive pressures will lead to an oversupply of credit, thereby increasing systemic risk.

The supervisory response was to enhance the role of bank capital and market discipline as a prudential tool. The majority of supervisory actions moved away from regulating banks' activities and business models, first towards an increased reliance on market discipline, resulting in enhanced demand for information disclosure. Second, the prudential regulation of banks progressively focused on bank capital. The use of bank capital as the preferred prudential supervisory tool was risky from a systemic stability perspective as it implicitly assumed that supervisors and bankers would be able, and willing, to set an appropriate level of capital sufficiency that would ensure banks' solvency in the event of crises (see Chart 9 above).

2.3.2 The increasing role of global factors

The rise of international capital flows, global banks and institutional investors has strengthened the co-movement of financial prices and credit flows. This has expanded the availability of credit internationally, although it has also raised the importance of global risk factors affecting domestic conditions. In practice, as global factors become more important, they also restrict the ability of national authorities to control credit flows, the loan supply and, more generally, the transmission mechanism of monetary policy via banks (see Box 2 for a discussion of the role of global capital flows).

²⁰ See, for instance, Vives (2016).

²¹ Hellmann et al. (2000) or Dell'Ariccia and Marquez (2006). More competitive banking markets reduce the value of information production and increase its relative associated costs. This reduces incentives for banks to generate costly information to attract business from competitors. Therefore, banks operating in credit markets with high levels of competition tend to exhibit laxer screening and monitoring of credit risks, eventually resulting in high levels of systemic risk. Another parallel argument suggests that the increase in competition makes coordination failures in banking more likely, leading to more instability.

Box 2: The Global Capital Flows Cycle: structural drivers and transmission channels

(by Fabrizio Venditti and Maurizio Habib)

Increasing international financial integration has led to the emergence of a global financial cycle where financial variables, either capital flows or asset prices, increasingly co-move across countries (Miranda-Agrippino and Rey, 2015). This co-movement is in part driven by MP shocks occurring in the United States and related to both financial market volatility and the degree of risk aversion of the market. The global financial cycle thus provides a synthetic measure of global risk. Studies show that more dollar-dependent economies should start to factor such a global component into their policymaking so they can better isolate their domestic conditions from global risk in order to reach their macroeconomic targets, such as inflation (Rey, 2018).

The global financial cycle significantly reduces the ability of policymakers to steer domestic financial conditions away from the global trend using traditional tools such as flexible exchange rates or running an interest rate policy that is independent of that of the United States.

According to the classical “trilemma” in international macroeconomics, if the capital account is open it is impossible to run an autonomous MP, i.e. set the policy rate independently from that of the core economy and, at the same time, have an exchange rate target. The global financial cycle morphs this trilemma into a “dilemma” as the policy choice is restricted to that between an independent MP and capital account openness.

Although there is still no comprehensive macro framework on the role of global financial cycles in driving national outcomes, such interdependence is already known to have potentially relevant implications. Rey (2018) highlights that countries that are more dependent on the core economy’s fundamentals should adopt additional tools such as macroprudential policies, in order to limit the “international” transmission channel through the banking sector. In addition, those countries using a mix of bank-based and market-based finance should also consider adopting capital controls as an exceptional but necessary tool to face the financial stability implications arising from the underlying “global” factor.

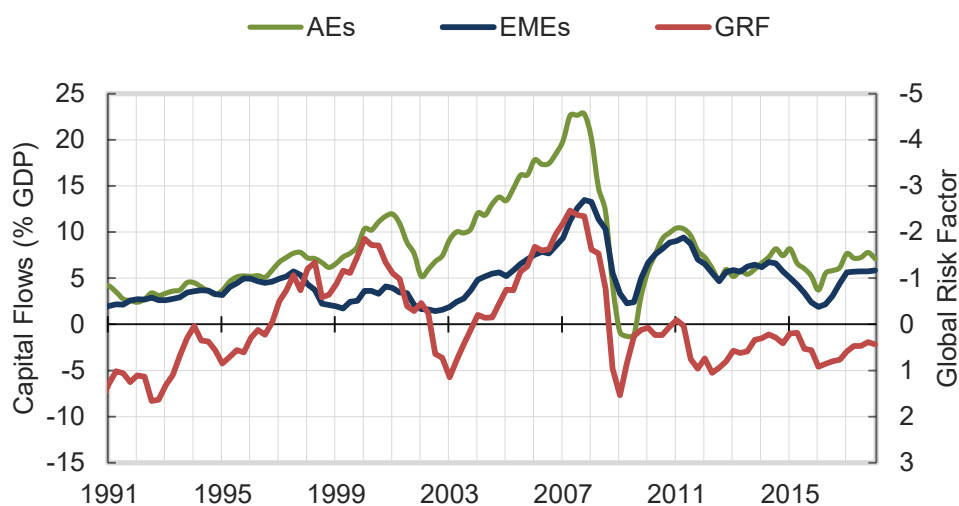
By affecting financial asset prices and capital flows, fluctuations in global risk, as driven by US MP, lead to significant changes in the leverage of global financial intermediaries in turn feeding on the global credit cycle. According to some studies, such episodes are so extreme that the role of global factors in international liquidity flows overshadows that of domestic factors (Forbes and Warnock, 2012), although this evidence has been questioned by a number of studies. Cerutti et al. (2017), for instance, argue that global factors do not explain more than 25% of the variation in capital flows in emerging countries, even when considering different types of flows such as FDIs, portfolio capital and bank credit.

A measure of global risk summarising the co-movement of stock market returns in 63 economies (the global stock market factor) provides a meaningful indication of the global financial cycle. This factor is tightly connected to cycles in global capital flows, as measured by the sum of capital inflows across 50 emerging economies (see Chart A below). An analysis based on a Structural Vector Autoregression (VAR) indicates that the main structural driver of this global stock market factor is a financial shock, which can be broadly interpreted as exogenous changes in the risk-bearing capacity of the financial sector. Such a shock, in turn, matters more than US MP in terms of driving global risk (Habib and Venditti, 2018).

The transmission of global risk to different types of capital flows depends on the degree of capital account openness, as well as on the exchange rate regime. A “trilemma” in the transmission of global risk to capital flows exists, as countries that are more financially open and that adopt a strict currency peg are more sensitive to global risk. This “trilemma” is largely driven by bank loans, thereby confirming the importance of global banks in the narrative of the global financial cycle. By contrast, portfolio flows appear to be less sensitive to global risk. Since the role of market-based finance is on the rise at the expenses of that of global banks, these results call for a careful assessment of the financial stability implications of global risk shocks. As the composition of global liquidity shifts away from bank loans to other sources of financing such as equity and bonds, sudden shifts in investors' risk attitude could propagate faster than in the past.

These results carry interesting implications for international macroeconomic models and for the analysis of the international transmission of monetary and financial shocks. First, the impact of MP on capital flows seems to be significantly mediated by global risk. In other words, MP affects capital flows mostly via its impact on the risk appetite of global investors. Second, global risk is also driven by other shocks, in particular financial shocks, and has a large idiosyncratic component, so US MP may not be seen as the only major factor behind the global financial cycle.

Chart A Total capital flows to advanced economies (AEs), emerging market economies (EMEs) and a global risk factor (GRF).



Sources: IMF, Datastream and ECB calculations.

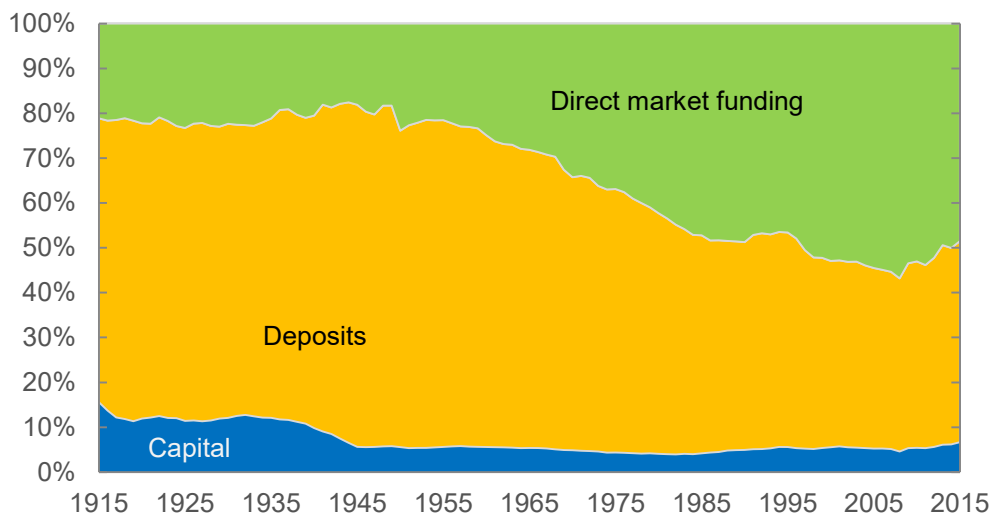
Notes: The latest observation is for the fourth quarter of 2017. Capital flows are reported as a share of the country group's GDP, i.e. capital flows to advanced economies divided by the sum of advanced economies' GDP and, similarly, for emerging economies (four-quarter moving average). The global Risk Factor is constructed from stock returns for 63 countries.

2.3.3 Funding structure

The other major trend in the pre-crisis period was banks' increasing dependence on market sources of funding (see Chart 10 below). The spectacular increase in the size of institutional investors coupled with financial innovation meant that banks could rely more on market sources of funding. The latter could be traditional (i.e. the covered bond or repo markets) or the result of financial innovation (i.e. securitization).

Chart 10
Funding of banks

(percentages of total liabilities)



Source: Jordà et al. (2017).

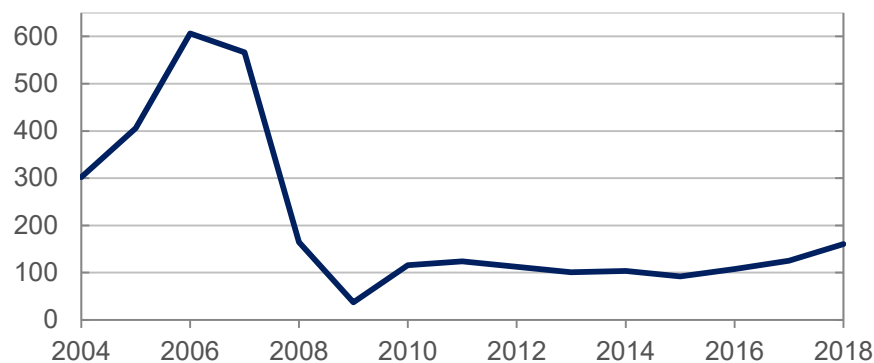
Notes: Data are expressed as the percentage share of total bank liabilities. Figures for each year are unweighted averages across 17 countries.

Funding in the form of customer deposits tends to be a stable source of funding owing to high switching costs and the presence of government insurance (Shleifer and Vishny, 2010). As banks become more dependent on market funding there is a closer connection between conditions in the bond markets and banks' ability to raise financing. This could also increase the probability of herding and make banks' incentives and ability to lend more sensitive to financial market conditions. Under normal conditions this closer connection would strengthen the credit cycle, making it smoother and longer. During crises, however, this dependence on market sources of funding could lead to less stable and scarcer funding. This means that the impact of a given level of interest rates on banks' loan supply could change over time, depending on financial market conditions.

A major source of market funding was securitisation. The decade prior to the global financial crisis coincided with spectacular increases in the use of securitisation and credit-risk-transfer techniques more broadly (see Chart 11 below; Marques-Ibanez and Scheicher, 2010). The typical view at the time emphasised the positive role played by securitisation in supporting bank stability and, therefore, the efficient transmission of monetary policy (see, for instance, Greenspan, 2005). Securitisation activity was expected to make the financial system more stable as risk was more easily diversified, managed and allocated economy-wide (Duffie, 2008).

Chart 11 Securitisation issuance in Europe

(USD billions)

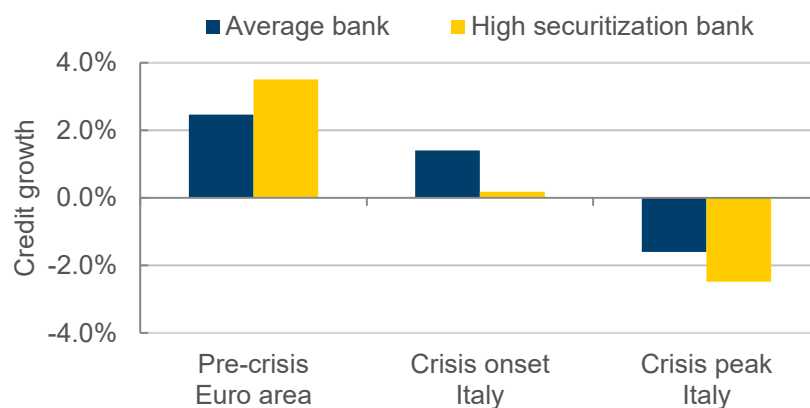


Sources: Bloomberg, JP Morgan, Merrill Lynch, Sifma, Thomson Financial and the Bond Market Association.
Notes: The chart uses total European security issuance until 2006 (before the crisis), and the total amount of placed securities from 2007.

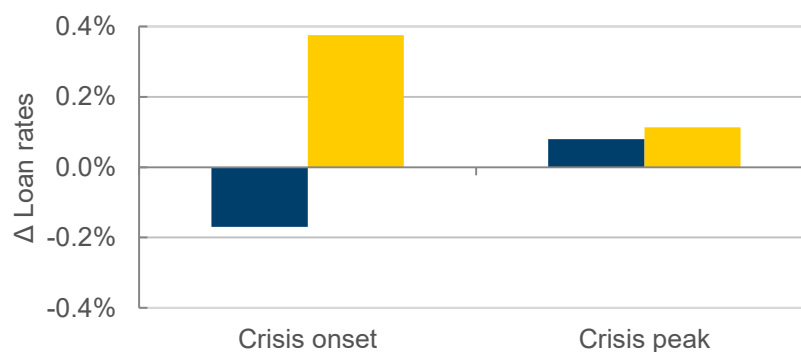
Chart 12 Impact of securitization on loan supply and on lending rates

(semi-annual percentage change; semi-annual absolute percentage difference)

(A) Loan supply



(B) Loan rates - Italy



Sources: Gambacorta and Marques-Ibanez (2011); Bonaccorsi di Patti and Sette (2016).
Notes: Chart on loan supply (A) compares semi-annual loan supply growth for average and high-securitisation (one standard deviation above average) banks in the euro area before the crisis (December 1999 to December 2005), at the onset of the crisis (June to December 2007) and during the crisis (June to December 2008). Chart (B) compares the semi-annual loan-rate change for average and high-securitisation (one standard deviation above average) banks in Italy at the onset of the crisis (June to December 2007) and during the crisis (June to December 2008).

However, securitisation was also modifying banks' ability to grant loans. Evidence from before the crisis suggests that the use of securitisation sheltered banks' loan supply from the effects of monetary policy. At the same time, there has been growing evidence suggesting an indirect spillover from MP to bank conditions: Relatively low interest rates contributed to increase investors' demand for asset-backed securities supporting an expansion in the use of securitization by banks. Partly because of this, securitisation, and market funding in general, greatly increased the amount of credit supplied (Loutskina and Strahan, 2009; Altunbas, Gambacorta and Marques-Ibanez, 2009). Securitisation strengthened the capacity of banks to supply new loans to households and firms at better prices for a given amount of equity capital (Mian and Sufi, 2015). This capacity, however, is cyclical and changes over time, in turn amplifying the credit cycle. In fact, empirical evidence, comparing crisis and non-crisis periods around the world, supports the role of banks' market funding in strengthening (shrinking) the supply of credit by banks in good (bad) times (see Chart 12 above).

2.4 Conclusions

Prior to the global financial crisis, there was no meaningful evidence of a bank lending channel at play. The relatively buoyant stage of the credit cycle was probably blurring differences in risk-taking across banks. Also traditional models of the bank lending channel emphasized heterogeneity in bank conditions, and were not able to capture underlying, but growing, systemic risks.

As in most banking crises, the global financial crisis showed that when the credit cycle reverses, bank conditions become crucial for the transmission of monetary policy. First, there is a macroeconomic effect as all banks restrict the loan supply. In this respect the section also shows that underlying structural factors in the financial system (i.e. deregulation, globalisation and funding sources) have affected the credit cycle increasing the amount of credit available in good times. Among these factors there is evidence suggesting that relatively loose monetary policy contributed to risk-taking by banks, but there is no consensus on the importance of this factor on the build-up of risks. Second, heterogeneity in bank conditions (such as funding or capitalisation) accentuated the drop in credit supply by some banks, and further obstructed the transmission of monetary policy. Therefore, assessing the spillovers between MP and bank stability and how these spillovers shape the credit cycle appear to be increasingly important in capturing the transmission of monetary policy.

3 Monetary policy during crisis times: Impaired transmission and unconventional monetary policy tools

The crisis triggered by the collapse of Lehman Brothers and the accompanying recession required the development of a new set of monetary policy tools. All the major central banks reacted to the deep and prolonged recession that followed the global financial crisis by aggressively cutting official rates and adopting a wide range of UMP measures. In addition, as policy rates approached their effective lower bound, all the major central banks used forward guidance and implemented large-scale asset purchase programmes (APPs), both aimed at lowering long-term yields. Forward guidance and APPs do not directly target banks' intermediation capacity, although the configuration of interest rates they imply, characterised by low levels and a flat term structure, has considerable implications for banks' balance sheets and activity.

The decisive reaction of central banks to the global financial crisis has revived and intensified the debate on the potential adverse bank stability implications of expansionary monetary policy (Borio, Disyatat and Rungcharoenkitkul, 2018). While no unanimous consensus on the prominence of the role played by monetary policy in creating the pre-crisis build-up of risk has emerged, an extensive body of empirical literature now provides convincing support for the view that low rates lead to increased risk-taking, notably by banks.²² Overly expansionary monetary policy has, then, been seen as potentially sowing the seeds of the next financial crisis (e.g. Borio et al., 2017).²³ While in the aftermath of the global financial crisis credit growth remained subdued, with a few notable exceptions, and inflation rates remained contained (Dell'Ariccia et al., 2018), risk premia in financial markets were compressed by historical standards and, as such, subject to possible sudden repricing, with potentially large repercussions for credit markets and banks. Moreover, the adoption of UMP measures has been seen as possibly inducing specific (adverse) side effects that operate via a reduction in banks' profitability and a weakening of their balance sheet position.

While such side effects could bring about serious dysfunctionalities in the financial system, a comprehensive account of post-crisis monetary policy measures needs to take into consideration what these measures were intended to achieve. In particular, the detrimental side effects can be juxtaposed against the direct effects that such measures were intended to have and which are consistent with, if not necessary for, preserving bank stability. For instance, while liquidity injections may create distortions in banks' funding strategies and lending activity, it should be remembered that the reason these were

²² Among others, Altunbas, Gambacorta and Marques-Ibanez (2012), Paligorova and Santos (2012), Dell'Ariccia, Laeven and Suarez (2017), Popov (2016), and Ciccarelli, Maddaloni and Peydró (2013).

²³ Others see the main culprits not so much in monetary policy but instead in the excesses induced by financial innovation and lax supervision (e.g. Diamond and Rajan, 2009 and Svensson, 2011). Global imbalances in capital flows, the so-called savings glut, have also been seen as the main culprit of the pre-crisis build-up of risk (Obstfeld and Rogoff, 2009) and, ultimately, as the factor underlying low (real) rates.

implemented in the first place was to avoid massive and disorderly deleveraging. Similarly, while low or negative rate policies may compress some items in banks' income statements, their purpose is to sustain economic activity, ultimately benefiting banks via a reduction in the level of risk embedded in their balance sheets and the stimulation of demand for banking services. As a third example, when monetary policy operates via the risk-taking channel, this is detrimental to bank stability only insofar as it leads to *excessively* high risk-taking. Otherwise, when the level of risk-taking is inadequately low, owing to panic or other frictions (e.g. capital constraints), lending supply may turn procyclical and exacerbate macroeconomic instability (Borio et al., 2001; Panetta and Angelini, 2009). Moreover, higher risk-taking may also follow from stricter capital requirements in the presence of tightened monetary policy, highlighting the importance of analysing the interaction of both policies (Martinez-Miera and Repullo, 2019).²⁴ To sum up, when assessing the bank stability spillovers of monetary policy, one should not forget that such measures represent the endogenous response to the deterioration in business and financial conditions. This holds for conventional monetary policy and, even more so for unconventional measures.

This section reviews the monetary policy measures adopted during the crisis period in the euro area, with the aim of assessing their adverse and beneficial spillovers to bank stability, with a particular focus on banks. This is achieved by formulating a taxonomy which classifies each measure according to the specific objective and market frictions or impairments that it was designed to tackle. The discussion will distinguish between spillovers affecting banks' intermediation capacity, i.e. the ability of banks to bear risk on their balance sheets, and spillovers affecting their risk appetite. To the extent possible, this chapter will provide a comprehensive account of all bank stability implications for each type of monetary policy measure, distinguishing between adverse and beneficial spillovers and emphasising the methodological aspects and limitations of the analytical toolbox available.

The analysis provided below is related to the bank lending and risk-taking channel literature, although it differs in some important dimensions. Typically, empirical studies of the bank lending channel exploit heterogeneity across banks to assess whether a lending channel or a risk-taking channel of monetary policy is at work. Although the underlying assumption is that monetary policy has an impact on banks' risk-bearing capacity or risk appetite, such an impact is typically not analysed directly. This has several implications. First, the size of the underlying bank stability spillovers is not directly quantified. So it is not clear if a given stimulus on lending supply is associated with a small or a large bank stability spillover. Second, the sign of such spillovers might not be clearly identified. For instance, a certain type of banks might respond by more to an expansionary monetary policy shock, either because such a shock is increasing its risk-bearing capacity or because it is lifting its risk appetite, with different implications for banking stability. Moreover, in the context of the discussion developed in this paper, the necessity arises of addressing issues which tend to be overlooked in the traditional bank lending and risk-taking channel literature. In particular,

²⁴ See, in this regard, the forthcoming ECB paper by Cozzi et al. (2019) on the macroeconomic impact of macroprudential policy measures and their interaction with monetary policy.

when assessing the banking stability implications of the bank lending channel, we cannot focus solely on cross-sectional differences and neglect the (general equilibrium) effects on the macroeconomy. Similarly, when assessing bank stability spillovers of the risk-taking channel it becomes evident that this analysis cannot sidestep an assessment of whether the extra risk taken is efficient or excessive. In the following review, these aspects will be discussed qualitatively and, wherever possible, quantitatively. Methodological limitations that prevent a fully-fledged consideration of all these aspects will also be outlined.

3.1 Measures adopted to overcome impairments in the transmission mechanism

3.1.1 Operations directly targeting financial market stress

One set of UMP measures activated by the ECB, with the aim of addressing impairments in the monetary transmission mechanism, specifically targeted dislocations in sovereign bond markets. This set of measures comprises the Securities Markets Programme (SMP) and Outright Monetary Transactions (OMTs). An increase in sovereign bond yields that is driven by market dysfunctionalities drives a wedge between the intended and the actual MP stance as it affects bank lending conditions through a number of channels. First, it affects bank funding conditions because government debt often acts as a floor for the pricing of other debt in the economy. This arises either mechanically owing to benchmarking practices or, more generally, through arbitraging that transmits an increase in sovereign bond yields to bank debt yields. Moreover, the erosion of the value of sovereign bonds reduces the availability of collateral that can be used in banks' secured funding operations. Second, this erosion of value generates losses on banks' sovereign debt holdings that deplete banks' capital and, therefore, limit their capacity to intermediate. Third, a non-fundamentally driven increase in sovereign yields opens up a return differential (in risk-adjusted terms) between investing in sovereign debt and extending loans to the private sector, which tilts banks' asset allocation towards the sovereign, thus diverting funding away from the private sector.²⁵

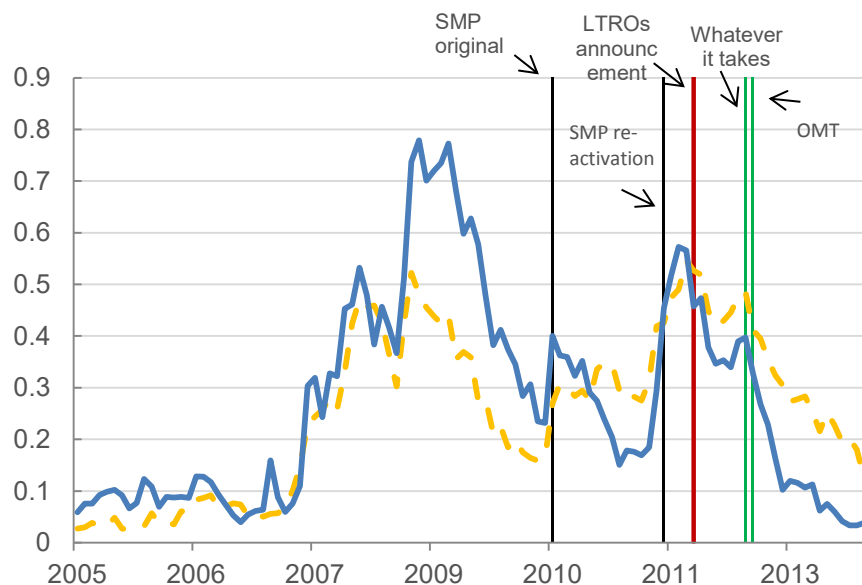
The scope of the first outright purchase programme (SMP), which entailed limited acquisitions of government bonds issued by Greece, Ireland and Portugal, was later significantly broadened with the announcement of OMTs. In May 2010, conditions in euro area financial markets – and sovereign debt markets in particular – had become very stressed (see Chart 13 below). The re-ignition of tensions in sovereign markets in the summer of 2011 led to a reactivation of the programme in August 2011, with purchases of government bonds issued by Italy and Spain added to its scope. Stress in sovereign debt markets nevertheless persisted, particularly as market participants started to price in redenomination risk (the risk that a security could be redenominated from euro to a national currency). This prompted the announcement of the OMTs on August 2012, which entailed

²⁵ In asset allocation what is important is the differential in ex ante returns. Under certain assumptions, however, the differential in ex post returns (which is what we will be able to easily monitor) may also be reflected in ex ante returns.

ex ante unlimited purchases of euro area sovereign bonds, subject to the issuing countries' complying with conditionality.

Chart 13

The composite indicator of systemic stress (CISS) and of systemic stress in government bonds (sovereign-CISS) in the euro area



Source: ECB calculations.

Notes: The CISS and sovereign-CISS are normalised to lie between 0 and 1. CISS is based on Kremer, Lo Duca and Holló (2012). Sovereign-CISS is based on Garcia-de-Andoain and Kremer (2018).

Beneficial spillovers (to banks' intermediation capacity)

While these measures were adopted in pursuit of monetary policy objectives, they were also beneficial for banking stability as they contributed to improving the capacity of the financial system to intermediate. The first, and main, channel through which this was achieved was the reversal of the unjustified widening of sovereign spreads that was detrimental to banks' funding and capital positions (as explained below, a significant part of this spread widening was "unjustified", in the sense of being related to redenomination risk). Chart 14 below shows the ranges of estimates of the impact of the SMP and OMTs on the yields of selected euro area countries, summarising the results from a number of studies. The SMP is estimated to have reduced yields on ten-year Italian and Spanish sovereign bonds by between 120 basis points and 230 basis points, while the impact for sovereign issuers that were under more intense market scrutiny (such as Greece and Portugal) is estimated to have been even more sizeable, with maximum effects of 690 basis points and 450 basis points respectively (Eser and Schwaab, 2013; Krishnamurthy, Nagel and Jorgensen, 2018; Ghysels, Idier, Manganelli and Vergote, 2017). Estimates for the OMTs point to a comparable, albeit somewhat smaller, impact on Italian and Spanish ten-year government bond yields and larger effects on securities with a two-year maturity, ranging between 175 basis points and 200 basis points for Italy and between 210 basis points and 250 basis points in the case of Spain (Altavilla, Giannone and Lenza, 2014; Krishnamurthy, Nagel and Jorgensen, 2018). Empirical evidence also points to some

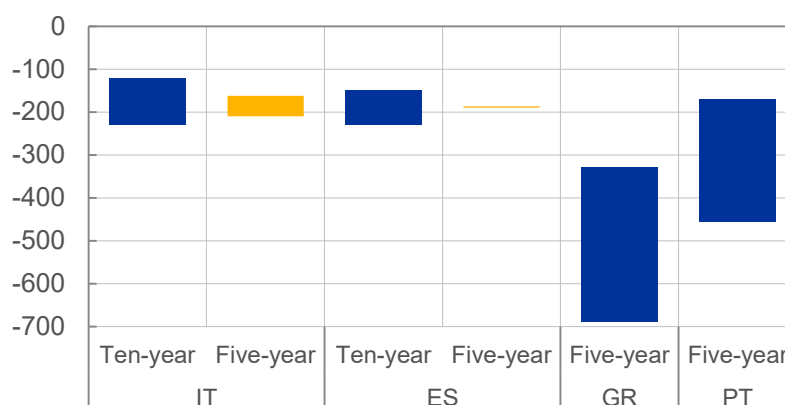
effects of the SMP on other market segments: Corradin and Maddaloni (2017) find that bonds bought under the programme experienced a higher “specialness premium” in the repo market.

Importantly, the impact of the OMTs proved to be long-lasting, as it was successful in quashing investors’ redenomination fears. De Santis (2015) proposes a measure of redenomination risk that employs the difference between US dollar and euro-denominated sovereign credit default swap (CDS) spreads (i.e. the quanto CDS). The redenomination risk measure is defined as the quanto CDS of a euro area country relative to the quanto CDS of a benchmark member country. Chart 15 below reports this measure for France, Italy and Spain and shows that the escalation of redenomination risk played a very sizeable role in driving up overall credit spreads for euro area sovereign issuers. Following the announcement of the OMTs, however, the measure of redenomination risk contracted very rapidly, settling at very low levels of about 10 basis points or below.

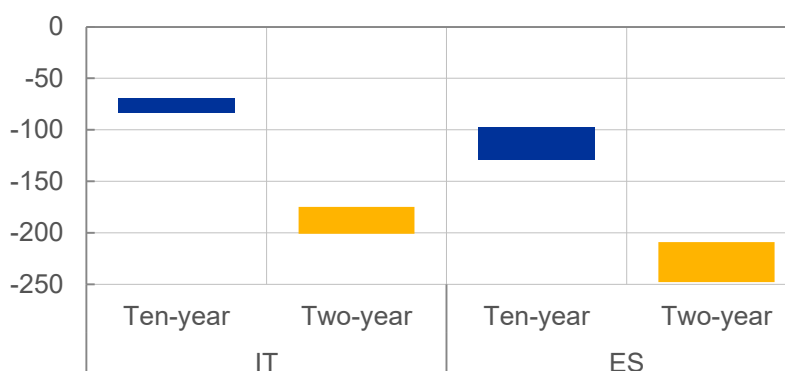
Chart 14
The estimated impact of the Securities Markets Programme and Outright Monetary Transactions on government bond yields

(basis points)

SMP



OMTs

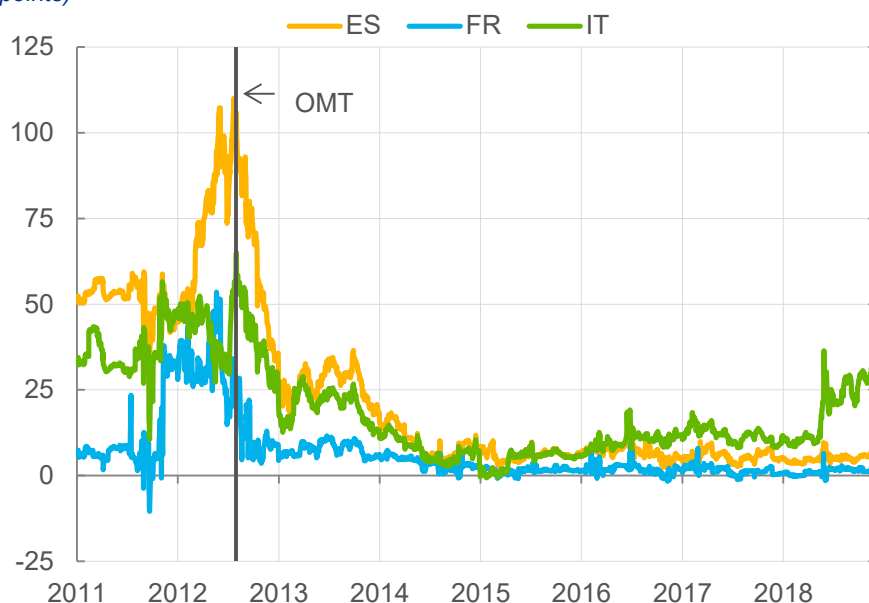


Source: ECB estimates.

Notes: Bars denote the range of estimates reported in various studies. The estimates for the SMP are based on Eser and Schwaab (2013), Krishnamurthy, Nagel and Jorgensen (2018) and Ghysels, Idier, Manganelli and Vergote (2017). The estimates for OMTs are based on Altavilla, Giannone and Lenza (2014) and Krishnamurthy, Nagel and Jorgensen (2018).

Besides the effect of the compression of government bond yields on banks' funding costs, there is evidence to suggest that the OMTs restored funding flows to banks that had been previously been shut out of the market for, in particular, unsecured, wholesale funding. Acharya et al. (2016) provide evidence that the OMTs, by permanently increasing the price of sovereign bonds in countries that were under stress and eliminating redenomination risk, also rendered these sovereign bonds attractive to non-domestic banks, which started re-investing in them. This, in turn, led to an improvement in the risk profile of banks in stressed countries and an alleviation of the sovereign-bank nexus. As a result, these banks were able to regain access to private unsecured funding, in particular from US money market funds (MMFs). Indeed, Acharya et al. (2016) show that, following the OMTs, individual banks' holdings of debt issued by stressed sovereigns have no bearing on their access to US MMF funding. In a similar vein, Gabrieli and Labonne (2018) show that before the OMTs banks were facing premia, when borrowing in the interbank market, that were related to the country in which they were based. Following the OMTs, these country-driven premia vanished and, instead, it is individual banks' balance sheet risk that determines the interest rate they are charged.

Chart 15
Quanto CDS-based measure of redenomination risk
(basis points)



Source: ECB estimates.

Notes: The measure of redenomination risk is based on De Santis (2015) and refers to the three-year maturity. A quanto credit default swap (CDS) is one in which the swap premium payments are not in the same currency. In this case, the redenomination risk is based on US dollar and euro-denominated CDS spreads.

Adverse financial stability spillovers (via banks' risk-taking)

The improved capacity for banks to bear risks following the OMTs may have also spurred some excessive or inefficient risk-taking, although evidence for this is generally scarce. One exception is Acharya et al. (2017) that argue that owing to the continued undercapitalisation of parts of the banking system, which gave rise to risk-shifting incentives, most of the post-OMT increase in loan volumes in the syndicated loan market was directed towards low credit quality firms, defined as firms with below-median interest

coverage ratios. The authors also provide evidence of lending at subsidised rates (“zombie lending” in the parlance of the authors) and the crowding-out of firms with better creditworthiness. Nevertheless, these authors do not dispute the positive effects of the OMTs on both monetary policy transmission and bank stability. This overall assessment is also shared by Alcaraz et al. (2018) who, based on granular loan data from Mexico, find that after the OMTs euro area banks operating in that market became more cautious in their risk-taking and loan pricing decisions. Overall, the evidence of an OMT-induced excessive risk taking remains generally scarce.

3.1.2 Operations directly targeting bank funding stress²⁶

The second type of measures adopted to address impairments in the transmission mechanism targeted dysfunctions in the interbank market and other important funding markets for banks. These measures were introduced sequentially, as the crisis evolved from a freeze in the money market in 2007 to the global financial crisis after the collapse of Lehman Brothers in September 2008, and the euro area sovereign debt crisis when sovereign funding stress spilled over into bank funding conditions in late 2011. In essence, throughout all these operations the Eurosystem has provided both liquidity support and term funding to euro area banks (a synopsis is provided in Chart 16 below). By avoiding the materialisation of an outright credit crunch or by materially limiting its effects, these measures have had a significant impact on the real economy (the quantification of such real effects is reviewed and discussed in Box 1).

The first set of liquidity measures was introduced as soon as tensions in the asset-backed securities market emerged and spilled over into interbank money markets.

The uncertain value of asset-backed securities and the lack of transparency in respect of banks’ direct exposures to these products led to liquidity hoarding and a partial freeze in short-term funding markets. The ECB reaction in the period spanning the summer of 2007 to the summer of 2008 was three-fold. First, the provision of reserves within the standard maintenance period was front-loaded. Second, the maturity of liquidity operations was lengthened: Six-month longer-term refinancing operations (LTROs) were introduced for the first time in this period. Third, US dollar liquidity was provided to euro area banks via swaps with the Federal Reserve. While liquidity was provided, on average, earlier during the maintenance period and had a longer maturity, the overall amount of reserves remained broadly unchanged during this phase.

With the collapse of Lehman Brothers the tensions in the money market further intensified, spreading to other segments of the financial market. These developments led to the adoption of a completely new set of measures including, but not limited to, the fully elastic provision of liquidity under the so called “fixed-rate full allotment” regime in regular refinancing operations (FRFA), the broadening of the range of assets eligible as collateral in central bank operations²⁷ and the extension of the maturity of long-term

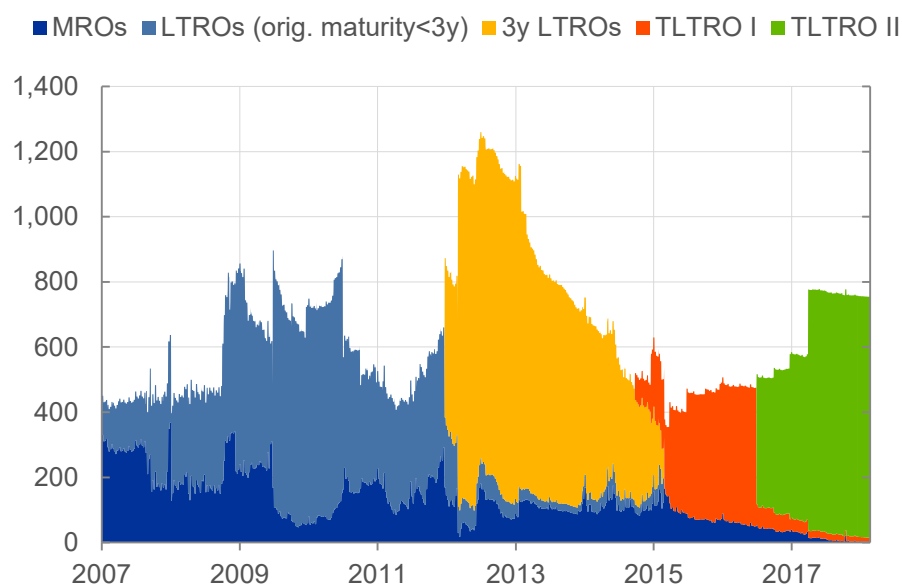
²⁶ This Section has been drafted with the contribution of Desislava Andreeva.

²⁷ See, for instance, Mésonnier, O'Donnell and Toutain (2017) for a study of the impact of an expansion in the universe of eligible collateral on banks’ liquidity advantage.

refinancing operations. In this phase the amount of liquidity intermediated by the Eurosystem increased substantially, as it effectively stepped in to substitute for private liquidity intermediation, which was being scaled back aggressively.

Chart 16 Evolution of central bank credit operations

(EUR billions)



Source: ECB.

Notes: The LTRO category includes longer-term refinancing operations with a maturity of (i) one maintenance period, (ii) three months, (iii) six months and (iv) one year.

At the height of the euro area sovereign debt crisis in the second half of 2011, wholesale funding conditions deteriorated markedly, prompting the Eurosystem to adopt new measures. Bank funding markets were seizing up and banks were facing large amounts of bonds that were coming up for refinancing. In this environment the Eurosystem conducted two three-year long-term refinancing operations in December 2011 and February 2012 respectively. As a consequence of these operations, the total amount of Eurosystem credit to the banking sector expanded further, peaking at about €1.2 trillion.

Beneficial spillovers to banks' intermediation capacity

By alleviating bank liquidity and funding difficulties, longer-term liquidity operations sustained credit supply and mitigated the risk of disorderly deleveraging. Substantial analytical efforts have been devoted to understanding the effectiveness of the three-year LTROs, the largest liquidity injections undertaken by the Eurosystem. De Santis and Darracq-Paries (2015) built a VAR relying, for identification purposes, on soft information on lending standards derived from the euro area bank lending survey. They conclude that such operations sustained loan provision to non-financial corporations, thereby avoiding a major credit crunch. Similar conclusions have been reached by a number of empirical studies based on micro data, with information on individual bank-firm lending relationships and looking at the introduction of the three-year LTROs in Italy (Albertazzi, Bofondi, and Pellegrini, 2013; Carpinelli and Crosignani, 2017), Spain (García-Posada and Marchetti,

2016), Portugal (Jasova, Mendicino and Supera, 2018) and France (Andrade, Cahn, Fraise and Mésonnier, 2018). In turn, the impact on corporate investment due to liquidity injections into the system via the LTROs seems to depend on whether firms use funds from LTRO banks (Daetz, Subrahmanyam, Tang and Wang, 2018).

The available studies based on granular data lead to somewhat diverse quantitative assessments of the impact of long-term liquidity operations on lending supply (see Chart 17). A common and important feature shared by these studies is that they can effectively disentangle credit demand from credit supply. This is done by exploiting the presence of multiple lending relationships, which facilitates a comparison of lending to the *same firm* across different banks.²⁸ The heterogeneity in their findings is at least partly explained by the different country-specific datasets used. However, differences in the approach used to tackle the other identification issues may play a role in driving results, thereby raising questions with regard to the external validity of these analyses and leaving some uncertainty as to the exact quantification of the impact.²⁹ More importantly, while these microeconomic studies significantly improve on the econometric identification of effects by allowing an effective disentangling of credit demand and supply, they are still not able to capture the impact of these measures on the overall stability of the banking sector. In this respect, the use of macroeconomic models would also not be helpful, as a comprehensive quantification of these aspects would entail assessing the impact vis-à-vis a counterfactual scenario featuring a truly systemic collapse of the banking system, i.e. a “bank run”. In other words, these studies provide a quantification of the impact on lending supply related to the provision of cheap term funding but cannot determine to what extent the availability of such funding has avoided the materialisation of the “inefficient run-equilibrium”. In conclusion, the studies show that by providing funding to banks at convenient terms, the three-year LTROs, had a significant positive impact on the loan supply. At the same time, these studies probably vastly underestimated the beneficial spillovers on bank stability.³⁰

Adverse financial stability spillovers via banks’ risk-taking

Eurosystem term funding was effective in avoiding disorderly deleveraging episodes, although it gave rise to side effects for banks, possibly partly undermining the beneficial implications for banking stability. Fundamental economic principles suggest that the provision of insurance is generally associated with a distortion of incentives. A number of studies have documented the presence of side effects associated with the liquidity injections implemented by the Eurosystem, including three-year LTROs,

²⁸ This desirable feature does not come free. An obvious related limitation is that it implies that such analyses are focused on firms with multiple lending relationships, which may not be fully representative of the rest of the population. Degryse et al. (2018) find that controlling for a number of firm characteristics typically available in micro studies is enough to adequately control for credit demand conditions, while at the same time they emphasise that it is also essential to keep single-bank firms in the picture.

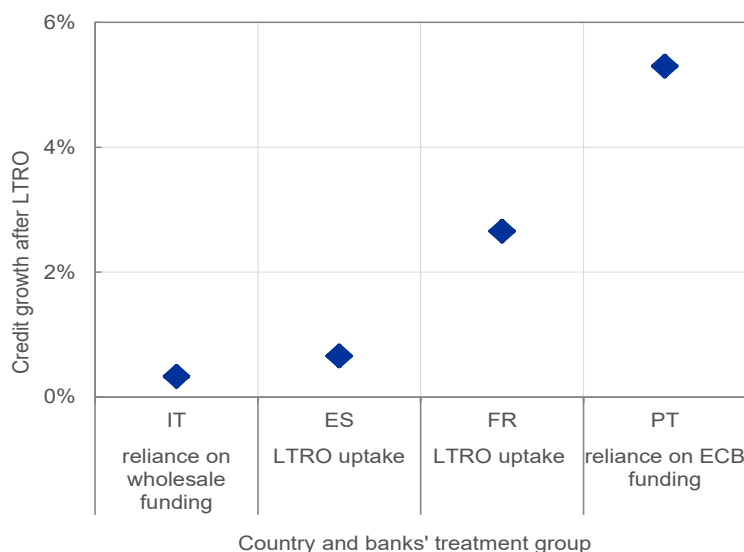
²⁹ A first obvious endogeneity problem concerns the timing of the implementation of these monetary policy measures, which was announced precisely when credit conditions started to deteriorate abruptly. Insofar as the operations stopped such deterioration from materialising, any analysis that does not duly take this into account will lead to an underestimation of their effectiveness. Indeed, aggregate lending growth does not show any visible differences around the announcement of these operations nor around the dates in which they were liquidated. Another related endogeneity issue concerns the amount borrowed by each bank at the time of the three-year LTROs, which is probably related to unobserved funding difficulties.

³⁰ These considerations are well expressed in Alves et al. (2016).

which, as mentioned, represented an effective backstop against the risk of a systemic deterioration of funding conditions for euro area banks.

Chart 17 Estimated impact of three-year LTROs on bank lending growth

(percentage growth)



Source: ECB calculations based on Carpinelli and Crosignani, 2017; Jasova, Mendicino, and Supera, 2018; Andrade, Cahn, Fraisse, and Mésonnier, 2018; García-Posada and Marchetti, 2016.

Notes: Distribution of estimated coefficients of elasticity derived from the above set of empirical studies. The labels below the countries indicate the approach applied in order to identify the treatment effects. Sample periods, countries and the level of granularity of the data considered vary across studies.

Banks with recourse to borrowing from the Eurosystem at the time of the three-year LTRO episode conducted sizeable purchases of risky assets such as domestic distressed sovereign debt. Drechsel et al. (2016) document that banks borrowing more Eurosystem funds up to December 2011 (i.e. not including the three-year LTROs) tended to be weakly capitalised and use riskier collateral. More importantly, they also argue that these institutions invested disproportionately in government debt issues, particularly domestic bonds, in more vulnerable economies. Similar conclusions have been reached by Acharya and Steffen (2015). At a general level, the interpretation of the patterns shown in these papers is that such banks, being in a weak position, exploited the liquidity injections in a “gamble for resurrection”. Andreeva and Vlassopoulos (2016) also point out the role played by the incomplete governance of the euro area and the strong nexus between banks and their domestic sovereign. In particular, their findings “are consistent with risk-shifting behaviour, whereby investing in domestic government bonds banks earn the full, high-risk premium while the risk is largely borne by their creditors as it materialises in states of the world where the banks are likely to be insolvent anyway”.

Tackling side effects with targeted operations

The Eurosystem, aware of the incentive distortions possibly undermining the effectiveness of its liquidity injections, redesigned its measures by shifting towards targeted longer-term refinancing operations (TLTROs). The main feature of these operations, which were launched in June 2014 (TLTRO I) and in March 2016 (TLTRO II), is that they embed an incentive scheme motivating banks to extend loans to the real economy (loans to firms and households, excluding housing loans). The operations were designed in

such a way that a better lending performance would provide banks with a benefit either in terms of the larger TLTRO volumes that they could borrow (TLTRO I) or in terms of the lower rates applied to such funds (TLTRO II). Another under-explore but presumably significant difference in the design of TLTROs vis-à-vis the three-year LTROs is that the former were conceived as a sequence of regular quarterly operations to be implemented over a prolonged period, rather than as one-off operations. By giving the option to access these operations also in the future, banks which wanted to secure availability of such funds over a given time horizon were not any more forced to do so by heavily borrowing upfront (and investing in government bonds).

TLTROs provided a backstop which protected euro area banks by relieving the pressure on their funding positions. As was the case for three-year LTROs, targeted operations also mechanically provided funding cost relief to euro area banks by offering a source of funding that is cheaper than bonds of comparable maturity issued in wholesale markets. More importantly, by reducing the supply of bank bond issuance and by eradicating part of the liquidity and credit risk, Eurosystem term funding reduced the cost of wholesale funding itself. In the case of TLTROs, Albertazzi, Altavilla, Boucinha and Di Maggio (2018), exploiting the design of the operation for identification purposes, estimate this effect at about 60 basis points for the average euro area bank participating in TLTROs.³¹ Non-participating banks also partly benefit in terms of lower funding costs, as their issuances compete with the smaller volumes of bonds issued by participating banks (“scarcity effects”), as shown, for the asset-purchase programme case, in Altavilla et al. (2015).

TLTROs have been successful in stimulating lending supply to the eligible sector, while containing side effects. As Charts 18(a) and 18(b) show, banks bidding in TLTROs exhibit better lending performance than their counterparts, both in terms of lending volumes and, at least in the more vulnerable economies, in terms of lending rates. While these raw data are indicative of the effectiveness of the programmes, casual effects are documented in a number of papers focusing on such operations. Andreeva and García-Posada (2019) confirm the expansionary impact of TLTROs on lending policies, relying on self-reported bank-level information on exposure to TLTROs obtained from the euro area bank lending survey. Benetton and Fantino (2018), based on loan-level data on lending relationships in Italy, conclude that TLTRO I has brought about a compression of rates of 20 basis points applied on new loans to firms. Albertazzi, Altavilla, Boucinha and Di Maggio (2018) corroborate these findings, while also documenting the relevance of the targeting features of TLTROs. First, they emphasize that such stimulus actually only reached the targeted segments (lending to firms and to households, excluding housing loans). Second, they show that participating banks *reduced* their exposure to domestic sovereign bonds. These findings are also consistent with simple descriptive statistics clearly showing different patterns between three-year LTROs and TLTROs. Not only did banks reduce their exposure

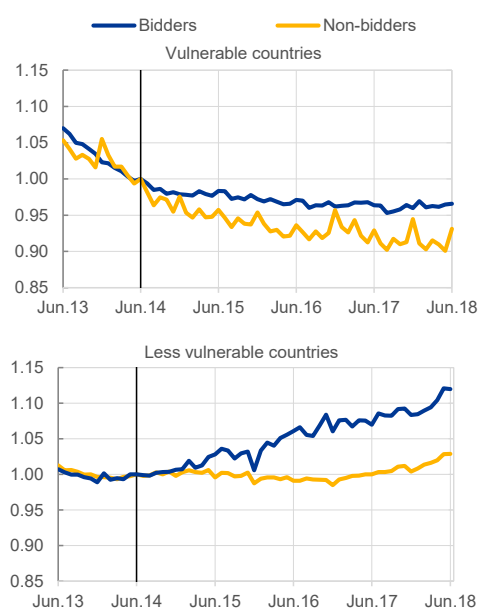
³¹ The design feature exploited in this study relates to the kink embedded in the definition of the benchmark lending that each bank is assigned and against which its lending performance is assessed. Deviation from the benchmark provides banks with either larger TLTRO fund borrowing allowances (TLTRO-I) or a lower cost of such funds (TLTRO-II).

to domestic bonds during TLTROs, a result largely ascribable to the concomitant purchases of bonds by the Eurosystem in the context of APP but, more importantly, such sales were disproportionate for banks bidding in TLTROs. This was the opposite of what was observed for three-year LTROs (see Chart 19).³²

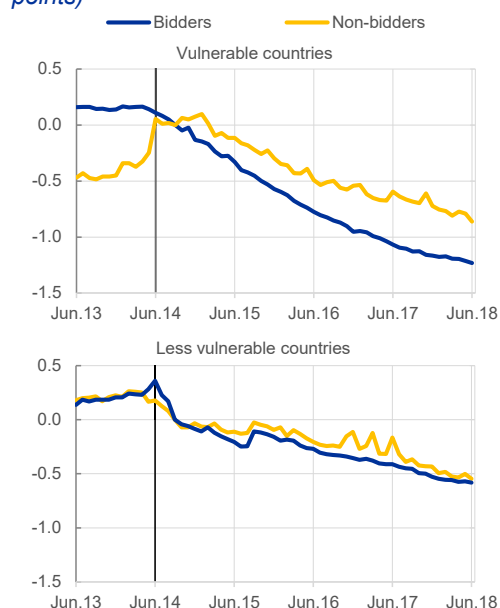
Chart 18

(A) Lending to non-financial corporations (NFCs) in the euro area: TLTRO bidders versus non bidders
 (B) Lending rates on new loans to NFCs, TLTRO bidders versus non bidders

(notional stocks, index: September 2014 = 1)



(change since September 2014, percentage points)



Source: ECB calculations.

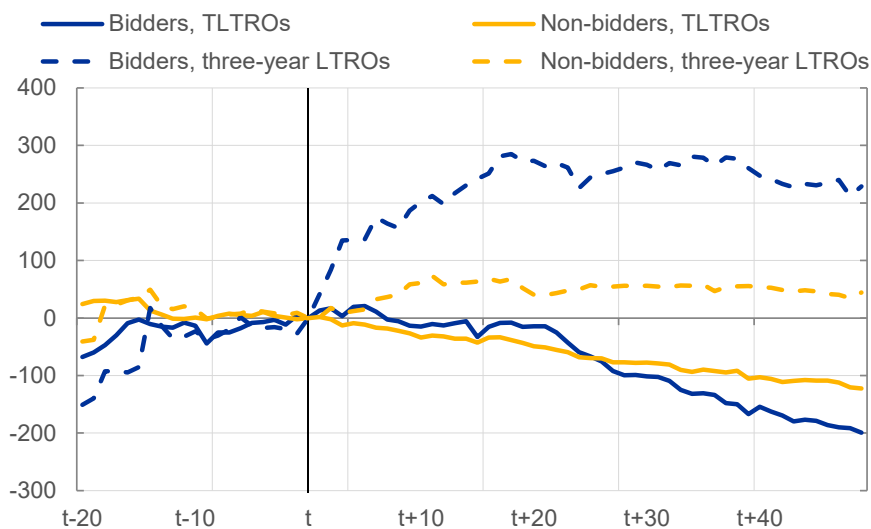
Unintended side effects were contained in the case of TLTROs, also because these were implemented as a series of quarterly operations rather than a one-off provision of liquidity. As already mentioned, this has, presumably, contributed to diminishing the amount borrowed, as banks could time their recourse to the operations in line with the evolution of their funding and liquidity conditions. By contrast, in one-off operations such as three-year LTROs, this liquidity backstop had to be taken onto banks' balance sheets by borrowing upfront and, at the same time, placing the proceeds in liquid assets such as bonds (although not necessarily domestic bonds). The implementation of TLTROs via a sequence of operations may, therefore, partly explain both lower borrowing volumes as well as the absence of bond purchases.

³² One interpretation of this finding is that banks borrowing during TLTROs also tried to improve their eligible lending performance by crowding out their exposure to sovereign bonds.

Chart 19

Changes in the composition of euro area credit institutions' bond portfolios from the first quarter of 2015 to the first quarter of 2018

(EUR billions)



Sources: ECB calculations. Notes: $t=0$ in March 2012 for three-year LTROs, and $t=0$ in September 2014 for TLTROs. Bidders in TLTROs are banks borrowing in either TLTRO I or TLTRO II. Holdings of debt securities with a residual maturity above one year by euro area credit institutions. The latest observation is for the first quarter of 2018.

3.2 Measures adopted to overcome the zero lower bound

The ECB started, in mid-2014, a new phase of UMP measures aimed at overcoming the zero lower bound. This set of UMPs included the negative interest rate policy and forward guidance on the path of policy rates, as well as the APP. The common objective of these measures was to provide additional accommodation in a context where policy rates were nearing the zero lower bound. The APP and forward guidance influence long-term rates by lowering the path of expected risk-free rates and by compressing term premia. The negative interest rate policy represents an attempt by a central bank to exploit the entire policy space, taking into account the fact that the frictions and costs related to holding physical cash imply that the effective lower bound for policy rates is below zero.

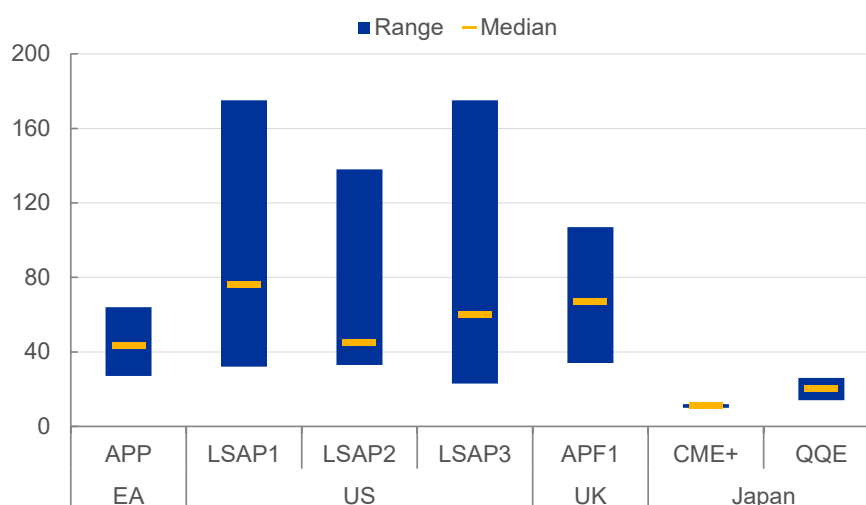
Low rates, and all the UMP measures that have been implemented to overcome the limitations posed by the zero lower bound, lead to a flattening of the term structure of interest rates. Forward guidance, by definition, is aimed at bringing down future short-term rates and this causes, all other things being equal, a flattening of the term structure of interest rates. A similar effect has been recorded for APPs, which largely target long-term assets and which have been documented as operating through a compression of term premia.³³ The empirical literature on APPs finds that the bulk of the effect materialised on announcement (“stock effects”), while the “flow effects” generated by the actual implementation of the programmes were limited (Andrade et al., 2016, provide a summary

³³ See, for instance, on the ECB's APP, Lemke and Werner (2017), van Dijk and Dubovik (2018) and Eser et al. (2019).

of a large number of studies looking at the international experience of APPs, see Chart 20 below).³⁴

The flattening and lower level of the yield curve induced by zero lower bound policy measures may potentially affect banks' profitability. Such monetary policy measures have the potential to strengthen banks' intermediation capacity by increasing the value of bonds held in banks' security portfolios. In addition, as the risk in the economy is reduced, given the low level of rates and the associated economic improvement, the amount of impairments and provisions for credit losses may fall. On the negative side, as banks' balance sheets are characterised by a gap between the financial duration of their assets and that of their liabilities the flattening of the term structure induced by MP may result in a compression of the loan deposit margin which is positively related to the term spread (Chart 21). The negative impact on banks' net-interest income is related to the intensity of their maturity transformation. Smaller margins, all other things being equal, imply a reduction in profitability and, in particular, a reduction in banks' net interest income. Current and expected lower profitability tend to worsen the capital position of banks and impair their intermediation capacity (van den Heuvel, 2002).

Chart 20
The impact of APPs on ten-year government bond yields
(reduction, basis points)



Source: ECB calculations based on the studies reported in Andrade et al. (2016). The chart shows the range and the median estimates from of the above studies. The impact is standardised to purchases of 10% of GDP. EA stands for euro area.

Similar considerations hold for the NIRP. Although NIRPs are meant to stimulate the economy they may also result in a disproportionate decline in the returns on banks' assets compared with the cost of their liabilities, in view of banks' reluctance to charge negative rates on their retail deposits. Indeed, deposit rates, unlike money market rates, tend to

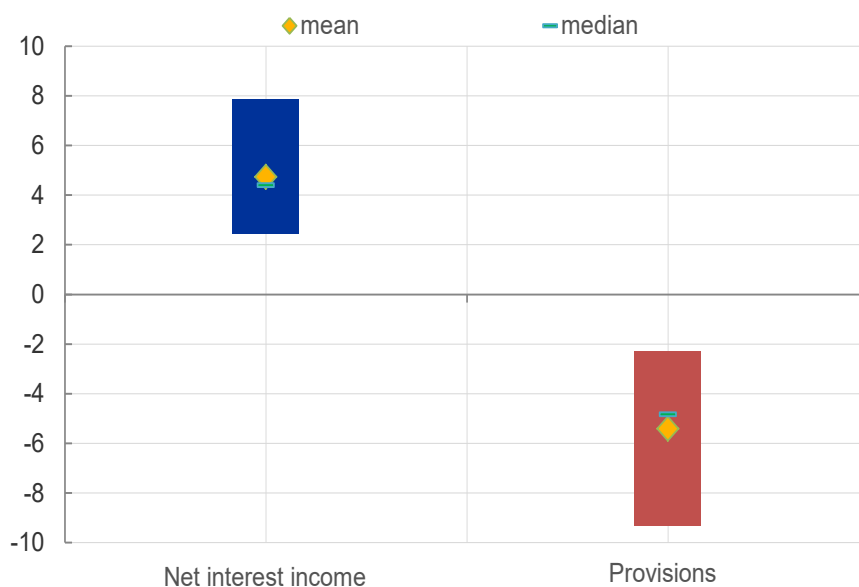
³⁴ More recently, De Santis (2019) has suggested that the impact of the APP's actual implementation on euro area sovereign yields is even larger than that suggested by previous studies, prevalently based on an event-study methodology, i.e. a decrease of around 72 basis points in 10-year euro area sovereign yields following a purchase worth 10% of GDP.

exhibit stickiness at the ZLB, especially those held by households.³⁵ Analyses of European banks' equity valuations show that a rate cut at the ZLB had a relatively more adverse effect on banks more reliant on deposit funding, and therefore more exposed to the lower bound constraint on deposit rates (Ampudia and van den Heuvel, 2018).

Chart 21

Estimated impact on bank profit components of an increase in term-spread of 100 basis points

(percentage points)



Source: ECB calculations based on the studies below.

Notes: Estimates of net interest income come from a number of papers that differ in terms of sample and time period: Albertazzi et al. (2014); Athanasoglou et al. (2008); Albertazzi and Gambacorta (2007); Albertazzi and Gambacorta (2009); Alessandri and Nelson (2015); Bolt et al. (2012); Dietrich and Wanzenried (2011); Claessens et al. (2017); Borio et al. (2017); Altavilla et al. (2017); Cruz-García et al. (2019). Estimates on provisions come from: Albertazzi and Gambacorta (2007); Albertazzi and Gambacorta (2009); Bolt et al. (2012); Albertazzi et al. (2014); Borio et al. (2017); Claessens et al. (2017); Altavilla et al. (2017). Net interest income is the difference between the interest income generated and the amount of interest paid out. Provisions are expenses set aside as allowances for uncollected credit-related payments.

The compressed margins and lower profitability may also induce banks to react by increasing their risk-taking. Banks may react to the compressed margins by rebalancing towards riskier assets with higher expected returns. Heightened risk appetite may be warranted as it is an important part of the mechanism for transmitting unconventional monetary policy measures. At the same time, risk-taking may feed the build-up of risk, leading to financial instability (Borio, Gambacorta and Hofmann, 2017; Borio and Gambacorta, 2017).

Beneficial spillovers to banks' intermediation capacity

The reduction in interest rates and the related economic improvement reduce default rates and, ultimately, the amount of credit-related losses incurred by banks. As (short-term) rates fall so does the cost of servicing debt for borrowers and, therefore, the default rate. Credit quality is also indirectly enhanced by the macroeconomic stimulus typically

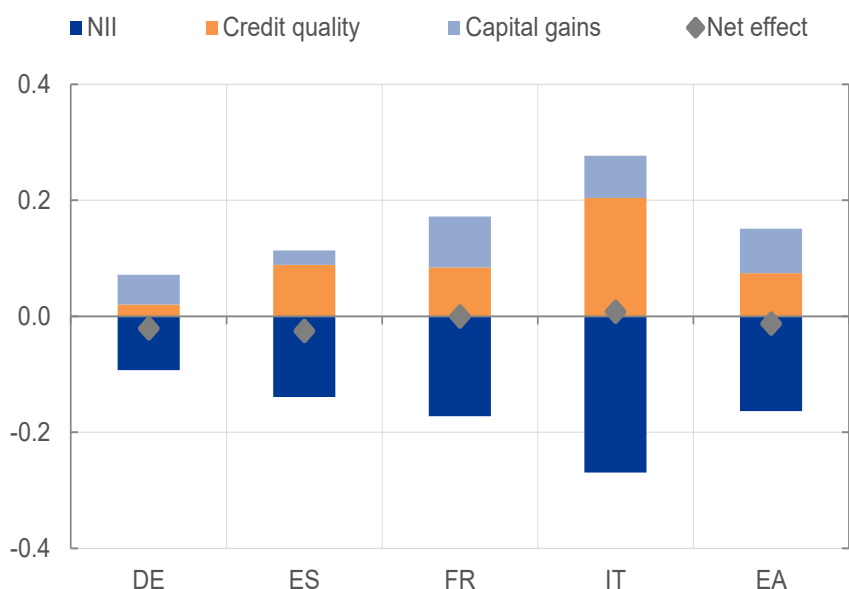
³⁵ After a few years' experience of negative rates, it transpired that, at least, stronger banks had actually managed to pass on negative rates to the remuneration applied to some of their deposits, i.e. those placed by non-financial corporations. This, in turn, is also reflected in lending conditions (Altavilla, Burlon, Holton and Giannetti, 2019). Nonetheless, a large part of the deposit base remains immune to negative rates.

associated with low rates. The improved credit quality translates into lower costs for provisions and impairments, sustaining bank profitability. The impact is estimated to be substantial (see Chart 21 above).

Chart 22

Estimated impact of monetary policy on bank profitability over the period 2014-17

(contribution to return on assets, percentage points)



Source: Altavilla, Andreeva, Boucinha and Holton (2018).

Notes: NII stands for net interest income. EA stands for euro area. The impact of monetary policy on bond yields and the respective effect on lending rates and volumes is consistent with Eurosystem macroeconomic projections. The impact on interest rates is reflected in new business volumes and in the outstanding amount of variable rate instruments including loans, deposits, and debt securities held and issued by banks. Owing to the low level of interest rates, it is assumed that banks only benefit from lower interest rates on long-term deposits. The assessment of capital gains takes detailed data into account in respect of the maturity, counterparty country and accounting portfolio of securities held by banks, as published by the EBA.

The impact of bond valuations on banks' profitability was material. Banks are among the largest holders of government bonds and, as such, are strongly affected by changes in the valuation of their portfolios of securities. APP purchases affect government bond yields and, therefore, their valuation. Considering the size and composition of these portfolios, it is estimated that the impact of the APP on the portfolio valuation for the average euro area bank was of the same order of magnitude as the corresponding reduction in provisions for credit losses (see Chart 22 above).

Adverse spillovers on banks' intermediation capacity

The flattening of the term structure of interest rates induces a reduction in net interest income, also in relation to the intensity of the maturity or duration transformation performed by banks (see Chart 21 above). A large number of papers have produced an estimate of the sensitivity of net interest income to changes in long-term yields. Based on existing empirical analyses, which differ in terms of sample periods, banking sectors analysed and level of granularity of the underlying data used, a compression of spread of 100 basis points between the ten-year government bond yields and the three-month money market rate could translate into a 4.9% reduction in net interest income. Chart 22 above

displays an estimate of the impact on the contribution to ROA of the increase in net interest income induced by the set of zero lower bound measures. It incorporates the effect via a compression of the net interest income as driven only by the smaller margins, although assuming constant intermediation volumes. At the same time, it also incorporates an estimate of the impact via an increase in intermediation volumes. This effect is, by construction, positive, as the improved macroeconomic conditions raise demand for financial services, including loans. The chart shows that the latter is not sufficient to compensate for the adverse impact stemming from the thinning of lending margins; the overall effect of net interest income is therefore negative.

Overall assessment of the spillovers to banks' intermediation capacity

The overall impact on banks' profitability of monetary policy measures taken to overcome the zero lower bound is broadly nil. As previously discussed, the adoption of such measures affects several items on banks' income statements, with an opposite effect on the level of profitability. As shown in Chart 21 above, for the average euro area bank, the overall impact on ROA tends to be broadly nil, with beneficial spillovers stemming from bond valuations and from the decline in loan loss provisions offsetting the compression of net interest income. There is cross-country heterogeneity, largely related to differences in the relative importance of the components of bank profits, and reflecting specific business models and macroeconomic conditions. Several caveats apply to this conclusion, one being that the assessment might change if these measures were maintained for a protracted period of time, as some of these items, namely bond valuations, are one-off in nature. Over time, therefore, the overall impact may be expected to gradually tilt towards negative values. On the other hand, other channels of transmission of UMP measures (positively) affecting banks' intermediation capacity are not taken into account as they are more difficult to assess. For instance, it has been argued that APPs improve the liquidity position of banks and facilitate the reallocation of funds on the assets side of banks' balance sheets (Rodnyansky and Darmouni, 2017).

A number of empirical papers focus on the negative interest rate policy, and indirectly assess its overall implications for bank profitability by looking at banks' response in terms lending supply, with somewhat mixed results (A number of empirical papers focus on the negative interest rate policy, and indirectly assess its overall implications for bank profitability by looking at banks' response in terms lending supply, with somewhat mixed results (Table 1, below). These papers distinguish between banks on the basis of a certain dimension that captures the extent to which the profitability of these institutions has been exposed to the negative interest rate policy, and test whether a larger exposure is associated with a relative increase or decline in lending supply. The specific objective of these papers is to test the presence (positive or negative) of the lending channel of the negative interest rate policy. In doing so, they also provide evidence for the sign of the overall spillover of the negative interest rate policy to banks' profitability, which is what is driving the impact on lending. Demiralp et al. (2019), using bank-level data for the euro area, show how banks adjusted their balance sheets in response to the negative interest rate policy and find, in particular, that the adjustment

depended on the amount of excess liquidity held. Heider et al. (2018) looked at syndicated lending to non-financial corporations, finding that banks with a higher reliance on retail deposits, more affected by negative rates, lend relatively less. By contrast, by distinguishing between banks on the basis of their reliance on interbank funding, Bottero et al. (2019) reveal that, for Italian banks, negative interest rate policy ultimately supported credit supply. Amzallag et al. (2019) focused on the Italian mortgage market and find that, following the implementation of the policy, banks with a higher reliance on retail overnight deposits increased the rates they charged on new fixed-rate mortgages, confirming that banks' funding structure affects the transmission of negative rates.³⁶ By contrast, Arce, Mayordomo and Ongena (2018), based on bank-level survey data, do not find that negative rates have any significant impact on the supply of credit, either in the euro area or in Spain. Relatedly, they find that banks whose net interest income is more affected by negative rates tend to compensate by increasing non-interest charges. Altavilla, Boucinha, Holton and Ongena (2018), exploiting a similar dataset, find that banks that reported having been more affected by the negative rate policy increased their lending growth more than other banks. More recent analyses show that the pass-through of rate cuts into negative territory via the bank-lending channel gradually tends to work as in positive territory, especially for sound banks. Altavilla et al (2019) documents that banks with more solid balance sheet position manage to charge negative rates on a larger and larger share of deposits placed by non-financial corporations and that such reductions in funding costs in turn translates on their lending supply, ultimately stimulating firms' investments.

Table 1
Negative interest rates impact on lending and risk-taking

Direction of impact	Outcome variable	Paper(s)	Geographic coverage
↑	Lending	Demiralp, Eisenschmidt and Vlassopoulos (2018); Altavilla, Boucinha, Holton, Ongena (2018); Altavilla, Burlon, Giannetti, Holton (2019)	euro area
↓	Syndicated lending	Heider, Schepens, Saidi (2017);	euro area
↑	Loan pricing on fixed rate mortgages	Amzallag, Calza, Georganakos, Sousa (2017)	Italy
-	Lending standards (and volumes)	Arce, Mayordomo, Ongena (2018)	euro area, Spain
↑	Risk-taking in loans	Heider, Schepens, Saidi (2017)	euro area
↑	Risk-taking in securities	Bubeck, Maddaloni, Peydro (2018)	euro area

Sources: Amzallag, Calza, Georganakos and Sousa (2019); Heider, Schepens and Saidi (2017); Bubeck, Maddaloni and Peydró (2019); Demiralp, Eisenschmidt and Vlassopoulos (2019).

One possible caveat that applies to most of the empirical evidence available on the effects of negative rates relates to the difficulty of achieving an estimation of the average effect of negative interest rate policies from these exercises. Most of the papers rely on a difference-in-difference methodology that exploits heterogeneity in banks' exposure to the policy, based on a number of proxies. Although, this approach is in line with the standard empirical literature on the bank lending channel, in the specific case of negative interest rate policies the null hypothesis of no effects is to be tested against a two-

³⁶ The authors, though, stress that the macro-economic impact is negligible which rules out the presence of significant dysfunctions in the transmission of negative rates to households.

sided alternative, as for negative interest rate policies the debate is not just over whether or not they have an impact on lending supply (as for standard monetary policy) but, instead, whether they actually dampen rather than stimulate it. It follows that an identification strategy that exploits the cross-sectional heterogeneity in the exposure to the negative interest rate policy shock is capable of testing the presence of differences in the pass-through across different groups of banks but does not necessarily allow to assess the average (aggregate) impact in the population. This limitation does not in principle apply to papers based on survey data with information reported by banks themselves on whether they are positively, negatively or at all affected by negative interest rate policy. On the other hand, relying on survey data poses other methodological challenges as the underlying assumption is that banks are actually able to identify the impact of the specific policy in question, including the indirect effects via the macroeconomic impact, and that their reporting is unbiased.

The overall assessment of zero lower bound measures on banks' intermediation capacity should also consider the indirect impact of measures targeting the bond market, namely the corporate sector purchase programme. The corporate sector purchase programme, by reducing corporate yield spreads,³⁷ has incentivised firms to issue more bonds, partially replacing bank loans. Reduced loan demand frees up space on banks' balance sheets for lending to other types of firms without direct access to financial markets. Recent empirical studies have focused on this indirect effect of the corporate sector purchase programme and found that it improved credit and lending standards for firms which could not directly benefit from the corporate sector purchase programme, such as SMEs. The results of these studies are summarised in Table 2.

Table 2
The corporate sector purchase programme and lending to small and medium-sized enterprises

Direction of impact	Outcome variable	Identification	Country
↑	Credit growth	For the mean bank in terms of credit outflows from bond-issuer firms	Spain
↑	Credit granting	For banks with above-median share of investment grade borrowers in their term loan portfolio	euro area
↑	Willingness to lend	For banks in the mean country by CSPP flow over GDP	Europe
↓	Loan rates	For the median bank; joint effect of CSPP and other QE measures	euro area

Sources: Based on a set of recent empirical studies on the effect of the corporate sector purchase programme: Betz and De Santis (2018); Arce, Gimeno and Mayordomo (2018); Grosse-Rueschkamp, Steffen and Streitz (2019). See also Ertan, Kleyменова and Tuijtin (2018).

Note: The table is based on a number of papers (see above) that use different measures of exposure to the corporate sector purchase programme.

Beneficial financial stability spillovers via banks' risk-taking

UMP measures aimed at overcoming the zero lower bound operate by affecting banks' risk tolerance. The compression of short and long-term rates induced by such UMP measures may introduce banking stability concerns through its impact on banks' risk-bearing capacity, as discussed above, but also by affecting banks' risk tolerance. As documented in a large body of literature (see Jiménez et al., 2014, and references therein), low levels of interest rates are associated with low interest margins, making banks

³⁷ See Zaghini (2019) and De Santis and Zaghini (2019) respectively.

marginally more willing to embark on riskier investment strategies in order to make up for diminishing profitability.

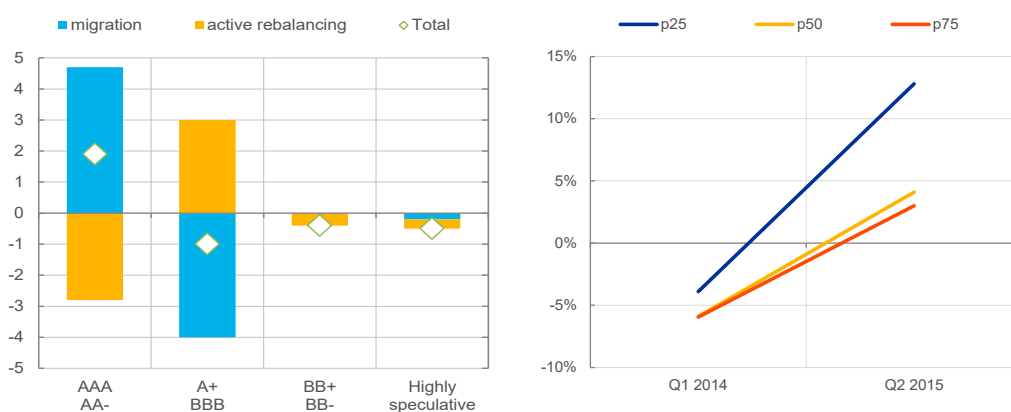
This risk-taking channel is considered to be particularly relevant for APPs, and may be the dominant component of their mechanism of transmission to the real economy. By reducing the return on government bonds or other comparable safe long-term securities, these policies make investors tilt their asset allocation towards assets characterised by higher expected returns and risk (Albertazzi, Becker and Boucinha, 2018).³⁸

Chart 23

APP and risk taking by euro area banks in security portfolios

(A) Changes in the composition of banks bond portfolios from 2015Q1 to the 2018Q1 (change in the portfolio share, percentage points)

(B) Percentage variation of the amount held of a security whose yield-to-maturity increases by one percentage point (vulnerable economies)



Source: ECB (Securities Holdings Statistics database), ECB calculations.

Notes: Chart A) Based on nominal values from the database for debt securities with a residual maturity of above one year and held by euro area credit institutions. The latest observation is for the first quarter of 2018. Chart B). Based on column 4 of Table 3, based on Albertazzi, Becker and Boucinha (2018). In each of the two periods considered, the chart displays the estimated coefficient of elasticity conditional on a given value for $m(h)$, the percentage change between the first quarter of 2014 and the second quarter of 2015 of the valuation of the security portfolio held in the first quarter of 2014. The coefficients shown derive from a regression of the log amount of the security held over its yield-to-maturity and a number of controls, including large sets of fixed effects to absorb unobserved heterogeneity. The yield-to-maturity is interacted with the $m(h)$ so the regressions can provide such elasticity coefficients, conditional on different levels of $m(h)$. P25, p50 and p75 denote the first, second and third quartiles of the distribution of $m(h)$ across the country-institutional sector (e.g. insurance corporations in France, households in Germany, etc.). A smaller $m(h)$ means a larger exposure to the APP shock. The estimates refer to the marginal portfolio, defined as that comprising only newly issued securities. "Vulnerable countries" are Ireland, Greece, Spain, Italy, Cyprus, Portugal and Slovenia.

The risk-taking channel of monetary policy does not necessarily conflict with the objective of preserving banking stability. Under adverse macroeconomic conditions, flight-to-quality episodes and procyclical movements in lending supply represent considerable threats to banking stability. Under these circumstances, increased risk appetite not only contributes to restoring favourable macroeconomic conditions, it also promotes financial stability. It is therefore necessary to assess not only whether a portfolio rebalancing channel has been at work with APPs which, in itself, would simply be a sign of

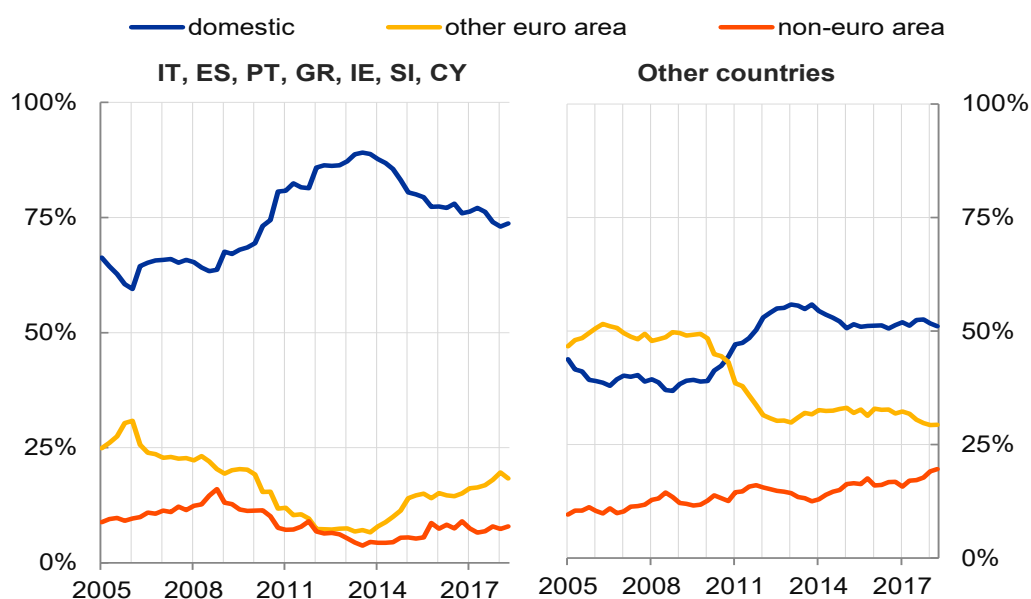
³⁸ As argued above, in the euro area experience, low rates and UMP measures have not significantly contributed to compress bank profitability. This finding does not necessarily imply that the risk-taking channel (banks taking more risk to compensate for the smaller profits) is not at work. Indeed, part of extra-profits generated by such UMP measures are one-off and so do not carry over to prolonged periods of low rates. Moreover, for a non-negligible share of banks, those deriving most of their profits from the traditional lending and deposit-taking activities, the overall impact of low rates on their profitability may be negative.

effectiveness, but also whether this has actually led to excessively high levels of risk-taking, which would be detrimental from a financial stability perspective. This assessment is more normative in nature and, arguably, more difficult to formulate. Nonetheless, Box 3 provides some indications on the excessiveness of risk-taking, notably by studying the pricing strategies adopted by risk-takers.

Since the start of the APP, banks' bond portfolios have shifted towards higher-yield investment grade securities (see Chart 23.A above). This change in composition across rating categories was driven by the active rebalancing out of the safest category of securities into other investment grade bonds. Over the same period, this development was more than offset by the effects of rating migration, against a backdrop of stronger macroeconomic dynamics and lower borrowing costs. From a financial stability spillover perspective, these findings suggest that the extra risk-taking induced by the programme has been more than offset by the concomitant macroeconomic improvement, which has contributed to containing the overall risk embedded in banks' balance sheets.

Chart 24
Composition of euro area banks' sovereign bond portfolios

(shares of total bonds held by banks in each group of countries, percentages)



Source: ECB.

Notes: Italy (IT), Spain (ES), Portugal (PT), Greece (GR), Ireland (IE), Slovenia (SI), Cyprus (CY). The latest observation is for the third quarter of 2018

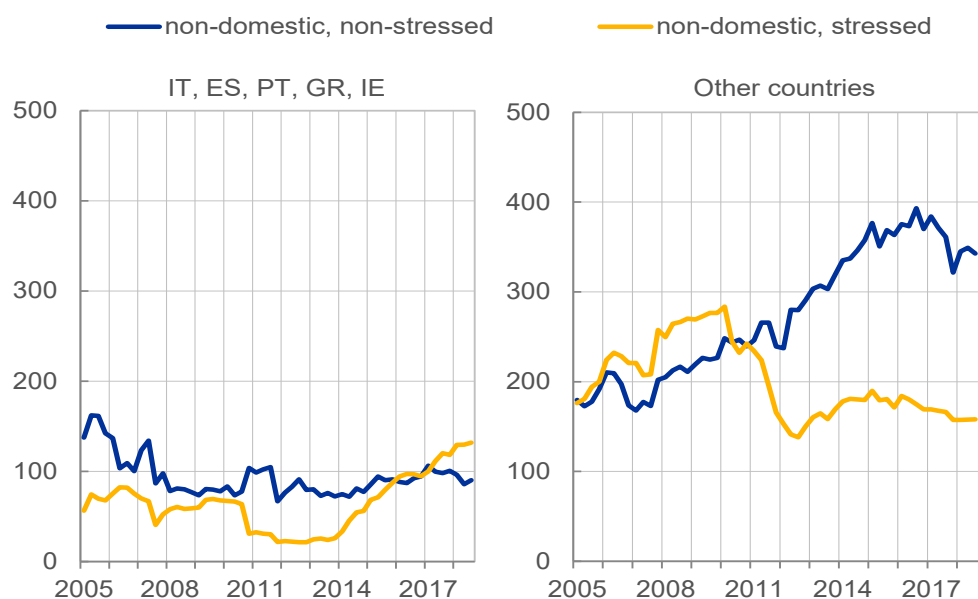
Portfolio rebalancing has not translated into a loading up of domestic government bonds (see Chart 24, above). It has been argued that large direct exposures to the domestic sovereign represent significant threats to financial stability as they could, potentially, activate the “sovereign-bank nexus” (Farhi and Tirole, 2018). Portfolio rebalancing in the context of the APP has not been associated with a loading up of domestic sovereign debt securities, not even in those economies where such securities offer high yields and where, instead, the share of domestic bonds has steadily declined since 2014. While to some extent this pattern mechanically reflects the implementation of the programme, in a context in which banks have been net sellers of APP-eligible securities, it may also have been fostered by the parallel implementation of measures such

as TLTROs. At the same time, the decreased share of domestic bonds in the security portfolio of banks in vulnerable countries has been mirrored into a larger share of exposures to non-domestic sovereign bonds issued in other vulnerable economies, suggesting a limited scope for risk diversification as well as persistent financial fragmentation (see Chart 25 below).

Chart 25

Evolution of non-domestic public sector exposures in the euro area of euro area banks

(USD billions)



Source: Bank for International Settlements (Consolidated Banking Statistics).

Notes: The latest observation is for the third quarter of 2018. Italy (IT), Spain (ES), Portugal (PT), Greece (GR), Ireland (IE).

APP-related rebalancing within the portfolio of securities held by euro area investors has been documented as being stronger in vulnerable economies

(see Chart 23.B above). More structural evidence of the impact of the APP on risk-taking is derived from econometric exercises exploiting granular information regarding the composition of security portfolios for each institutional sector in each euro area economy (Albertazzi, Boucinha and Becker, 2018). In the economies that have been most affected by the crisis, and where risk premia have remained relatively high, some portfolio rebalancing has been recorded towards riskier securities. The estimated elasticity of the amount held of each security in a given portfolio as a function of its yield-to-maturity, a proxy for risk appetite in asset allocation, increased significantly from before the announcement of the APP until the second quarter of 2015, when purchases started. Moreover, such increase was sharper for investors who, before the announcement of APP, were holding securities whose yields declined by more at the time of the announcement.

The APP has been associated with a sharp improvement in the relative attractiveness of lending to the real economy, compared with APP-eligible bonds

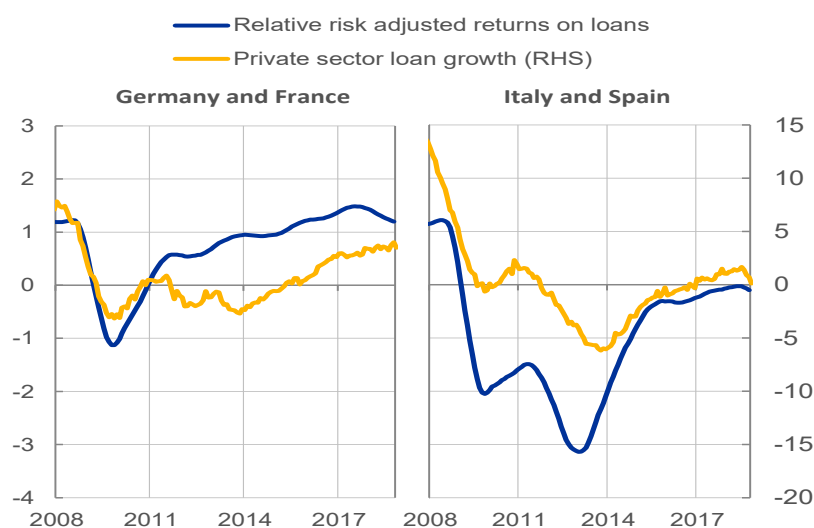
(see Chart 26 below). Given the central role that the banking sector plays in financing the euro area real economy and, in particular, small and medium-sized enterprises, it is crucial to assess to what extent credit intermediaries have been able and willing to translate the

accommodation directly induced by the APP in financial markets into better credit terms and conditions. By altering the relative profitability of different investment instruments – mainly bonds versus loans – the APP may tilt banks’ asset allocation in favour of one at the expenses of the other. Since 2014 the risk-adjusted returns on loans, relative to bonds, have increased considerably in vulnerable economies. The strong correlation between this indicator and lending growth suggests that the APP has played a role in sustaining the recovery of credit activity. It is also interesting to note that the improvement in the relative risk-adjusted returns of loans not only mechanically reflects the compression of bond yields but also, and significantly so, the improvement in credit quality.

Portfolio rebalancing has been shown to also support the supply of loans – more so in countries less affected by the crisis. Econometric estimations validate the view that APP-related rebalancing has supported lending supply in the euro area. Based on granular bank-level information on portfolio composition and lending activity for the 25 largest euro area banking groups, it has been estimated that a one-standard deviation in the proxy of exposure to APP (i.e. a 1.2 percentage point increase in a bank’s APP-related portfolio valuations) has been associated with a 2 percentage point increase in the growth of credit to the non-financial private sector (Albertazzi, Boucinha and Becker, 2018). This finding is documented as being statistically significant only in countries that have been less affected by the crisis. In these jurisdictions, where already-compressed spreads have made rebalancing within the security portfolio more difficult and where constraints on loan demand and supply have been less significant, a higher risk tolerance has been more vigorously reflected in an expansion of lending supply. The impact on lending rates has, instead, been documented as being more broad-based. A study by Paludkiewicz (2018) finds that, following the APP, a decline in yield of one standard deviation increased loans to the real economy by 4.8% between 2013 and 2015; the impact was particularly strong for banks facing a large number of reinvestment decisions. This is in line with findings showing that similar targeted interventions by the Fed (i.e. the Large Scale Asset Purchases Programme, LSAP) had a positive impact on loan origination volumes (Di Maggio, Kermani and Palmer, 2016).

Chart 26 Risk-adjusted returns on bank assets and lending growth

(percentages)



Source: ECB and ECB calculations.

Notes: Risk-adjusted return on loans (lending rate net of expected losses and capital requirements; PDs proxied by NPL ratios) relative to the yield on 5-year government bonds; 12-month moving averages. Yearly loan growth. Private sector loans exclude loans granted to MFIs. Monthly data, last observation: December 2018.

Adverse financial stability spillovers, via banks' risk-taking

Unconventional monetary policy measures led to heightened risk-taking, with possible financial stability implications. As discussed above, a few papers study risk taking implicitly considering it as a warranted feature of the transmission mechanism of MP. Other papers, instead, attach a negative connotation to risk taking and emphasize its adverse implications for banking stability. In the case of negative interest rate policy, Heider et al. (2018) not only find that banks more reliant on retail deposit funding cut lending relative to their peers but also document that these intermediaries tilted their loan supply towards riskier borrowers. Similarly, Bubeck, Maddaloni and Peydró (2019) show that, after the introduction of such a measure by the ECB in June 2014, banks that were more reliant on customer deposits exhibited some search for yield in the composition of their security portfolios.

While the literature on the effects of MP on risk-taking is burgeoning, the implications for banking stability remain somewhat contentious. Some (partial) indications on whether risk taking is excessive or efficient may be obtained by looking at the characteristics of banks whose risk appetite is heightened. For example, in the case of conventional monetary policy, it has been shown that the lower policy rates induce risk-taking more for banks with lower capital ratios, suggesting that this channel may be linked to managerial incentives for risk-shifting (see, for the euro area, Jimenez et al, 2014, and, more recently, Bonfim and Soares, 2018). As excessive risk-taking tends to be associated with risk under-pricing, one possible avenue could derive from an examination of how banks price the extra risk taken. Box 3 at the end of the section shows an application of this idea to euro area banks' behaviour since 2014, which is approximately when the main UMP measures aimed at overcoming the ZLB were first adopted. The results of the exercise,

exploiting self-reported qualitative information on banks' risk appetite, do not corroborate the notion that the extra risk taken on during the period under examination was, on average, inadequately priced. More research efforts, including new methodological approaches to assess and measure the excessiveness of risk-taking, are certainly warranted.

3.3 Conclusions

The monetary policy measures implemented by the Eurosystem during the crisis contributed positively to banking stability in two ways. First, they addressed and, ultimately, restored the capacity of the financial system to provide financial intermediation services at a time when this capacity had been severely undermined. Second, they acted as a decisive circuit breaker that prevented the activation of adverse macro-financial feedback loops and encouraged agents in the economy to coordinate to seek benign equilibria, at a time when disruptive equilibria were emerging as plausible alternative outcomes.

Policy interventions of the size and duration of those performed by the Eurosystem since the outbreak of the global financial crisis are also bound to have unintended side effects, in particular on banking stability. This chapter has identified three main types of such negative spillovers. The first is a potentially negative effect on bank profitability and intermediation capacity, stemming from the compression of interest margins brought about by a flat yield curve and negative short-term rates. The overall picture emerging from all the analyses cited in this chapter suggests that this negative impact has been largely offset by a beneficial impact on the cost of risk (provisioning costs), associated with the improvement in the macroeconomic outlook. A second side effect relates to the increase in risk-taking and the possible under-pricing of risk. Indeed, the professed aim of a number of MP measures taken was to promote portfolio rebalancing away from safe assets so that entrepreneurial activities – which inherently entail a measure of risk – could be financed. There is scant empirical evidence that such risk-taking may have become excessive in a general sense. Nonetheless, macroprudential surveillance has been indicating pockets of aggressive risk-taking in some market segments (see IMF, 2019 and ECB, 2018). Third, the backstop nature of some policy interventions invokes concerns regarding the emergence of incentive distortions and moral hazard problems, which can in turn be detrimental to banking stability, e.g. through an exacerbation of the sovereign-bank nexus. While there is evidence that these concerns may have been at least partly justified for some of the measures introduced by the Eurosystem (most notably the three-year LTROs), this seems to have informed the formulation of subsequent measures, such as the TLTROs, whose design is specifically geared towards addressing some of these issues.

On balance, the beneficial spillovers to banking stability from the monetary policy measures introduced since the crisis outweigh the adverse spillovers, although some of the latter may not yet have fully played out. Although the debate is ongoing, the emerging consensus seems to be that monetary policy has been effective in stabilising the economy through the crisis and restoring the functioning of financial intermediation. In

this sense it has prevented catastrophic scenarios from materialising and, therefore, also contributed to maintaining banking stability overall. This assessment is, however, dynamic in nature and, as the period of exceptionally accommodative monetary policy is extended, some of the adverse spillovers to banking stability may be accentuated, pushing the balance closer to a tipping point.

The overall balance between the beneficial and adverse spillovers of monetary policy to financial stability has benefited from the reinforced regulatory and supervisory framework set-up in Europe. Important regulatory reforms have been initiated in the aftermath of the global financial crisis, leading to a strengthening of banks' balance sheets (ECB, 2018). The establishment of a harmonised banking and financial supervisory framework supports the financial integration of the continent, allowing risks to be shared more efficiently (Draghi, 2018).³⁹ Moreover, centralised supervision has helped to reign in some risk-taking that may have been spurred by accommodative MP (Altavilla et al. 2019). The completion of the reform agenda – in particular the banking union – will facilitate the further tempering of the adverse side effects of MP on banking stability, thus further expanding central banks' room for manoeuvre.

³⁹ "The Benefits of European Supervision", speech by Mario Draghi at the ACPR Conference on Financial Supervision, Paris, 18 September 2018.

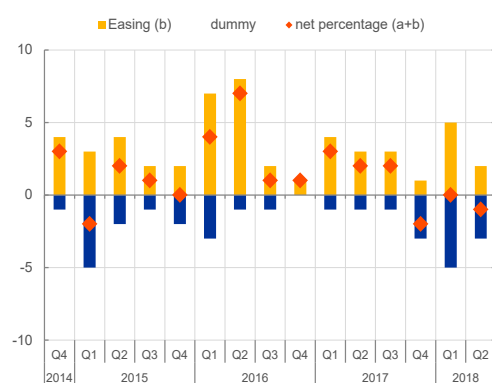
Box 3: Assessing the excessiveness of banks' risk-taking

(by Ugo Albertazzi, Carlo Altavilla and Miguel Boucinha)

Monetary policy stimulus raises risk appetite as a part of its transmission process but, if excessive, it may compromise banks' resilience. Over the last year, the repricing of risk premia in global financial markets has been viewed as a major risk to financial stability. In particular, the mispricing of risks and excessive risk-taking have been identified as possible sources of vulnerability which could be triggered by a number of factors, including heightened geopolitical tensions and sovereign stress, vulnerabilities in emerging markets and the possible disruptive effects of Brexit. These factors have translated into concerns over increased risk-taking by investment and pension funds. For the banking sector, in the context of the current ample degree of monetary policy accommodation, some risk-taking is to be expected and even intended, as portfolio rebalancing is an important channel of monetary policy transmission. At the same time, a protracted period of accommodative policy raises concerns over the possibility of excessive risk-taking by banks.

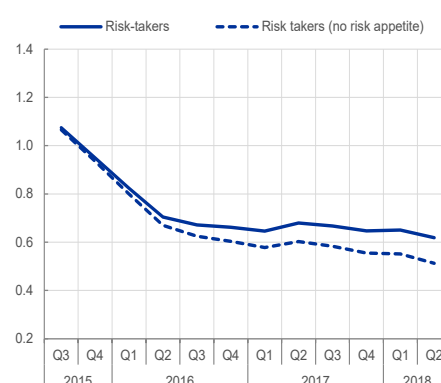
(A) Contribution of risk tolerance and competitive pressure to changes in credit standards

(share of banks, percentage points)



(B) Contribution of risk appetite to developments in expected unit profits

(percentage points)



Sources: ECB and ECB calculations.

Notes: Chart A) The chart displays the percentage of banks reporting in the euro area Bank Lending Survey that risk appetite contributed to an easing of credit standards (positive numbers) together with the percentage of those reporting a tightening contribution (negative numbers). Risk appetite is computed as the median of each bank's reply to questions on the effect of the bank's risk tolerance and of the pressure from competition on credit standards. The final indicator corresponds to the median for each sector: NFCs, households for house purchases and for consumption, and other purposes. The latest observation is for the second quarter of 2018 Q2. Chart B) The chart displays the expected unit profit (including cost of equity) for banks with positive cumulated risk appetite indicator and a counterfactual for how their margins would have evolved if they had not shown higher risk appetite.

The excessiveness of risk-taking in lending can be assessed by studying whether the extra risk assumed is priced in a way that does not imply a compression in (expected) profitability. Following Ioannidou, Ongena and Peydró (2014), risk-taking may be defined as excessive or inefficient whenever intermediaries under-price their risk exposure, i.e. extend risky loans without commanding adequate risk premia. This definition of banks' excessive risk-taking rests on the notion that adequate risk premia are sufficient to prevent risky borrowers from being unduly subsidised.

The bank lending survey (BLS) indicates that risk appetite has increased since 2014, contributing to an easing of lending standards (see Chart A above). Information on banks' risk appetite is available from the individual bank's responses to the survey, which includes questions on how risk appetite and pressure from competition contribute to changes in credit standards. About 40% of the sample of euro area banks considered, comprising the institutions that participate in the survey and for which regulatory risk parameters are available, have reported at least once during the period.

Regression analyses suggest that an increase in the risk appetite indicator is associated with higher expected unit profits, which is inconsistent with the notion of excessive (under-priced) risk taking. Specifically, it is estimated that (abstracting from unit operational costs and taxes) risk taking has been associated with an increase in the expected unit profit by just over 10 basis points for the average risk taker at the end of the estimation sample period, 2018Q2 (see Chart B above). This figure corresponds to 14 per cent of the average expected unit profit for risk takers (which stands close to 70 basis points, on average, in the sample).

The analysis exploits information on a sample of 72 banks reporting lending and deposit rates, probability of default (PD) on their exposures and participating in the euro area bank lending survey (BLS), it is possible to test if the extension of loans in a context of increasing risk appetite improves or weakens expected profitability. Abstracting from unitary operational costs and taxes, which can be plausibly assumed to be unaffected by risk appetite, the contribution to expected profitability of one additional euro of loans is equal to $\pi_{it} = (1 - PD_{it}) \times M_{it} - PD_{it} \times LGD_{it}$. In this expression PD_{it} is the probability of default of loans extended by bank i at time t ; LGD_{it} represents the loss given default (i.e. the share of the loans that is lost if the borrower defaults); M_{it} is the unit margin, i.e. the difference between the lending rate and the bank's funding cost. All variables in the expression are a function of risk appetite α_{it} . An increase in risk appetite can be considered appropriate if it induces an increase in expected profits, that is if $\partial\pi/\partial\alpha > 0$, which in turn depends on the reaction of these variables to an increase in risk appetite. Assuming that LGD_{it} is constant across time and as such it does not react to changes in

risk appetite, one can write $\frac{\partial\pi}{\partial\alpha} = \frac{\partial M}{\partial\alpha}(1 - PD_{it}) - \frac{\partial PD}{\partial\alpha}(M_{it} + LGD_{it})$, whose quantification requires an estimate of the two derivatives $\frac{\partial M}{\partial\alpha}$ and $\frac{\partial PD}{\partial\alpha}$. The analysis below provides an assessment of the magnitude of $\partial\pi/\partial\alpha$ based on the estimation of two regression equations for PD_{it} and M_{it} where the main explanatory variable is the bank-specific indicator of risk appetite (Box Table below).

Box Table The impact of risk tolerance on PDs and margins

Dependent variable:	Margin	PD	Margin	PD
	(1)	(2)	(3)	(4)
Risk-appetite _{t-1}	0.0787** (0.0388)	0.0446* (0.0250)	-	-
Risk-appetite _{t-1} X NFC	-	-	0.198* (0.107)	0.107** (0.0506)
Risk appetite _{t-1} X Housing loans	-	-	0.244** (0.0989)	0.0786** (0.0379)
Risk appetite _{t-1} X Other household lending	-	-	-0.331 (0.259)	0.127** (0.0543)
Country-time fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	No	No
Bank-sector fixed effects	-	-	Yes	Yes
Bank-level demand	Yes	Yes	Yes	Yes
Bank-level controls	Yes	Yes	Yes	Yes
Lagged dependent variable	Yes	Yes	Yes	Yes
Number of observations	908	908	2665	2582
Number of banks	72	72	72	72
R ²	0.951	0.961	0.808	0.953

Sources: ECB and ECB calculations.

Notes: Robust standard errors clustered at the bank level and reported in brackets. *** Significant at 1%, ** significant at 5%, * significant at 10%. Columns 1-2 report results for the non-financial private sector as a whole. Columns 3-4 report specific results for NFC loans, housing loans and other loans to households. Banks' risk appetite is measured by individual bank replies to the bank lending survey (iBLS). The figures are cumulated so as to proxy the level of risk appetite for each bank in each quarter, $\alpha(i,t)$. Bank-level loan demand control is obtained from the BLS (median reply across the different market segments). Bank-level controls are lagged and include: the Tier 1 capital ratio, the funding gap (loans to deposits ratio), exposure to domestic sovereign bonds (as a fraction of main assets), traditional business model orientation (NFPS loans to main assets) and the log of main assets. The sample comprises 72 IRB institutions that also belong to the bank lending survey sample. Sample period: fourth quarter of 2014 to the second quarter of 2018.

Panel regressions of the impact of risk appetite on the probability of default (PD) and on the margin indicate that, as expected, higher risk appetite induces a significant increase in the PD and in unit margins (see Box Table above). All other things being equal, higher risk appetite should be associated with an increase in risk in a bank's portfolio, so that a positive coefficient for risk appetite is expected in the PD equation. The relationship between unit margins and risk appetite is a priori unclear, since countervailing forces are likely to be at play. On the one hand, higher risk appetite could be associated with higher margins, so as to cover for the associated increase in risk. On the other hand, higher risk appetite could also induce banks to compress their margins in order to attract new borrowers. An increase in the risk appetite indicator is also associated with higher expected unit profits on average, whereby the risk-taking observed could be considered to be efficient. The positive coefficient for risk appetite in the equation for the margin is a necessary but not sufficient condition for the adequate pricing of risk. $\partial\pi/\partial\alpha > 0$ ultimately depends on the relative magnitude of the two derivatives $\partial PD/\partial\alpha$ and $\partial M/\partial\alpha$, obtained from the above regressions. If these numbers are plugged into the analytical expression for $\partial\pi/\partial\alpha$, it follows that, in the sample, risk-taking has sustained profitability by raising the expected unit profit (abstracting from unit operational costs and taxes) by just over 10 basis points for the average risk-taker at the end of the estimation sample period, the second quarter of 2018. As mentioned in the main text, this does not seem to be a negligible contribution as it corresponds to 14% of the average expected unit profit for risk-takers (about 70 basis points, on average, in the sample). Finally, it is important to note that results are qualitatively unchanged by the inclusion of a country-specific rather than a euro area measure for the cost of equity (at the cost of reducing sample size) and by making the estimation without considering the cost of equity. This is a reassuring result, given the uncertainty involved in estimating the cost of equity.

In conclusion, the relative increase in the PD observed for risk-takers has been more than offset by the larger margins applied, so that risk-taking has sustained expected profitability. In other words, patterns of risk-taking during the period under examination do not seem to be consistent with reckless lending policies but, instead, reflect the appropriate functioning of the pass-through mechanism of the unconventional monetary policies implemented.

4 Banks and the transmission of monetary policy after the crisis

After years of crisis management characterised by the abundant use of UMP tools, the European monetary policy community is moving into post-crisis mode. While normalisation could entail some form of interest rate lift-off (from negative to positive territory), reductions in central bank balance sheets, and the unwinding of extraordinary liquidity assistance tools for banks, low-for-long interest rates may call for the introduction of new policy tools or the simple extension of existing ones.

The analytical toolkit presented in the earlier sections has been extremely important in informing policymakers as to how the impact of such measures would be transmitted through banks. This section summarises the advantages and limitations of the analytical tools discussed in Section 3 in studying the bank lending channel during the up phase of the cycle, both in general and in the specific context of the ongoing recovery in the euro area. It first asks whether such tools are fit for purpose in terms of gauging the impact that a withdrawal or extension of such policies would have on banks' capacity to transmit monetary impulses effectively. Second, the section discusses the ways in which the growth of non-bank intermediaries and regulatory reforms affect monetary policy transmission through banks. Finally, it discusses the trade-off between growth and stability in the context of an economic recovery, and compares the post-crisis period with previous historical episodes.

The overall conclusion is that macro and micro-analytical models have fundamental strengths and limitations and should be used jointly in a complete assessment of the bank lending channel, while remaining mindful of specific recent euro area developments. Both monetary policy and regulation should bear in mind such specificities. Foremost among these is financial innovation – such as fintech – which tends to be procyclical and therefore poses clear financial stability challenges. Another is the rise of non-bank intermediaries, which tends to complicate the analysis of the transmission of monetary policy. Finally, while it is a global phenomenon, the bank-sovereign nexus (discussed in depth in Box 4 at the end of the section), is particularly fragile in the euro area given banks' relatively high balance sheet exposure to sovereign bonds.

4.1 The available analytical toolkit: Strengths and weaknesses

4.1.1 DSGE, empirical macro and empirical micro models: Strengths...

Since the 2008-09 global financial crisis, central banks around the world have developed and enhanced a number of tools to monitor the transmission of both conventional and unconventional monetary policy through the bank lending channel. There are three broad classes of tools: The first comprises various dynamic stochastic general equilibrium (DSGE) models, which also include the financial sector. The second

class encompasses empirical macro models with structural features linking monetary policy and financial stability (e.g. Bayesian and traditional VARs, among others). The third class is dominated by policy evaluation techniques centred around a difference-in-difference analysis of the transmission of actual policy changes to bank lending and risk-taking, and largely reliant on highly granular data.

DSGE models are a popular tool used to analyse the aggregate implications of various policies. In short, DSGE is an umbrella term for macroeconomic methods whereby aggregate economic phenomena, as well as the effect of policy on these phenomena, are analysed using econometric models based on general equilibrium theory and microeconomic principles. These models facilitate an analysis of the propagation of different shocks to the real economy, including changes in the monetary policy rate, changes in financial regulation, or the expansion of central bank credit intermediation, under a number of micro-founded assumptions. For example, New-Keynesian DSGE models assume that prices are set by monopolistically competitive firms and cannot be adjusted in a costless, instantaneous manner. If the characteristics of representative economic agents are suitably calibrated, these models allow researchers to analyse how these shocks affect aggregate outcomes such as inflation or output. Smets and Wouters (2007)'s model, for example, has been widely used by central banks to quantify the propagation of conventional monetary policy.

The second class of models relies on a system of equations based on empirical relationships between macroeconomic variables describing the path of the economy. One widely used reduced-form macro-empirical methodology to analyse the monetary transmission mechanism is that of vector autoregression models (VARs). This methodology seeks to relax the restrictions required in large structural macroeconomic models, thus proposing a method that treats all variables as endogenous and avoids the endogenous / exogenous dichotomy. VARs have proved to be a convenient method of summarising the dynamic relationships between variables since, once estimated, they can be used to simulate the response over time of any variable in the set to either an “own” disturbance, or a disturbance to any other variable in the system (see Cochrane, 2017, for a discussion of VAR analysis in the context of studying the link between asset prices and economic fluctuations).

The third class of models relies on policy evaluation techniques using micro-level data on banks and firms. Difference-in-difference analyses are very common and rely on assumptions regarding ex ante differences across banks (such as variations in capitalisation) or across firms (such as technology or net worth). The analysis relies on comparing the reactions of banks and firms to policy changes depending on these differences. The explicit assumption embedded in these models is that one group of agents (treatment) is affected by a particular policy owing to its underlying characteristics, while another group of agents, for which these characteristics are absent, is not (control). This approach has become widely used since the advent of bank-level datasets, like Credit Registers, and firm-level datasets with a creditor link, like Orbis. An increasing body of research using this analytical approach has informed policymakers of the impact of

monetary policy on bank lending (Jimenez et al., 2012), on bank risk-taking (Jimenez et al., 2014), as well as on real outcomes, such as firm investment (Kalemi-Ozcan et al., 2018) and employment (Chodorow-Reich, 2014; Bentolila et al., 2017; Popov and Rocholl, 2018). The policy evaluation analyses presented in Section 3 on the impact of the LTROs (see Chart 16) are based on this methodological approach.

Finally, it is worth mentioning analyses based on empirical asset pricing models that map changes in the monetary policy stance to the prices of various asset classes.

Such studies typically use short horizons to gauge effects that are reliably driven by a particular policy announcement, and are not contaminated by a wider toolbox of measures. Furthermore, they tease out the channels through which monetary policy affects asset prices, by studying both common and country-specific components in a collection of asset prices. At the same time, because the main unconventional monetary policies were implemented by the ECB during the sovereign debt crisis, most of these analyses focus on the impact on government bond yields. Papers using this type of analytical approach have typically found that unconventional monetary policies pushed down government bond yields and reduced redenomination risk. For example, in the case of Italy and Spain the SMP is estimated to have reduced yields on ten-year sovereign bonds by as much as 230 basis points, and the OMT by as much as 250 basis points (Altavilla, Giannone and Lenza, 2014; Eser and Schwaab, 2013; Ghysels, Idier, Manganelli and Vergote, 2017; Krishnamurthy, Nagel and Jorgensen, 2018), with the effect of the LTRO being small in comparison at around 50 basis points at the most (Krishnamurthy, Nagel and Jorgensen, 2018).

4.1.2 ...and weaknesses

At the same time, these classes of models have significant limitations. Broadly speaking, these relate to models of macro responses being silent on micro transmission; micro transmission models not being informative about aggregate effects; models relying on group comparisons based on unclear choices of control and treatment groups; and, in all cases, the analysis inherently depending on interactions of particular shocks with the rest of the economy, such as the phase of the credit cycle. While these are permanent features of the models under discussion, they are likely to be accentuated when employed to analyse questions related to the transition from crisis-period to boom-period monetary policy.

Starting with DSGE models, we note that these are built to describe aggregate effects, rather than to identify micro channels. While they perform reasonably well when forecasting the evolution of various macroeconomic variables in response to monetary policy shocks, they cannot predict individual effects and they cannot inform policymakers as to which channels adjustments take place through. This limits the ability of DSGE models to provide policy advice, first because there are so many, often contradictory, models to choose from, and second because they provide no guidance as to how exactly policy shocks propagate through the real economy. Furthermore, DSGE models remain highly complex in terms of the methodological restrictions they are based on, thus limiting policymakers' scope for analysis.

In addition, DSGE models fail to provide realistic accounts and descriptions of the financial sector and its evolution. While more recent analytical efforts have brought banks into DSGE models, these describe very specific moments and have limited predictive powers. Models such as those developed by Gertler and Karadi (2011) and Clerc et al. (2015) introduce a banking sector into the analysis, and allow for the quantification of the impact of unconventional monetary policy and various macroprudential policies. Nevertheless, a standard DSGE model will have little to say on how the financial or banking sector responds to a return to positive interest rate territory. Even DSGE models that incorporate a financial sector and can therefore make predictions about the path of financial aggregates, such as credit growth, will only capture particular aspects of financial intermediations and will therefore, for example, be silent on balance sheet adjustments or the evolution of risk-taking.

In comparison, difference-in-difference analyses based on micro data aim at identifying micro channels of transmission, although they have significant limitations in terms of aggregate implications. Put simply, such an analysis is, by default, a partial equilibrium. This means that the impact of a particular policy on an individual bank, holding constant all background forces that influence the individual bank's behaviour, can be identified reasonably tightly. From there, under the same assumption, an aggregate effect can be calculated based on observable information for all observations in the sample. However, precisely because the analysis does not account for the impact of the policy on other background forces, it cannot produce a reliable estimate of the overall effect. To give an example, a standard difference-in-difference analysis using a credit register can ascertain the effect of the unwinding of the APP on individual institutions, based on differences that are important ex ante for the transmission of the programme. At the same time, this analysis will be silent on how the same policy will affect banks through changes in asset prices or through shocks to credit demand. In this way, it will fail to inform policymakers of the overall impact of a particular policy.

A second limitation of this type of analysis is related to the policy set-up. Ideally, the natural experiment should resemble as closely as possible the set-up in the programme evaluation, whereby individual observations are chosen so they are similarly based on observables and then randomly assigned to the control or the treatment group. In practice this is rarely the case. Firms may borrow from their banks of choice, resulting in non-random bank-firm matches. Banks may sort themselves into different groups by adjusting their characteristics, such as size, thereby switching from the treatment to the control group. Even an ex ante valid split along a dimension that banks did not anticipate before the policy experiment does not preclude them from manipulating their balance sheets later on, resulting in estimation bias.

Thirdly, and largely owing to data limitations, most micro-based tools have been developed using granular datasets which were developed after the crisis. The damage caused by the failure of Lehman alerted policymakers to the need to collect more (and more granular) information on financial agents, their asset holdings and liability structures. A natural consequence of this has been that most impact assessment tools have

benefited from the increased data granularity, but have also been limited by the short time series available. For example, several studies have been carried out against a background of already low or falling interest rates and are therefore silent on the possible asymmetric impact of interest rate increases (Holton and Rodriguez d'Acri, 2015).

None of the aforementioned approaches is well suited to capturing nonlinearities or asymmetries in the transmission of monetary policy. There is abundant evidence that monetary expansions have different effects from monetary contractions (*sign* asymmetry) and that larger monetary policy shocks have a smaller impact than smaller shocks (*size* asymmetry). Changes in unemployment, private sector confidence, the existence of a convex aggregate supply, credit market imperfections, uncertainty, menu costs and the level of financial stress are also thought to play a role (Barnichon et al. 2017; Tenreyro and Thwaites 2016; Florio 2006; Ravn and Sola 2004; Sensier et al. 2002; Gupta and Jooste 2018; Jannsen et al. 2015; Saldias 2017).

Asymmetries have generally been identified in the context of conventional monetary policies, although recent studies have ascertained that they also apply to the transmission of non-standard policies. Using US data for the period 1959-2007, Barnichon et al. (2017) find that contractionary monetary policies have significantly stronger effects on unemployment than expansionary policies, with similar asymmetries also being identified in euro area countries (Clausen and Hayo 2006; Huchet 2003). Size and sign asymmetries are confirmed to exist for UMP shocks as well as for conventional shocks (Karras 2013) with uncertainty conditioning the former's effectiveness (Gupta and Jooste 2018). Moreover, there are other reasons to expect UMPs to be nonlinear. As these were introduced to tackle dysfunctions and impairments in the monetary policy transmission process, such as dislocations in sovereign bond markets (SMP and OMT), once the underlying stress event addressed by the measures subsides, their withdrawal should be expected to be neutral. Gerlach et al. (2018) argue that, with the end of UMPs, such as fixed-rate full allotment or the long-term operations, bank funding needs would be absorbed by markets, with a manageable increase in funding costs.

4.2 Changes to transmission imparted by non-bank intermediaries and regulatory reform

4.2.1 Accounting for non-banks in the available toolkit

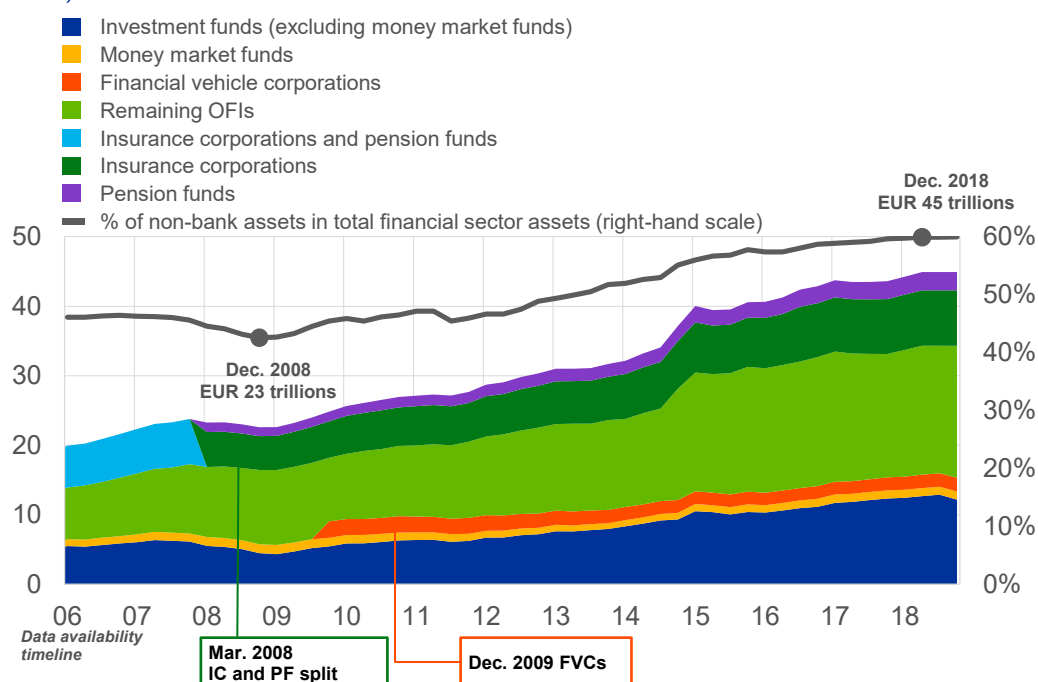
While credit provision in the euro area remains largely dominated by banks, non-bank intermediaries significantly expanded their lending, both in the euro area and globally, during the global financial crisis. With impairments in the banking sector resulting in a contraction of bank credit, non-banks⁴⁰ provided an important buffer, financing the economy by acting as a “spare tyre” (IMF 2015; ECB 2016; see Chart 27). The regulatory burden imposed on banks (Kashyap et al. 2010), deregulation in traditional

⁴⁰ Shadow banking covers “credit intermediation that involves entities and activities (fully or partly) outside the regular banking system” (FSB 2015; Doyle et al. 2016).

banking activities (Neuhann and Saidi 2016), and the new liquidity regulations introduced in Basel III (Gete and Reher 2017) also contributed to the observed migration of banking activities towards non-banks.⁴¹ Concerns over the potential financial stability risks posed by non-banks grew in parallel because of the potential disruption caused by easy redemption options, incentive problems, procyclical margining and run-like dynamics (Brunnermeier and Pedersen 2008; Fecht and Wedow 2014; Gennaioli et al 2013; Pozsar and Singh 2011) and the sector's growing exposures to credit, liquidity and interest rate risk (ECB FSR November 2018).

Chart 27
Assets of the non-bank financial sector

(EUR trillions on left-hand scale; percentage of total assets of the financial sector on right-hand scale)



Source: ECB calculations (euro area accounts and balance sheet data of individual sectors).

Notes: The non-bank financial sector includes investment funds, money market funds, financial vehicle corporations, insurance corporations (ICs), pension funds (PFs) and the remaining other financial intermediaries (remaining OFIs). The total financial sector includes the non-bank financial sector and MFIs (central banks are excluded). Period: first quarter of 2006 to fourth quarter of 2018.

Transmission mechanisms for non-banks differ from those of banks and operate through the asset allocation behaviour of institutional and retail investors. While the new view of the bank lending channel includes bank and non-bank entities (Section 1.2.5), non-banks' reaction to monetary policy normalisation is a priori unclear. The diverging regulatory gap between the two suggests that lending decisions may be determined differently. In addition, bank and non-bank credit cycles differ between each other and across countries in terms of amplitude and length (Kemp et al. 2018). Reactions of institutional and retail investors also vary. While insurance corporations, being long-term investors, are less likely to respond to short-term market volatility, mutual fund investors,

⁴¹ Non-bank intermediaries generally include non-market mutual funds (which drove the sector's rapid expansion), financial vehicle corporations, money market funds, insurance corporations and pension funds.

whose return performance is strongly correlated to risk premia, react more strongly to changes in monetary policy (ECB 2016; Timmer 2018).

Despite their growing relevance, non-banks rarely feature in the standard analysis of the monetary policy transmission process. Also owing to data limitations, the impact assessment toolkit for UMPs generally focuses on banks and firms. Even fewer studies have addressed the interactions and spillovers between the two sectors. While Irani et al. (2018) investigate the connection between bank capital regulation and non-banks in the US corporate loan market, they do not address the question of how monetary policy transmission is affected by the reduction in loan retention by weaker, less-capitalised banks.

Only recently have studies started to address the question of monetary transmission through non-banks. Boneva et al. (2019) studied the impact of the withdrawal of monetary accommodation in terms of portfolio rebalancing, based on the granular data of all financial agents' securities holdings. Using data on security-by-security holdings, they find evidence that an equal change in bond yields led to larger portfolio rebalancing by euro area insurance corporations, investment funds and banks after the crisis than in early-2015 (see Chart 28 below). This is interpreted as evidence of asymmetric investment behaviour at the end of the APP compared with when it was introduced. More studies on monetary policy transmission through non-banks are required to better assess the potential side effects of normalisation. Although a central bank can encourage risk-taking and monitor its progress, it will generally struggle to ensure that the unwinding of riskier positions occurs smoothly. This is more the case given that policymakers' understanding of how transmission operates through non-bank intermediaries is less developed.

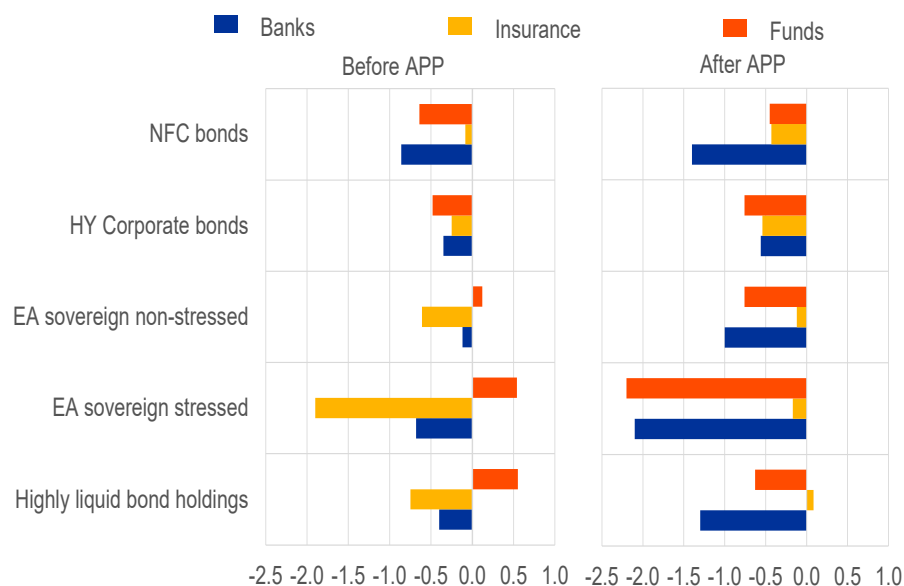
4.2.2 Regulatory reform, financial innovation and the transmission of monetary policy through banks

As a response to the global financial crisis, European regulators significantly expanded their oversight of the financial sector. New prudential policy instruments were introduced to improve the overall resilience and resolution of banks via Basel III (introduced in December 2010 and finalised in December 2017), the Capital Requirements Regulation and Directive and the Bank Recovery and Resolution Directive, encompassing capital-based, liquidity-based and asset/liability-based measures. At a global level, new institutions such as the Financial Stability Board (FSB), as well as supervisory and resolution bodies in Europe, were created to improve policy coordination and implementation. Against this backdrop of a rapidly evolving regulatory landscape, the implementation of monetary policy and its transmission has become more complex (Beyer et al. 2017).

Few studies have, however, documented how regulatory-induced changes in the banking system affect the transmission of monetary policy. By looking at the US interbank market, Kim et al. (2018) suggest that a monetary policy strategy that relies on the reactivation of the interbank market may no longer be feasible. While the increase in

Chart 28 Sensitivity of sectoral bond holdings to past yields by asset class

(Percentage change of bond holdings after 100 basis point yield change)



Sources: Boneva et al. (2019); ECB Securities Holdings Statistics by sector and ECB calculations.

Notes: Coefficients are based on security-by-security level regressions of the percentage change of holdings on their one-quarter-lagged yield-to-maturity. The "Before APP" sub-sample includes holdings between the fourth quarter of 2013 and the second quarter of 2015, while the "After APP" sub-sample includes holdings between the third quarter of 2015 and the third quarter of 2018.

excess reserves contributed to the drying up of the interbank market, it shows that even if excess reserves were significantly drained from the system, the interbank market would not return to pre-crisis levels of activity. The reason for this asymmetry is that two planks of the new post-crisis regulatory framework, the Basel III leverage ratio and the Federal Deposit Insurance Corporation's assessment fee, increase the costs of interbank trading, thus impeding its revival.

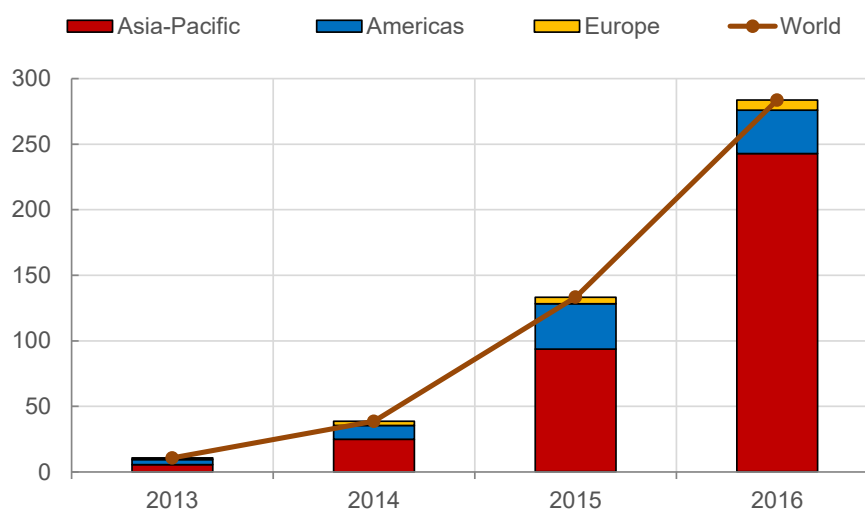
Looking ahead, regulatory requirements imposed on banks may have a further impact on banks' intermediation capacity. Several elements of the Basel III framework have been further revised to introduce into EU law the leverage ratio requirement, the revised market risk capital framework, and the net stable funding ratio requirement affecting the interplay between UMPs and regulatory requirements. In addition, from 2019 onwards, while G-SIBs will need to hold a minimum volume of total loss-absorbing capacity, EU banks will need to meet minimum requirements with regard to own funds and eligible liabilities (MREL, Klaus and Sotomayor 2018). As the issuance of MREL-eligible debt will change the composition of banks' liabilities, the impact on banks' funding costs and profitability (Gaiduchevici and Zochowski 2017), and the emergence of possible MREL-shortfalls, may affect banks' capacity to transmit monetary policy impulses.

In addition to these regulatory developments, the rapid technological change which is characterising the financial system will also affect banks' capacity to transmit monetary policy. The emergence of new business models and technologies, such as fintech (see Chart 29 below), poses additional challenges for banks by potentially altering

the competitive environment in which they operate. The provision of credit facilitated by electronic platforms, i.e. fintech credit, may have a bearing on banks' loan pricing behaviour. Fintech technology is expected to facilitate the offering of lower interest rates to borrowers and higher returns to lenders, given the reduced operating costs compared with more traditional banks, and the use of technology to make the loan application and credit risk assessment process more efficient (FSB 2017). For example, recent research has shown that the use of web-based digital footprint information can complement more traditional credit scoring techniques in predicting default rates for borrowers (Berg et al. 2019). Recent evidence suggests that around one-third of the doubling in the shadow bank market share in US residential mortgages between 2007 and 2015 was due to the adoption of fintech (Buchak et al. 2018). At the same time, by reducing the concentration of credit in the banking sector (FSB 2017), the rise of fintech increases the procyclicality of credit provision, thus interfering with the monetary policy transmission process.

Chart 29
Global volumes of new fintech credit by economic region

(USD billions)



Sources: Claessens, Frost, Turner and Zhu (2018); data from the Cambridge Centre for Alternative Finance and research partners; Bank for International Settlements calculations.
Note: Figures on fintech credit for Africa are very low in scale (between USD 40 million and \$135 million during the period) and are therefore not shown on the chart.

4.3 Monetary policy, financial stability and the recovery: Historical experiences

There are well-understood financial stability trade-offs in the conduct of monetary policy at all stages of the business cycle. During an economic downturn a central bank typically reduces interest rates to stimulate the economy and address the transmission impairment issue which risks deepening and prolonging the downturn. At the same time, by reducing bank funding costs, monetary policy easing plants the seeds for future risk-taking. Therefore, while supporting price stability and reducing current financial stability risks, accommodative monetary policy during a downturn increases the risk of financial instability in the future. Then, as the recovery takes shape and inflation returns to target, the central bank increases rates to slow down the economy and bring inflation down. Such monetary

policy tightening can have implications for financial stability, especially in an environment in which banks' funding structures have changed or banks have taken on risky asset positions.

The trade-offs in question are exacerbated when the downturn is particularly prolonged and severe, requiring the central bank to keep policy rates very low for very long. A low interest rate environment contributes to the build-up of vulnerabilities and banking stability risks in a number of areas of the financial system and the economy. Empirical analysis of the US and the European experience during the early and mid-2000s is particularly instructive. In both jurisdictions, interest rates were kept low for long in view of the perceived severity of the recession in the early 2000s. Using loan-level evidence from different jurisdictions, a number of empirical contributions have shown that during the long period of very low interest rates, which stretched from 2002 to 2005, banks softened their lending standards and took on excessive risk (e.g. Altunbas, Gambacorta and Marques, 2014; Jimenez, Ongena, Peydró and Saurina, 2014; Dell'Ariccia, Laeven and Suarez, 2017).

The current scenario of a protracted low interest rate environment accompanied by low growth has shown both similarities to and differences from analogous historical episodes. For example, Heider, Saidi and Schepens (2018) show that when negative policy rates were introduced in mid-2014 they resulted in less lending and more risk-taking. At the same time, while this effect is consistent with prior experience of low-for-long rates, it is driven by a novel mechanism – because banks are reluctant to pass on negative rates to depositors, negative rates increase the funding costs of high-deposit banks. As a result, the reduction in bank lending and the increase in bank risk-taking are entirely driven by high-deposit banks. These findings imply that if the banking sector is dominated by high-deposit banks, negative rates are less accommodative and can pose a risk for financial stability. Along similar lines, Altavilla, Boucinha and Peydró (2018) find that a protracted period of low interest rates might have a negative effect on bank profits. However, this effect only materialises after a long time and tends to be counterbalanced by improved macroeconomic conditions.

Against this backdrop, it is instructive to look at other countries' experience of monetary policy normalisation after a particularly severe downturn. Two such recent experiences include the exit from Japan's quantitative easing program, which took place between 2001 and 2006, and the unwinding of the Federal Reserve's UMPs that were enacted to counter the impact of the global financial crisis, starting in 2008. As the discussion below further clarifies, these two episodes offer vastly different scenarios for the ECB's own attempt to normalise monetary policy in the euro area. In addition, the emergence of a sovereign-bank nexus and the large exposure of banks to their domestic sovereigns clearly distinguish the euro area experience from that of the United States and, to a lesser extent, Japan (see Box 4 at the end of the section).

Quantitative easing (QE) began in Japan in March 2001 and ended in March 2006.⁴²

The Bank of Japan drove the overnight interest rate to zero and pledged to keep it at that level until deflation ended, mainly by flooding the banking systems with excess reserves. To create all these reserves, the Bank of Japan bought mostly Japanese government bonds. The core idea behind QE in Japan was to stimulate the economy by flattening the yield curve, rather than by decreasing risk spreads. During this period, real GDP growth averaged 1.8%, about a percentage point higher than it had been between 1996 and 2001, and long-term bond rates declined. However, it is not clear how much of the increase in real growth and the decline in bond rates was due to QE, and how much was due to close-to-zero interest rates. In particular, a surge in economic growth in China during this period led to a rapid expansion of Japanese exports, obscuring the impact of monetary policy. The empirical evidence seems to suggest that the commitment policy on short- and medium-term interest rates had a clear effect. However, evidence for the effect of the expansion of the monetary base and the adjustment in the composition of the Bank of Japan's balance sheet is decidedly mixed (see Ugai, 2007 for a survey). At the same time, there is weak evidence of QE aiding weaker Japanese banks and generally encouraging risk tolerance in the Japanese financial system (Spiegel, 2006).

While excess reserves climbed gradually from ¥5 trillion to ¥33 trillion over the course of two and a half years, they declined to around ¥8 trillion over just a few months in 2006.

The rapid withdrawal of central bank money was mostly driven by fears of incipient inflation, although it never materialised. While the suddenness of the Bank of Japan's exit from QE does not appear to have damaged the economy, it is still an open question as to whether it hampered Japan's ability to stage a strong recovery (Blinder, 2010), e.g. by supporting weak banks and encouraging the evergreening of nonperforming loans.

In the United States, and in response to the financial market meltdown in 2008, the Federal Reserve adopted a number of UMPs, pushing interest rates close to zero and ultimately buying trillions of dollars of assets through its QE programme.

Between 2008 and 2015, the Federal Reserve's balance sheet ballooned from \$900 billion to \$4.5 trillion. In comparison with the Japanese case, the massive increase in bank reserves after Lehman Brothers' bankruptcy happened very quickly. Because of the size and importance of the mortgage market, the majority of the assets that the Federal Reserve purchased were mortgage-backed securities, which stands in stark difference to how QE was enacted in Japan. Moreover, between December 2008 and December 2015, the target Federal Funds rate remained within the range 0.00–0.025%, the lowest rate in the Federal Reserve's history. A broad consensus among academics and policymakers is that through these actions, the Fed prevented another Great Depression. The US economy registered average growth rates of around 2% between 2010 and 2015, while inflation stabilised at around 2%. Regarding the banking sector, the evidence suggests that the increase in reserves outstanding by the Fed did not create pressure on banks to reduce other components of bank assets, such as loans to the private sector (Ennis and Wolman, 2015).

⁴² The more recent round of quantitative easing via stock purchases, which started in 2013, is still ongoing.

The evidence suggests that the tempering of APPs and the increase in interest rates back to their current level of 2.25–2.50%, both of which started in 2015, have not been accompanied by tremors in either the financial markets or the real economy. GDP continued to grow, unemployment continued to fall, and inflation remained stable after the Federal Reserve signalled the beginning of tapering in 2013. While this change of stance was followed by a bond market sell-off – an episode dubbed “taper tantrum” – the evidence suggests that this was driven by better economic news rather than by changing expectations for the end of balance sheet expansion (Greenlaw, Hamilton, Harris and West, 2018). At the same time, the Federal Reserve’s tapering seems to have had a significant effect on capital flows to and asset prices in emerging markets, mirroring the earlier impact of QE itself (e.g. Aizenman, Binici and Hutchinson, 2016; Chari, Stedman and Lundblad, 2018; Eichengreen and Gupta, 2015). This appears to be particularly the case for countries with weaker macroprudential frameworks (Takáts and Temesváry, 2017), a fact that has important implications for the impact of the ECB’s monetary policy normalisation on non-euro area countries in which euro area banks are active.⁴³

4.4 Conclusions

This section discussed the interplay between MP and FS during the up phase of the business cycle in general, and in the context of the ongoing euro area recovery in particular. The strengths and limitations of the models used to analyse the transmission of MP during the crisis were evaluated, and the specific challenges of the post-crisis euro area environment were discussed, also in relation to prior episodes of MP normalisation in peer economies.

First, we argue that macro- and micro-analytical models have fundamental strengths and limitations and should be used jointly in a complete assessment of the bank lending channel during the up phase of the cycle. Macro models (e.g. DSGE or VAR types of analysis) are reasonably effective at forecasting the evolution of various macroeconomic variables in response to monetary policy shocks, although they cannot predict individual effects or identify the channels of adjustment, which limits their ability to provide concrete policy advice. In addition, they often **fail to provide a realistic account of the financial sector and its evolution. By contrast, difference-in-difference analyses based on micro data do a good job of identifying micro channels of transmission, although such an analysis is by default partial-equilibrium, limiting the models’ ability to predict and quantify aggregate effects.** Moreover, the models rely on granular datasets that have become available only recently – rendering the pre-crisis world difficult to study – and they rely on policy shocks that do not always fulfil the requirement of a natural experiment.

⁴³ Morais, Peydró, Roldán-Pena and Ruiz-Ortega (2018), for instance, show results supporting the international risk channel, based on which a change in foreign monetary policy, including by the ECB, induces real effects in emerging markets through the activity of the foreign banks present in that country.

Second, we argue that, for the future, monetary policy and regulation need to be mindful of a number of recent developments that have made the post-crisis environment different from previous post-crisis episodes. One such specificity is the intensification of financial innovation – i.e. fintech – which tends to be procyclical and therefore poses financial stability challenges. Another is the rise of non-bank intermediaries, which tends to complicate the analysis of the transmission of MP. Finally, the interdependence between banks and sovereigns is particularly fragile in the euro area owing to the relatively high holdings of sovereign bonds accumulated by banks during the crisis.

Box 4: The sovereign-bank nexus

(by Agnese Leonello and Alex Popov)

The sovereign-bank nexus derives from a complex set of linkages between governments and banks. The first linkage is the **sovereign-exposure channel** whereby banks demand and hold large amounts of (typically domestic) sovereign bonds on their balance sheets. In this way, banks simultaneously provide funding to the government and expose themselves to sovereign risk. The second linkage is the **safety-net channel** whereby banks operate in an environment of explicit and implicit government guarantees. This factor also creates a loop between sovereigns and banks: on the one hand, an increase in sovereign risk reduces the government's ability to support banks, weakening the bank safety net; on the other, a banking crisis activates the backstop, with adverse implications for the fiscal account. The third linkage is the **macroeconomic channel**: for example, a sovereign debt crisis can depress economic activity, reducing bank profitability. Alternatively, problems in the banking sector can impair the credit supply, slowing the economy down and reducing the government's tax intake.

While all channels play an active role, the sovereign-exposure channel is particularly important in developed economies where banks hold a substantial amount of public debt. For example, between 2005 and 2013, the average bank exposure to government debt in advanced economies ranged from 6.5% to 8.8% of bank assets (Dell'Ariccia et al., 2018). This implies that sovereign distress has an immediate and direct impact on bank balance sheets (as, for instance, in the euro area sovereign debt crisis). In turn, since banks absorb a significant portion of bond issuances, their distress may lead to problems in sovereign bond markets.

The literature offers **three non-mutually-exclusive explanations for why banks hold sovereign debt. The first is related to the fact that government bonds are typically liquid and safe, so they have high eligibility as collateral (liquidity and safety).** Government bonds typically command substantial liquidity and safety premia (Krishnamurthy and Vissing-Jorgensen, 2012). This may be an optimal response to an underlying market imperfection if weak institutions are hampering the supply of financial assets by the private sector (Holmstrom and Tirole, 1998). Moreover, informational frictions and hedging properties can explain why banks predominantly prefer to hold domestic government bonds as opposed to foreign bonds, resulting in a well-documented home bias in sovereign bond holdings (Van Nieuwerburgh and Veldkamp 2009; Gennaioli et al. 2014b).

The second reason is that the risks associated with holding government bonds are not priced correctly (risk-shifting). Such a mispricing of risk may take place because banks expect to be bailed out in the event of a sovereign default (Broner et al., 2014; Farhi and Tirole, 2017), or because there is a correlation between the government's risk of default and their own risk of bankruptcy or distress (e.g. Livshits and Schoors, 2009; Andreeva and Vlassopoulos, 2019). The combination of these factors may explain the home bias in government bond holdings: when banks purchase government debt, they are transferring risk to those states of nature in which they would go bankrupt anyway.

The third reason is related to explicit or implicit pressure by the government on banks to hold domestic sovereign bonds (financial repression). For example, the tax regime may be adjusted to favour public over private investment (Acharya and Rajan, 2013). The regulatory framework may also tilt the balance in favour of (domestic) sovereign holdings by imposing zero risk weights on domestic sovereign bonds. There is ample evidence that a combination of interest rate ceilings, direct lending to governments and regulation of international capital movements in the aftermath of World War II helped to boost banks' sovereign exposure in many advanced economies (Reinhart and Sbrancia, 2015). Financial repression may even be optimal in some environments, such as when it can help to prevent liquidity runs or as a commitment device against default (e.g. Chari et al. 2014). Alternatively, the government may be pressuring banks directly to increase their holdings of domestic bonds (moral suasion).

The empirical evidence suggests that **all three mechanisms can help to explain the substantial increase in sovereign bond exposures among European banks since the start of the global financial crisis, especially in some countries.** For example, the literature has shown that, during the crisis, undercapitalised banks purchased domestic sovereign debt in order to shift risk (Drechsler, Drechsel, Marques-Ibanez and Schnabl, 2016), make a profit (Acharya and Steffen, 2015), or obtain central bank liquidity during periods of large-scale lender-of-last-resort (LOLR) operations (Crosignani, Faria-e-Castro and Fonseca, 2015). Finally, a number of recent papers present evidence consistent with this idea of moral suasion (e.g. Battistini, Pagano and Simonelli, 2014; Altavilla, Pagano and Simonelli, 2017; Becker and Ivashina, 2018). Ongena et al. (2019) calculate that the holdings of domestic sovereign bonds by banks in stressed countries increased by around 150% between 2010 and 2013 as a result of the combined effect of risk-shifting and moral suasion, with risk-shifting accounting for about two-thirds of the effect.

To the extent that banks' incentives to hold public debt are distorted, this may also imply that their bond holdings crowd out efficient lending and investment. Consistent with this view, Becker and Ivashina (2018) find that sovereign debt purchases by banks in the euro area periphery crowded out corporate borrowing, pushing firms away from loans into bonds, even as conditions in bond markets became tighter. Bofondi, Carpinelli and Sette (2018) find that after the start of the sovereign debt crisis, domestic banks in Italy reduced credit supply, increased interest rates on credit granted, and lowered their probability of accepting loan applications more than foreign banks, which were less affected by the sovereign crisis. Popov and van Horen (2015) show that banks in non-stressed countries with large balance sheet exposures to stressed sovereigns reduced their lending to the corporate sector. In this regard there is also evidence showing that a sovereign debt crisis results in credit rationing (Ferrando, Popov and Udell 2015).

Looking ahead, **policy should be mindful of two trade-offs which emerge from the exposure channel of the bank-sovereign nexus. The first is between efficiency and stability.** Increasing bank holdings of (domestic) sovereign bonds may increase financial stability by improving the sovereign's fiscal position and by improving bank capitalisation, although this may come at the expense of reduced lending to the real sector. **The second trade-off is between short-term stability and long-term fragility.** Increasing banks' holdings of (domestic) sovereign bonds may increase financial stability in the short run by improving the sovereign's fiscal position. However, in the long run, larger sovereign exposures by banks may increase financial fragility during times of future sovereign stress by weakening the safety net provided by the government to the banking sector.

These trade-offs also have important implications for monetary policy. For instance, the ECB's acceptance of sovereign bonds as collateral may provide incentives for banks to load up with domestic sovereign debt in times of fiscal stress (Uhlig, 2013). In addition, between 2010 and 2012 the ECB adopted a number of extraordinary measures aimed at restoring the monetary policy transmission mechanism impaired by tensions in sovereign bond markets, such as the Securities Markets Programme (SMP), the longer-term refinancing operation (LTRO) and the Outright Monetary Transaction (OMT). **Conceptually, the effect of the ECB's policies on the sovereign-bank nexus is twofold. On the one hand, an increase in the liquidity provided by the ECB to banks can lead to an increase in banks' holdings of domestic sovereign bonds, thus strengthening the bank-sovereign nexus.** In this case, the negative spillovers between banks and sovereigns worsens in that banks become more exposed to the health of their sovereign and, at the same time, their distress may have a larger impact on the sovereign's stability. **On the other hand, by improving the liquidity and depth of sovereign bond markets and investors' expectations, the ECB's policies can reduce the level and volatility of government bonds yields, neutralising impairments in lending capacity due to financial markets dislocations, and reducing sovereign risk.** In this case, the intervention has a beneficial impact on the sovereign-bank nexus.

The existence of these two counteracting effects makes it difficult to assess the overall impact of the ECB's policies on the sovereign-bank nexus. For example, a number of empirical contributions have documented an increase in banks' domestic sovereign bonds around the introduction of the LTRO in peripheral countries. However, the implications they derive for the sovereign-banks nexus are quite different. Acharya and Steffen (2015) and Drechsler et al. (2016) explain the increase in the banks' sovereign bond holdings as a form of risk-shifting by banks, thus hinting at more severe negative spillovers between banks and sovereigns. By contrast, Crosignani et al. (2017) show that the purchases of three-year domestic sovereign bonds by the Portuguese led to a drop in the level of short-term yields and, in turn, had beneficial consequences for both the sovereign and the banks. Similarly, Eser and Schwaab (2013) show that the SMP had a beneficial impact on the levels and the volatility of sovereign bond yields, as well as on sovereign CDS, and Krishnamurthy et al. (2018) find the same results in the case of the OMT.

5 Conclusions

This paper has sought to bridge academic insight and policy experience on how monetary policy and banking stability interact. It has done so by focusing on the monetary policy response to the global financial crisis in the euro area and how this may have affected the stability of the banking system. Prior to the crisis, both the academic and the policy communities had, at best, only a partial appreciation of the importance of the state of the banking system in determining the effectiveness of monetary policy transmission. Indeed, most of the pre-crisis empirical literature found little evidence that banks had a major role in shaping the transmission mechanism of monetary policy in Europe. Moreover, the pre-crisis consensus afforded virtually no role to shocks originating in the financial sphere driving macroeconomic outcomes. The global financial crisis brought these considerations into sharp focus, prompting central banks to introduce unprecedented measures to restore the transmission of monetary policy. In addition, as economies were pulled towards operating at or near the effective lower bound for policy rates, unconventional monetary policy measures were deployed to stave off the risk of deflation.

A definitive bottom-line assessment of the impact of monetary policy on banking stability is fraught with methodological and conceptual difficulties. This paper has sought to describe and quantify the main channels through which the monetary policy measures enacted by the ECB in the aftermath of the global financial crisis have interacted with banking stability. In doing so, it recognises that monetary policy measures may exert both a benign and a harmful impact on banking stability.

In this respect, the analysis highlights three important points. First, when assessing the impact of monetary policy measures it is essential to take into account the fact that they are a reaction to actual, or expected, business and financial conditions. Second, it is also important to construct the appropriate counterfactual as the basis for making such an assessment, which is particularly intractable when the economy finds itself at risk of shifting from one equilibrium to another. Third, any bottom-line assessment is time-varying, as some of the adverse spillovers to banking stability may be accentuated the longer the monetary policy measures are in place, e.g. the impact of negative rates on bank profitability. Similarly, some negative effects may only surface once monetary policy has normalised.

Looking ahead, the role of asymmetries and non-linearity is likely to be critical in an assessment of the transmission of monetary policies and their implications for banking stability. This paper points to at least two reasons for this. First, the already well-documented asymmetries associated with expansionary versus contractionary monetary policy may be amplified by the fact that monetary policy would, eventually, be normalising from the effective lower bound. Second, significant structural shifts in financial intermediation are taking place. These relate both to financial and technological innovations, which alter traditional banking business, and to the marked increase in the role played by non-bank financial intermediaries. For both of these reasons, the analytical toolkit

that has been deployed to study the interaction between monetary policy and banking stability in this paper should be enriched and expanded, using tools that are better able to cope with these developments.

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Abbreviations

Country codes

BE	Belgium	HR	Croatia	PL	Poland
BG	Bulgaria	IT	Italy	PT	Portugal
CZ	Czech Republic	CY	Cyprus	RO	Romania
DK	Denmark	LV	Latvia	SI	Slovenia
DE	Germany	LT	Lithuania	SK	Slovakia
EE	Estonia	LU	Luxembourg	FI	Finland
IE	Ireland	HU	Hungary	SE	Sweden
GR	Greece	MT	Malta	UK	United Kingdom
ES	Spain	NL	Netherlands	US	United States
FR	France	AT	Austria		

In accordance with EU practice, the EU Member States are listed in this report using the alphabetical order of the country names in the national languages.

Others

APF	Asset Purchase Facility	LSAP	Large-Scale Asset Purchase
APP	Asset Purchase Programme	LTROs	long-term refinancing operations
BIS	Bank for International Settlements	MFI	monetary financial institution
CDS	credit default swap	MIP	macroeconomic imbalance procedure
CISS	composite indicator of systemic stress	MP	monetary policy
CPI	Consumer Price Index	NCB	national central bank
CME	Comprehensive Monetary Easing	NFC	non-financial corporations
DG ECFIN	Directorate General for Economic and Financial Affairs, European Commission	NIRP	negative interest rate policy
ECB	European Central Bank	SMP	security market programme
EDP	excessive deficit procedure	SSM	Single Supervisory Mechanism
EER	effective exchange rate	TLTROs	targeted long-term refinancing operations
EMU	Economic and Monetary Union	UMP	unconventional monetary policy
ERM	exchange rate mechanism		
ESCB	European System of Central Banks		
ESRB	European Systemic Risk Board		
EU	European Union		
EUR	euro		
GDP	gross domestic product		
HICP	Harmonised Index of Consumer Prices		
IMF	International Monetary Fund		

Conventions used in the tables

“-” data do not exist/data are not applicable

“.” data are not yet available

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