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Contents

The results of the EU-wide bank stress testing exercise may trigger further macroprudential and systemic effects, which are analysed in a macroprudential extension of the stress test. Bank solvency projections are adjusted to account for the reduction in credit to the economy under the adverse scenario. The potential second-round effects of adjustments made by weaker euro area banks to meet higher capital targets through a further reduction in lending may also be sizeable and further weaken the banking sector. The release of macroprudential capital buffers could, therefore, be vital to contain such adverse feedback loops in a real crisis scenario. Systemic risks related to the interconnectedness of banks may further erode bank capital.

While risk-taking by financial institutions can foster the intermediation needed to support economic recovery, if excessive it can lead to the build-up of financial imbalances, especially in a low yield environment where institutions struggle to boost their profitability. To ensure that macroprudential policy measures are effective, the regular monitoring of financial institutions' risk-taking behaviour is required. An analysis of detailed bank-level information on developments in the assets of SSM significant institutions shows that banks are currently de-risking and reshuffling their portfolios towards safer assets. Evidence of de-risking is identified in the reduction in average risk weights and the shift towards exposures with lower probabilities of default.

New developments in financial markets related to the growth of high-frequency trading may give rise to financial stability risks by affecting liquidity, volatility and market resilience. Two recent ECB research papers investigate the impact of such developments. The first studies how high-frequency quoting affects information processing and how markets react to external shocks. The second considers the effect of trading in dark pools on price volatility. These papers suggest that, while market developments related to high-frequency trading may dampen market volatility during normal times, they might also amplify it during crisis times, giving a new perspective on regulating such activities.

Foreword

ECB Vice-President
Vítor Constâncio

Macroprudential policy can comprise a broad range of issues and topics. This is clearly reflected in the second issue of the ECB's Macroprudential Bulletin.

The Bulletin starts with the **macroprudential effects of the EU-wide bank stress testing exercise**. The first chapter of the Bulletin explains how the dynamic response of banks to macro-financial stress and the impact of intra-sector and cross-industry contagion can be captured. The results are translated into second-round macroeconomic effects arising from a shrinking of credit supply. The analysis aims to provide insights into the potential benefits of macroprudential policy measures.

The second chapter of the Bulletin provides an **analytical approach** to gauge developments in banks' risk appetite and behaviour, which might call for targeted macroprudential policy measures if they become excessive. As risk-taking is typically not directly observable, it must be inferred from a variety of quantitative and qualitative information sets. The analysis looks at significant institutions as defined by the SSM.

Finally, the last chapter looks at **macroprudential regulatory issues** in an attempt to shed light on the role of high-frequency quoting and dark pools. This chapter is based on two ECB research papers, one recent and another forthcoming, both of which investigate the impact of such developments on market volatility in normal and stressed times. The results also provide information on the pros and cons of potential options for regulating high-frequency trading and dark pools.

The Macroprudential Bulletin ends again with an **overview of recent announcements on macroprudential instruments** adopted by national authorities in the euro area.

Vítor Constâncio
Vice-President of the European Central Bank

Chapter 1 – Topical issue Macroprudential effects of systemic bank stress[1]

This article outlines a top-down macroprudential extension of the supervisory system-wide bank stress test. The extension is based on an analytical framework developed by ECB staff. It starts with projections of banks' profitability and solvency based on the assumption that loan volumes change depending on the common baseline and adverse macro-financial scenario. Banks are then assumed to adjust to a specific capital ratio target under stress, at least partially by reducing their risk-weighted assets, leading to an ex ante negative loan supply shock. The resulting deterioration of macro-financial conditions would negatively affect bank solvency. Additionally, contagion and spillovers both within the banking sector and across economic sectors further erode banks' capital.

As illustrated by the recent EU-wide stress test conducted by the EBA, the first-round impact of an adverse scenario can be rather severe. The aggregate CET1 capital ratio for the 37 largest euro area banks included in the 2016 EU-wide stress test was projected to drop by 390 basis points under the adverse scenario, from about 13.0% in 2015 to about 9.1% at the end of 2018.

Nonetheless, this impact does not include potential second-round effects that could be triggered by the materialisation of bank distress. The purpose of this chapter is to show how these effects could be quantified using an analytical framework developed by ECB staff, using the conceptual vision provided in Constâncio (2015) as a basis. This modular framework, referred to as the macroprudential extension of the stress test, includes several stand-alone models and tools that can be combined to provide a broad perspective of the impact of macro-financial stress.

1 Structure of the macroprudential extension

The objective of the macroprudential extension is to, without knowing the results for other banks in the system, account for several effects that cannot be captured in a bottom-up setting where individual banks are responsible for projecting their solvency and profitability.

Importantly, the methodology of the EU-wide stress testing exercise imposes a static balance sheet assumption on banks. No changes in the volume or composition of the balance sheet are permitted – an assumption that is not consistent with the macroeconomic scenario of the exercise but, pragmatically, allows for comparability

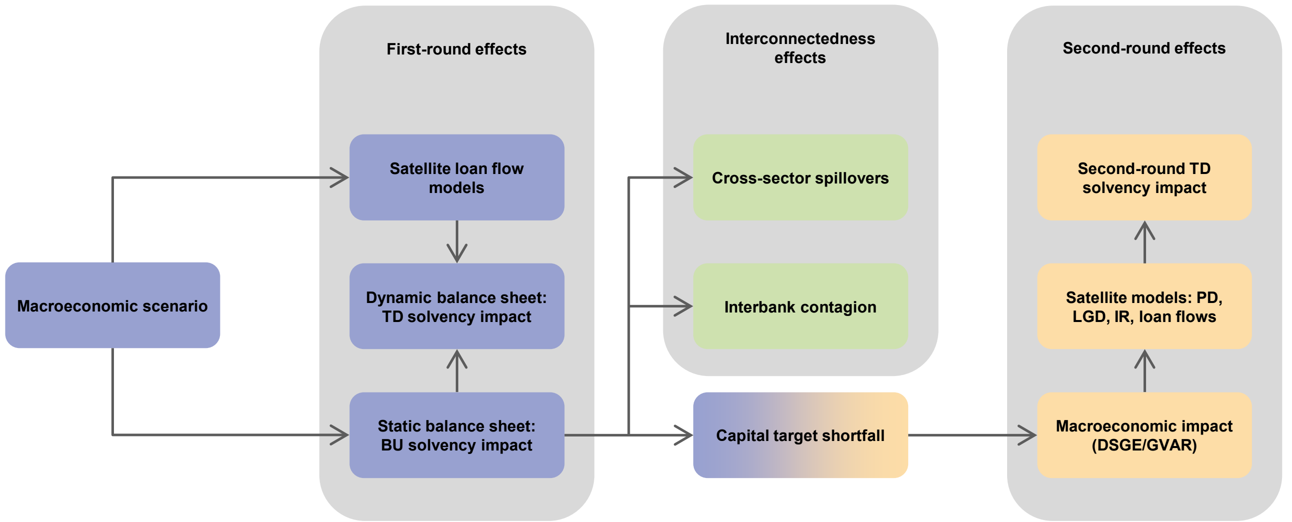
[1] Prepared by Dees, S., Gaiduchevici, G., Grodzicki, M., Gross, M., Hilberg, B., Maliszewski, K., Rancoita, E., Silva, R., Testi, S., Venditti, F., and Volk, M.

and a level playing field. Under this assumption and following the EBA methodology, banks calculate the first-round impact of the scenario on their solvency. In the macroprudential extension, the static balance sheet assumption is relaxed for banking book exposures to the private non-financial sector (see the left-hand side of **Figure 1**). However, no further management actions, such as cost reductions, are considered.

Beyond accounting for the changing credit needs of the economy, banks would react to the finding that they may be unable to withstand the adverse scenario. They would attempt to increase their capital ex ante, for example by constricting new lending or raising capital from external sources. Individual banks' responses, aggregated at the system level, may reach systemic proportions and give rise to second-round effects. A credit supply shock, for instance, would translate into lower consumption and investment, which in turn would impact on all macro-financial variables. The deterioration of the macroeconomic environment would further worsen bank asset quality and reduce pre-provision profitability, thus eroding bank capital further (see the right-hand side of **Figure 1**).

Additionally, the macroprudential extension aims to analyse the potential spillovers arising from the interconnectedness of banks through money market exposures, as well as cross-holdings of financial instruments by various economic sectors (see the middle part of **Figure 1**).

Figure 1
Structure of the macroprudential extension of supervisory stress tests



Notes: BU: bottom-up (banks' results); DSGE: dynamic stochastic general equilibrium model; GVAR: global vector autoregressive model; IR: interest rates; PD: probability of default; LGD: loss given default; TD: top-down.

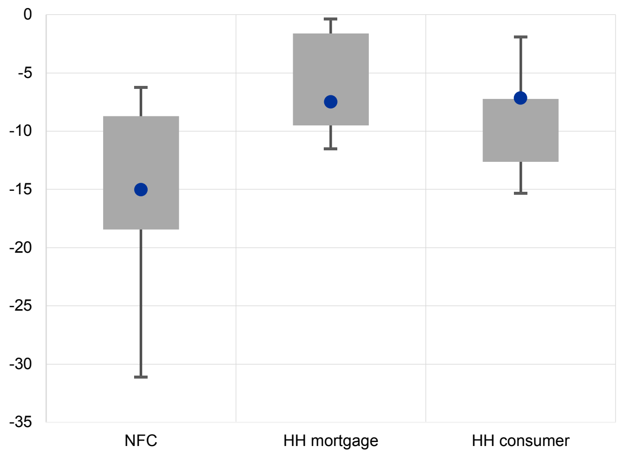
2 Loan volume adjustments under the adverse scenario

The first step of the macroprudential extension is to estimate the impact of changes in the stock of aggregate bank loans on bank solvency, thus removing part of the inconsistency introduced by the static balance sheet assumption. Credit growth can be expected to be weaker under the adverse scenario than under the baseline scenario. The flow of credit is a function of the macroeconomic variables (and vice versa); on the one hand, credit demand may fall during recessions, while, on the other, banks facing capital and funding constraints would reduce credit supply. Risk would also play a role, as some of the potential borrowers may become too risky in the event of macroeconomic stress.

Figure 2

Total loan stock change

Difference between three-year growth rates, adverse scenario to baseline scenario, percentage points



Notes: Blue boxes indicate the interquartile range across EU countries, dots indicate the EU aggregate, and black lines indicate the range between the 10th and 90th percentiles. NFC: non-financial corporations; HH = households.

We use aggregate loan flow models in order to project the size of credit portfolios, at the bank level, consistent with the baseline and adverse scenarios. The aggregate loan dynamics in the euro area economies are modelled using an autoregressive distributed lag (ADL) model structure, linking loan flow variables for different portfolio segments to a set of macro-financial variables.[2] A Bayesian model averaging (BMA) approach was employed to estimate the parameters of these satellite equations. The models were estimated for 24 European Union (EU) countries and for three loan portfolio segments: corporate lending, housing loans and consumer credit. The evolution of the loan stock is determined by the estimated new flow and maturity structure of the existing loan books.

The choice of the flow of new lending as the dependent variable is motivated by both economic and statistical factors. Since GDP (and its components) is a flow concept, the rate of GDP growth can be expected to be related more strongly to the rate of growth in the flow of new credit than to changes in the credit stock. From a statistical perspective, loan flow series are less likely to be distorted by factors such as movement of loans within financial groups, sales of loans to non-bank entities, write-offs and prepayments.

An application of these models to the 2016 EU-wide stress test scenario is shown in Figure 2. In this illustration, the scenario-conditional rates of change for new loan flows at the consolidated bank level differ substantially in the baseline and adverse scenarios across all portfolio segments, with the gap being particularly significant for the non-financial corporate portfolio. Large euro area banks would significantly reduce their stock of corporate loans, on aggregate by about 15% over the three-year period with respect to baseline levels. Credit to the household sector would be somewhat less strongly affected by the worsening macro-financial conditions, as mortgages and other consumer lending would shrink by about 9% with respect to the baseline.

[2] The satellite model structure, with loan flows as the dependent and macro-financial variables as the independent predictor variables, does not preclude the scope for a reverse relationship between loan flows and macro conditions. This endogeneity is ignored here (although econometrically accounted for) as the objective is merely to derive loan flow paths that are consistent with the initial macroeconomic scenario.

The impact of changes in the volume of bank lending on the capital position of the banks is obtained using the ECB top-down stress testing models (see e.g. ECB Occasional Paper 152). Banks' profits, loan losses and risk exposure amounts (risk-weighted assets) are adjusted in line with the projected loan flows. Beyond these adjustments, it is assumed that no additional management action, such as internal restructuring, reducing operating expenses or discontinuing unprofitable business lines, would take place.

The evolution of other balance sheet items, such as securities holdings, derivatives, and liabilities, could also be modelled. However, for the sake of simplicity, a number of assumptions are made. In order to conform with the balance sheet equation, total liabilities are treated as a residual item after adjusting equity for retained profits and losses and changes in revaluation reserves. The composition of liabilities is assumed to remain constant; that is, it is assumed that banks fund the loan growth using the same liability mix as that observed as at the reporting date. Similarly, if the loan books shrink, it is assumed that banks reduce all liability classes at the same speed.

The impact of the introduction of the dynamic loan flow projections on aggregate CET1 capital ratio is not clear-cut. Some banks could be able to benefit from lower loan flows, while others could become worse off as a result of their operating profits being reduced. Looking in more detail at the main drivers of the dynamic balance sheet results, the overall capital ratio would be supported through a lowering of risk exposure amounts and credit losses, as the absolute size of loan books is projected to contract. However, the reduction in net profits, especially interest income, would work in the opposite direction. The dynamic response of banks may therefore, in net terms, lead to a counterproductive outcome, as some banks would be weakened by their own deleveraging, which would reduce future profits.

An alternative approach to the economy-wide loan flow models, established at the micro level, is based on the portfolio optimisation theory.[3] Subject to regulatory capital and liquidity constraints, it is assumed that banks periodically adjust their asset structure with the objective of maximising the risk-adjusted returns on capital. The optimisation procedure yields changes in each bank’s asset composition and shifts in bank asset allocation between cash, securities and loans. Economy-wide changes in loan stocks result from an aggregation of the projections for individual banks.

3 Macroeconomic consequences of banks' response to stress

Banks’ responses to the macroeconomic scenario, through an upfront adjustment of their capital ratio to conform with a specific target capital ratio, would likely result in a contractionary loan supply shock for the euro area economies. This is what we consider a potential second-round effect (see **Figure 1**). The magnitude of that

[3] For details on this approach, see Hałaj, G., “Optimal asset structure of a bank”, *Working Paper Series*, No 1533, ECB, Frankfurt am Main, April 2013.

shock would depend on the adjustment strategy adopted by the banks and the desired capital level under stress.

The target capital ratio could be determined by the supervisor, as in the 2011 and 2014 EU-wide stress testing exercises, or it could be an internal bank target. In the latter case, such targets may be set with the objective of reassuring bank investors – creditors and shareholders – about the safety and soundness of the bank, thus reflecting market discipline and benchmarking against stronger banks. The choice of capital target is central to the magnitude of the economic impact: the higher the target, the more severe the consequences of banks' adjustments could be for the economy. The supervisor usually sets the targets used in this context lower than the current combined buffer requirements. If cyclical risks materialise, countercyclical capital, as buffers could be drawn down to absorb the impact. For illustration purposes, the two thresholds used in this article (the 6% and 8% target CET1 ratios) are both higher than the past supervisory targets used in the EU-wide stress testing exercises.

The nature of banks' adjustments plays a key role in the calibration of the second-round effects. If capital markets are open to banks, and it is possible to cover the capital needs identified by the stress testing exercise by selling new stock, second-round effects will not be significant. However, this option is often not available to weaker banks during times of macro-financial stress, and further deleveraging through a reduction in assets may be required. In the macroprudential extension, we assume that banks may choose one of two strategies to increase their capital ratio upfront, with a view to adjusting to the materialisation of stress and achieving the desired capital level. The first strategy channels the adjustment through a reduction in assets (full deleveraging strategy), which is equivalent to an assumption that capital markets would be closed to banks. The second strategy replicates the historical bank response to stress, assuming a mixture of a reduction in assets and raising capital from external sources.

To estimate the macroeconomic effects of adjustment to a higher capital target, the macroprudential extension can use two macroeconomic models. The first model used is a dynamic stochastic general equilibrium (DSGE) model.[4] In this model, the capital needs are treated either as a shock to the capital ratio target, leading to both an increase in equity and a reduction in credit, or as a shock to bank mark-ups, which, directly, only reduces the supply of loans. These results are complemented by simulations based on a semi-structural global vector autoregressive (GVAR) model[5], where the capital needs are translated into shocks to either the actual capital ratio[6]

4 See Darracq-Pariés, M., Kok, C., and Rodriguez Palenzuela, D., "Macroeconomic Propagation under Different Regulatory Regimes: Evidence from an Estimated DSGE Model for the Euro Area", *International Journal of Central Banking*, Vol. 7, No 4, Washington, D.C., 2011, pp. 49-113; and Darracq-Pariés, M., Kok, C., and Rancoita, E., "Quantifying the policy mix in a monetary union with national macroprudential policies", *Financial Stability Review*, ECB, Frankfurt am Main, November 2015, pp. 159-161.

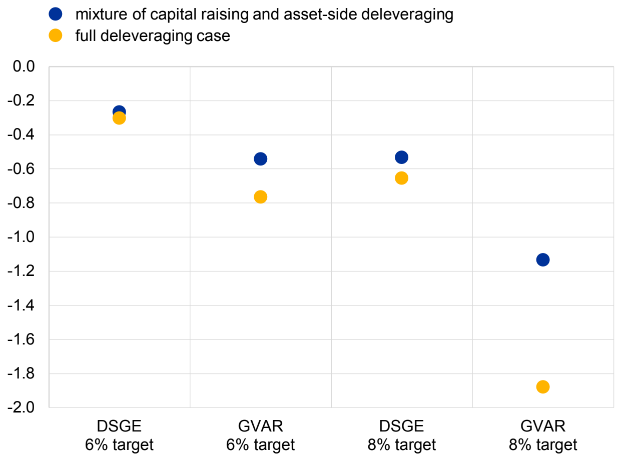
5 See Gross, M., Kok, C. and Żochowski, D., "The impact of bank capital on economic activity – Evidence from a Mixed-Cross-Section GVAR model", *Working Paper Series*, No 1888, ECB, Frankfurt am Main, March 2016.

6 Note that, while the capital ratio target is shocked in the DSGE model, it is assumed in the GVAR model that the actual capital ratio is shocked.

or the credit supply only, reflecting a full asset-side deleveraging scenario in the latter case. In both cases, the initial capital needs lead to an impact on the domestic economy, which is thereafter propagated to other euro area economies through the trade channel (and, in the GVAR, to an additional extent through the cross-border supply of credit through direct lending).

Figure 3
Impact of bank response on euro area GDP

Percentages, deviation from baseline levels, end-2018



This distinction between a full deleveraging strategy and a strategy that combines deleveraging and raising equity is key insofar as the impact on the economy is concerned, with the former strategy leading to a significantly stronger loan supply shock and therefore more severe second-round macroeconomic effects than the latter.[7] On aggregate, the adjustments made by banks in line with their historical pattern of increasing capital ratios may reduce euro area GDP by about 0.2% to 0.5% in 2018, compared to the baseline, in the case of the 6% capital target (see **Figure 3**). The full deleveraging approach would result in a reduction in GDP of between 0.3% and 0.8%.

The use of two different models is intended to reduce the risk of misspecification. However, as demonstrated, it can also lead to significant differences in the resulting projections. Conceptually, one of these models is a general equilibrium model, while the other is a semi-structural model involving sign constraints for the purpose of identifying the credit supply shock scenario. Additionally, the GVAR model captures, in an endogenous fashion, trade and financial cross-border spillovers, while the DGSE model results reflect only trade spillovers.[8]

4 Second-round impact on banks

The deterioration of macroeconomic conditions, set in motion by the banks' ex ante adjustments to the higher capital target under stress, is likely to further increase the impact on bank solvency. It is also likely to affect, through trade and financial channels, banks that otherwise would not have needed to adjust to a higher target, and even banks operating in countries where no banks would have needed to adjust.

[7] For a more detailed discussion on differences between these two strategies, see Gross, M., Kok, C., and Żochowski, D., op. cit.; Behn, M., Gross, M. and Peltonen, T., "Assessing the costs and benefits of capital-based macroprudential policy", *Working Paper Series*, No 1935, ECB, Frankfurt am Main, July 2016 (also published as "Assessing the costs and benefits of capital-based macroprudential policy", *Working Paper Series*, No 17, ESRB, Frankfurt am Main, July 2016); Gross, M., Henry, J. and Semmler, W., "Destabilising effects of bank overleveraging on real activity – An analysis based on a Threshold MCS-GVAR model", *Macroeconomic Dynamics*, forthcoming.

[8] Trade spillovers are not modelled directly in the DSGE setting, which uses a closed economy approach; instead, they are estimated separately using Stress Test Elasticities, a multi-country tool based on the macroeconomic models of ESCB central banks.

The ECB top-down stress testing tools are used to translate the second-round macroeconomic effects into an impact on bank solvency. The credit risk parameters – these being probability of default and loss given default, as well as interest rate parameters and loan flows – are re-calculated under the revised macroeconomic scenario. The additional reduction in the solvency ratios is obtained using the balance sheet tool, a top-down tool that projects the profits and capital ratios of individual banks conditional on the risk parameters. On aggregate, euro area banks' CET1 capital ratio would fall by between eight and 26 basis points owing to the second-round effects in the case of the 6% capital target.

Bank solvency stress may, additionally, trigger the materialisation of liquidity risk of both an idiosyncratic (bank-level) and system-wide nature, even in the absence of bank failures. Weaker banks may experience funding outflows, which in turn could prompt a further reduction in lending, coming on top of the second-round effects arising from adjustments to a higher solvency ratio (as discussed in the previous section). This feedback loop between liquidity and solvency may further weaken the banking sector.

The top-down solvency results could be used in early warning exercises, too. Bank-specific and country-level early warning systems[9] can provide an estimate of the probability that a bank or country would be affected by financial distress for up to two years beyond the three-year horizon of the stress test. At the banking sector level, this would provide a summary measure of financial sector fragility and the risk of a systemic financial crisis from a dynamic perspective, extending beyond the usual stress test horizon.

5 Contagion and spillovers

Apart from the second-round effects that arise from the endogenous response of the banking sector to stress, an adverse scenario is likely to trigger further bank losses related to the interconnectedness of individual banks and cross-sector spillovers. Banks are directly exposed to each other through several types of financial instruments: secured and unsecured loans, holdings of debt securities and equity, and holdings of derivatives. In the event of bank resolution or an outright failure, some of these claims may become impaired; this is more probable for shareholdings and unsecured credit claims (both debt securities and loans). Moreover, other economic sectors may be affected by bank stress, in particular in their role as shareholders in the banking sector.

[9] For example, see Lang, J. H., "A bank-level early warning model and its uses in macroprudential policy", *Macroprudential Bulletin*, ECB, Frankfurt am Main, March 2016, and Alessi, L. and Detken, C., "Quasi real time early warning indicators for costly asset price boom/bust cycles: A role for global liquidity", *European Journal of Political Economy*, Vol. 27, No 3, Amsterdam, 2011, pp. 520-533. See also Behn, M., Gross, M. and Peltonen, T., op. cit., in which the authors integrate an early warning model based on an indicator of systemic banking crises into a GVAR model as referred to earlier in this section.

5.1 Interbank contagion

The stress test data do not enable the bilateral exposures of participating banks or cross-holdings of bank bonds and bank stocks to be identified. Only aggregate data on the interbank exposures of each bank to banks located in selected countries are available.

This data constraint is tackled using the random network approach of Hałaj and Kok (2013).[10] The random network model was calibrated using the total exposures per bank collected from the stress test data. The first-round solvency impact was assumed to trigger losses on interbank exposures to all banks that fall below a prescribed threshold. The group of banks that are assumed to default on their interbank liabilities includes banks that initially remain above that threshold but fall below it as a result of being exposed to weak banks. Banks would additionally sell debt securities to maintain a constant leverage ratio, and this would lead to a second-round price effect that would affect the entire system. This approach should be considered highly conservative for two reasons. Credit risk mitigation provided by collateral (such as government bonds pledged in repo transactions) or other guarantees cannot be taken into account owing to data constraints; however, it would substantially reduce losses in an actual stress scenario. Additionally, interbank exposures are generally protected by a layer of other claims in the hierarchy of creditors, such as Additional Tier 1 and Tier 2 capital.

Figure 4
Direct interbank contagion does not lead to sizeable second-round losses

x-axis: percentile of the distribution, y-axis: euro area bank losses on interbank exposures to banks falling below the 6% threshold, percentage points of CET1 ratio.

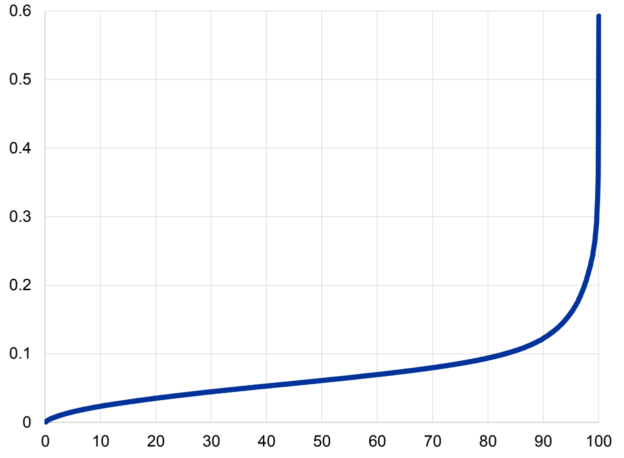
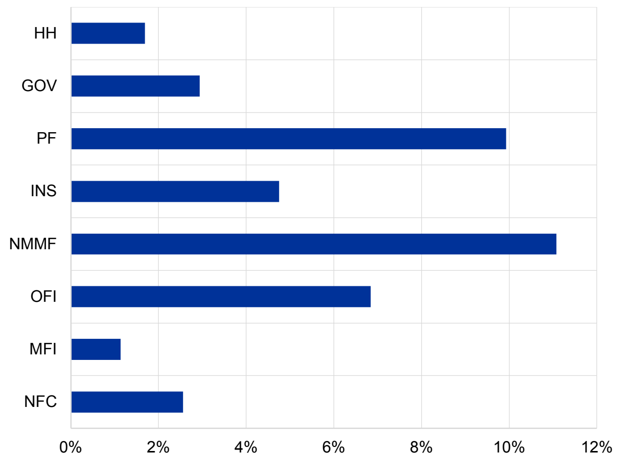


Figure 5
Cross-sector spillovers would largely affect the non-bank financial sector

Losses triggered by a reduction in market value of bank equity, euro area aggregates, percentages of total financial assets.



Note: NFC: non-financial corporations, MFI: monetary financial institutions, OFI: other financial institutions, NMMF: non-money market investment funds, INS: insurance companies, PF: pension funds, GOV: general government, HH: households, RoW: rest of the world.

[10] Hałaj, G. and Kok, C., "Assessing Interbank Contagion Using Simulated Networks", *Working Paper Series*, No 1506, ECB, Frankfurt am Main, January 2013.

The random network model indicates the possible reduction of the capital adequacy ratios as a result of interbank contagion amounting to more than 20 basis points in less than 2.5% of the cases at sample level. At the aggregate level, the CET1 ratio reduction at the 90th percentile is estimated to be 12 basis points, whereas the median reduction is 6 basis points (see **Figure 4**). This outcome seems consistent with the latest developments in the banking sector since the global financial crisis, including a decrease in interbank exposures, and with the characteristics of the data sample (largest, most resilient European banks).

5.2 Cross-sector spillovers

The cross-sector spillovers are estimated using the country-level financial and non-financial accounts of the economic sectors according to the European System of Accounts (ESA 2010) methodological framework. These sectors are interconnected via holdings of financial instruments issued by a given sector, thus forming a closed and internally consistent system. Bilateral exposure data are available for listed shares and investment fund shares/units, two out of the three instruments used to shape the network employed in the contagion analysis. The third instrument (unlisted shares) is not covered in the "who-to-whom" accounts, and the matrix for this can be estimated based on the distribution of holdings of listed shares.

The spillovers arise from the holdings of bank equity. In the first round, the market value of bank equity decreases as the banking sector recognises losses under the adverse scenario. We assume that price-to-book ratios remain unchanged. This means that, if a sector experiences an adverse shock to the book value of its equity, this loss of equity value is transmitted, through mark-to-market accounting, to those sectors that hold the equity on the asset side of their balance sheets.[11] In turn, the shareholders of sectors affected in the second round would pass the losses on to their shareholders, and the propagation would continue until the incremental spillovers in the subsequent round became negligible.

Non-bank financial institutions, in particular investment funds and pension funds, are most strongly affected by the equity shock to the banking sector (see **Figure 5**). They may lose up to around 10% of the total value of their financial assets at the euro area aggregate level. Households and non-financial corporations are less severely affected.

6 Conclusions

Supervisory stress testing exercises, such as the EU-wide bank stress testing exercise, may not be able to cover important effects related to the changing credit needs of the EU economy and to idiosyncratic bank responses to changing conditions and adjusted capital targets.

[11] See Castrén, O. and Kavonius, I. K., "Balance sheet and interlinkages and macro-financial risk analysis in the euro area", *Working Paper Series*, No 1124, ECB, Frankfurt am Main, December 2009.

This article outlines a conceptual framework for capturing these effects. If the static balance sheet assumption is relaxed and credit aggregates are allowed to follow the path implied by macroeconomic developments, banks' vulnerability may increase compared with the static balance sheet case. This deterioration may be exacerbated by bank-specific deleveraging initiated by weaker banks that aim to comply with a self-imposed capital target under stress. Such behaviour may be enforced by market discipline. Contagion and cross-sector spillovers, as well as feedback loops between solvency and liquidity, may further amplify the impact on the banks.

It is therefore important to steer banks in need of adjustments towards a response that would be less damaging to the economy and that would not be partially self-defeating. In the longer run, macroprudential capital buffers – and especially countercyclical buffers that are raised during economic expansions and drawn down during downturns – would be a very useful instrument, allowing the macroprudential authority to cushion the shock if an adverse scenario were to materialise.

Chapter 2 - Macroprudential policy analysis and tools[12] - Monitoring euro area banks' risk weight developments[13]

While risk-taking by financial institutions can foster the intermediation needed to support economic recovery, if excessive it can lead to the build-up of financial imbalances, especially in a low yield environment where institutions struggle to boost their profitability. To ensure that macroprudential policy measures are effective in preserving financial stability, the regular monitoring of financial institutions' risk-taking behaviour is required. By using detailed bank-level information on SSM significant institutions' asset developments in the last year, this analysis shows that, at the current juncture, banks are de-risking and reshuffling their portfolios towards safer assets. Evidence of de-risking is identified in the reduction in average risk weights and the shift towards exposures with lower PDs.

1 Purpose of the analysis

Risk-taking of financial institutions is a standard element of financial intermediation. When excessive and/or widespread, however, risk-taking by financial institutions can fuel asset price booms and leverage cycles that eventually lead to the build-up of financial imbalances, increasing the risk of financial crises.[14] This concern becomes increasingly relevant in a low yield environment where institutions struggle to boost their profitability, in the face of demanding return-on-equity targets. Macroprudential policy measures may in this context be used to prevent the building-up of excessive risk-taking.[15]

Risk-taking is typically not directly observable and hence may have to be inferred from a variety of quantitative and qualitative information sets. This article presents an

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12 This chapter provides some examples of the analytical tools used by the ECB for its macroprudential policy. It should be noted that the results provided in the Macroprudential Bulletin should not be interpreted as an indication of the final ECB view on national macroprudential measures, as the ECB uses several tools for its assessment.

13 Prepared by M. Caccavaio, C. Rodriguez d´Acri.

14 See, e.g., Acharya, V. and Naqvi, H., 2012, "The seeds of a crisis: A theory of bank liquidity and risk-taking over the business cycle", Journal of Financial Economics volume 106, issue 2, 349–366; Adrian, T. and Shin, H., 2009, "Financial intermediaries and monetary economics", Federal Reserve Bank of New York Staff Reports 398; Adrian, T. and Shin, H., 2010, "Liquidity and Leverage", Journal of Financial Intermediation 19, 418-437; Borio, C. and Zhu, H., 2008, "Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism", BIS Working Papers 268; Geanakoplos, J., 2009, "The Leverage Cycle", NBER Macroeconomics Annual 2009 24, 1-65.

15 For a discussion of interactions between monetary and macroprudential policies in a monetary union, see Draghi, M., "Hearing at the European Parliament's Economic and Monetary Affairs Committee", speech, Brussels, March 2015; Constâncio, V., "Financial stability risks, monetary policy and the need for macroprudential policy", speech at the Warwick Economics Summit, February 2015; and special feature article "Quantifying the policy mix in a monetary union with national macroprudential policies" in the November 2015 Financial Stability Review.

analytical approach that – using supervisory data – may help gauge developments in SSM significant institutions' risk appetite and behaviour.

Regulatory reporting offers one window through which economic risk-taking can be evaluated. Specifically, by monitoring the relative contribution of changes in risk-weighted assets (RWAs) and total assets (TAs), and by resorting to sectoral portfolio data, it is possible to interpret the dynamics in risk weights (RWs, the ratio of RWAs to TAs) for the significant institutions (SIs) under the direct supervision of the ECB. While the main focus of this approach is to identify cases where banks may have expanded into riskier activities, it is also used to investigate cases where average RWs have decreased. This is to distinguish between reductions in RWs which result from a shift to safer portfolios from reductions which are driven by the increasing reliance of banks on the Internal Rating-Based (IRB) approach which, under some circumstances, might reflect an under-pricing of risk.[16]

2 Description of the analysis

Decomposing the changes in average risk weights helps shed light on banks' risk-taking behaviour. Movements in banks' TAs which are not commensurate with changes in their respective RWAs allow portfolios to be identified where banks may be taking risks that are not adequately priced. In practice, the analysis focuses on (i) the credit risk component of banks' portfolios, as this constitutes the main part of banks' RWAs,[17] and (ii) the credit portfolio under the IRB approach, which can account for more than 80% of the total credit risk of SSM SIs.

For a more in-depth analysis of cases where RW adjustments are larger (smaller) than those observed for the whole distribution of banks, and the contributions of RWAs and TAs are not commensurate with each other, resort is made to granular information on obligor grade RWs and probabilities of default (PDs).

Formally, the change in the average risk weights (RW = RWA/TA) between period t and t-1 can be quantified by using a "shift-share" analysis,[18] as follows:

$$\Delta RW_t = \frac{RWA_t}{TA_t} - \frac{RWA_{t-1}}{TA_{t-1}} =$$

$$= \frac{RWA_t - RWA_{t-1}}{TA_{t-1}} + RWA_{t-1}\left(\frac{1}{TA_t} - \frac{1}{TA_{t-1}}\right) + (RWA_t - RWA_{t-1})\left(\frac{1}{TA_t} - \frac{1}{TA_{t-1}}\right) \quad (1)$$

16 It is important to note that the BIS is currently performing a review of internal model approaches to reduce the variation in credit risk weighted assets across banks (http://www.bis.org/bcbs/publ/d362.htm). This and other studies have flagged that RW variation can be attributed to a lack of data leading to the inaccurate assessment of default rates and model parameters. Indeed, the IRB approach opens the door to intentional and unintentional under-pricing of risk and therefore requires intense micro-prudential scrutiny. Moreover Behn et al. (2016) document that the risk-based approaches underlying capital requirements for the IRB banks may have led to an under-pricing of default risk; see Behn, M., Haselmann, R.F.H. and Vig, V., 2016, "The limits of model-based regulation", ECB Working Paper No. 1928.

17 While an important proviso of this approach is that the focus is solely on the credit risk portfolio of SSM banks, possibly underestimating the importance of non-credit risk portfolios, credit risk is clearly of material importance to euro area institutions.

18 See Dunn, E.S. (1960), "A statistical and analytical technique for regional analysis", Papers of the Regional Science Association, vol. 6, pp. 97-112.

where $\frac{RWA_t - RWA_{t-1}}{TA_{t-1}}$ is the so-called "RWA contribution" and $RWA_{t-1}\left(\frac{1}{TA_t} - \frac{1}{TA_{t-1}}\right)$ is the so-called "TA contribution"; the residual component is defined by $(RWA_t - RWA_{t-1})\left(\frac{1}{TA_t} - \frac{1}{TA_{t-1}}\right)$ and since it is insignificant it is not reported in the charts. Having applied the above decomposition to banks' aggregated credit risk portfolio, the approach is used to separately identify those contributions emerging from portfolios rated using the standardised or the IRB approach.[19]

3 Illustrative results

It is useful to recall that in the euro area banking sector between 2008 and 2015 leverage ratios declined (with the ratio of tangible assets to tangible common equity falling from 44 to 22), capital ratios increased (with CET1 increasing from 7% to 13%), and average risk weights decreased (from 37% to 34%).[20] For the more granular analysis presented below, data limitations only allow analysis of the dynamics of RWs for SSM banks between Q4 2014 and Q4 2015.

The results of the above decomposition are shown in Chart 1 with negative changes indicating a contribution to the decline of RWs and positive changes indicating a contribution to their increase. In other words, a negative change denotes a contraction in RWs, resulting from either a reduction in RWAs or an increase in assets, or a combination of both; a positive change, by contrast, is the result of either higher RWAs or lower assets, or both.

At the SSM area level, a reduction in RWs of 0.45 percentage points (from 33.37% to 32.92%) was observed. The RW reduction reflected an increase in TAs that more than offset the RWA increase. It was primarily driven by G-SIBs which reduced their average RW by 0.59 percentage point. Minor changes in average RW are observed for O-SIIs, while smaller banks reduced their average RW by 0.97 percentage point by means of an RWA reduction that more than offset the decrease of TAs. This means that, for non-systemic institutions, the reduction in RWs reflected a process of deleveraging.

Turning to the country level, RWs decreased in the majority of the countries examined. Very heterogeneous country-specific adjustment paths were observed, however; with only few SSM countries experiencing material changes to average RWs (e.g. +/- 2 percentage points). Only in a few countries (Greece and Ireland) did average RWs increase in 2015, on the back of strong reductions in TAs. In those

19 Formally the analysis is done by reapplying equation (1) and subdividing the overall effects in order to directly capture the contribution of changes in standardized approach (SA) and IRB portfolios the change in the Risk Weights over period *t* and *t-1* can be decomposed as follows:

RWA contribution: $\frac{RWA_t - RWA_{t-1}}{TA_{t-1}} = \frac{RWA_t^{IRB} - RWA_{t-1}^{IRB}}{TA_{t-1}} + \frac{RWA_t^{SA} - RWA_{t-1}^{SA}}{TA_{t-1}}$

Total asset contribution: $RWA_{t-1}\left(\frac{1}{TA_t} - \frac{1}{TA_{t-1}}\right) = \frac{RWA_{t-1}}{TA_t TA_{t-1}}(TA_{t-1}^{IRB} - TA_t^{IRB}) + \frac{RWA_{t-1}}{TA_t TA_{t-1}}(TA_{t-1}^{SA} - TA_t^{SA})$

20 Data are from SNL Financial and refer to the sample of SSM Significant Institutions.

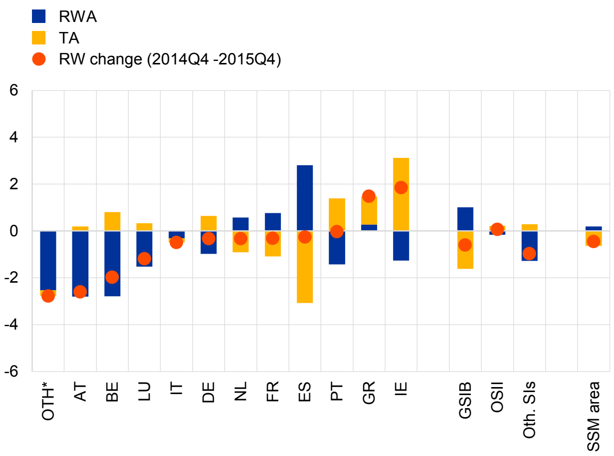
countries where average RWs declined the most, changes were primarily driven by lower RWAs.

Chart 1

Decomposition of the changes in RWs of significant SSM banks

Change in and contribution to changes in risk weights in significant SSM banks' credit risk portfolios

(Q4 2014 - Q4 2015, percentage points)



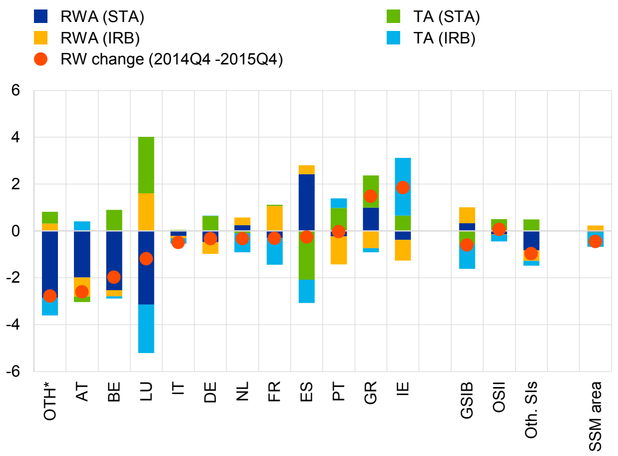
Sources: ECB.
Note: OTH includes Cyprus, Estonia, Finland, Latvia, Malta, Slovenia and Slovakia. The OSII sample excludes entities classified as GSIBs. An increase in TA results in a reduction in risk weights and is therefore captured by a negative bar. An increase in RWA instead results in an increase in risk weights, captured by a positive bar.

Chart 2

Decomposition of the changes in RWs of significant SSM banks disentangling the effect of IRB and STA adjustments

Change in and contribution to changes in risk weights in significant SSM banks' credit risk portfolio

(Q4 2014 - Q4 2015, percentage points)



Sources: ECB.
Note: OTH includes Cyprus, Estonia, Finland, Latvia, Malta, Slovenia and Slovakia. The OSII sample excludes entities classified as GSIBs. An increase in TA results in a reduction in risk weights and is therefore captured by a negative bar. An increase in RWA instead results in an increase in risk weights, captured by a positive bar.

Disentangling the effects of IRB and standardised (STA) portfolio adjustments shows that, for the aggregate of significant institutions, the bulk of the changes were attributed to the RWA and TA evolution of the IRB portfolios. The reduction of average RWs mainly reflected an increase in IRB assets that more than offset the corresponding increase in IRB RWAs (Chart 2). All banks increased their IRB assets. However, while G-SIBs also increased their standardised exposures, non G-SIBs decreased them.

The main drivers behind the increase in total assets appear to have been: (i) an increase of loans to the non-financial private sector (two-thirds of which went to households for house purchase); (ii) an increase of exposures to the general government sector and; (iii) a reduction in interbank loans. While it is difficult to assess a priori whether the observed portfolio reshuffling was consistent with a shift to safer assets, the reallocation was mainly directed towards those categories that require less (regulatory) capital, such as general government securities and residential mortgages.[21]

[21] While it cannot be ruled out that the regulatory risk weights applied to these exposures may underestimate the credit risk of the portfolio, the lack of information about the underlying borrower characteristics means that the true creditworthiness of the borrowers cannot be assessed and "safer assets" de facto refer to exposures with lower regulatory risk weights.

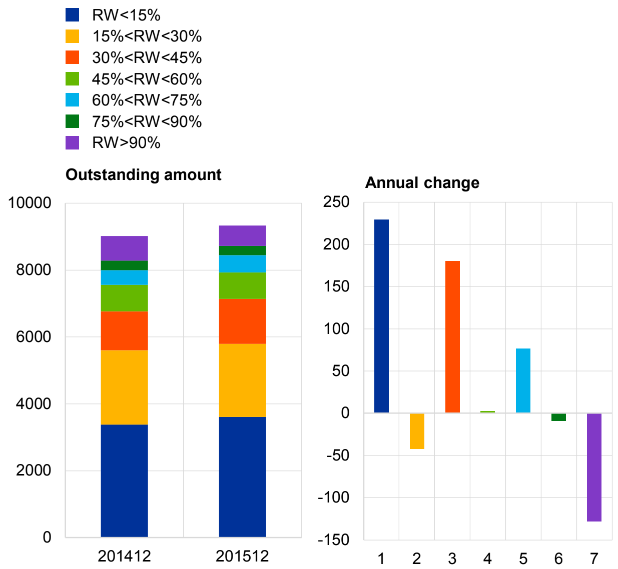
A more granular look at banks' IRB portfolio shifts confirms the overall de-risking trend. The within-portfolio movements between riskier and safer exposures can be analysed by looking at the average risk weights and PDs of banks' exposures broken down by obligor grades.[22] Banks report information on their IRB exposures on the basis of "obligor grades" or "pools" which are used to group exposures on the basis of the risk of obligor default (Chart 3, left-hand panel). By looking at the change in volumes reported in such classes, it appears that significant SSM banks decreased their holdings of the riskiest exposures (e.g. those with RWs higher than 90%) and increased those with lower risk weights (Chart 3, right-hand panel). This message is furthermore confirmed when SSM banks' exposures are analysed by PD category (Chart 4): exposures to borrowers with lower PDs increased while those to borrowers with greater PDs decreased.

Chart 3

SSM banks decreased their holdings of the riskiest exposures and increased those with lower risk weights

Breakdown of assets by RW and by obligor grade categories for IRB reporting institutions

(annual change Q4 2014 - Q4 2015; EUR billions)



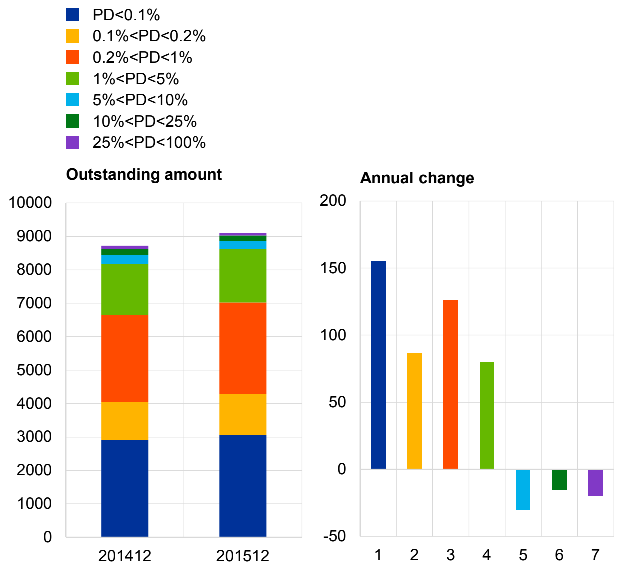
Source: ECB.

Chart 4

SSM banks decreased their holdings of the riskiest exposures and increased those with lower probabilities of default

Breakdown of assets by PD and by obligor grade categories for IRB reporting institutions

(annual change Q4 2014 - Q4 2015; EUR billions)



Source: ECB.

Almost all banking systems reduced those exposures classified as "riskier", with the shift being most pronounced in France, Spain, Germany and Italy. In a few countries (Belgium, Ireland and Luxembourg), exposures in the high RW grades increased, albeit by less than the observed increases in exposures in the lower RW grades. This trend can also be seen when looking at more granular sectoral breakdowns: exposures to corporates (excluding SMEs and specialised lending) with the lowest RW grades increased in nearly all countries, while those to corporates with high

[22] An important proviso is that while the obligor-grade analysis is informative about portfolio flows, it does not determine precisely whether the observed changes in volumes of risk weighted assets are due to adjustments of the underlying IRB models, actual portfolio reshuffling or just credit risk migration.

RWs largely decreased. While the reduction in riskier exposures has been particularly pronounced for the G-SIBs, it was also observed for smaller banks.

The reduction in RWs might have been driven by many banks rebalancing their portfolios into this less capital intensive asset class away from potentially riskier (and more capital intensive) assets. For instance, the monitoring of selected exposure classes suggests that overall the change in average risk weights has been strongly influenced by changes in sovereign exposures.[23] At the same time, the extent to which increased sovereign exposures may harbour excessive concentration risk also depends on how diversified sovereign portfolios are across different counterparts. SSM banks' exposure towards euro area sovereigns, as a share of total sovereign exposure, has remained unchanged. Nevertheless, banks' relative exposures towards their domestic sovereigns, as a share of their total sovereign exposures, decreased in seven SSM countries (most notably in Ireland, Italy and Portugal) and increased in ten (most notably in Luxembourg and the Netherlands), suggesting that a reallocation of sovereign exposures across SSM countries is ongoing.

3.1 The granular analysis: risk weight adjustments in individual institutions

Turning to the most granular level of analysis, the bank entity, very heterogeneous bank-specific adjustment paths emerge; these are documented by means of a scatterplot chart (Chart 5). In line with a "shift share" analysis representation, the dots positioned below the red diagonal refer to institutions that reduced their RWs, while the ones positioned above, increased them: between 2014 and 2015, 52% of significant banks decreased their RWs. While the magnitude of the change in RWs, captured by the distance from the red diagonal, is below 1% in almost all cases, we observe a substantial dispersion across banks.

Most banks appear to have reduced both assets and RWAs, suggesting that a process of deleveraging is still ongoing for these institutions (segments D and E of Charts 5 and 6). The small share (12%) of banks that increased their RWs, despite having seen a reduction in their total assets, did so by reducing their general government portfolio (segments G and F of Charts 5 and 6).

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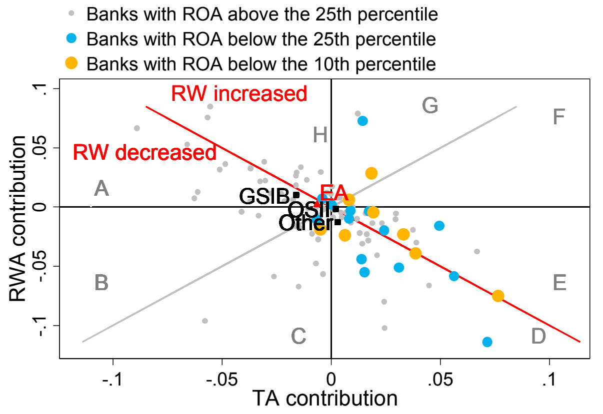
23 European banking regulation grants preferential treatment to banks' exposures to sovereign entities of advanced economies, setting a virtually nil capital requirement for their credit risk and exempting them from the rules on concentration risk. The BCBS is currently undertaking a review of the regulatory standards for the prudential treatment of banks' exposures to sovereigns.

Chart 5

Banks with lower ROA are decreasing both assets and RWAs

Contribution to changes in risk weights in SI's credit risk portfolios by ROA

(annual change Q4 2014 - Q4 2015; ROA Q4 2014)



Specifically, the eight segments capture:

Risk weights decreased:
A = asset increase more than offsetting RWA increase
B = asset increase and RWA reduction (asset increase prevails)
C = RWA reduction and asset increase (RWA reduction prevails)
D = RWA reduction more than offsetting asset reduction

Risk weights increased:
E = asset reduction more than offsetting RWA reduction
F = asset reduction and RWA increase (asset reduction prevails)
G= RWA increase and asset reduction (RWA increase prevails)
H = RWA increase more than the offsetting asset increase

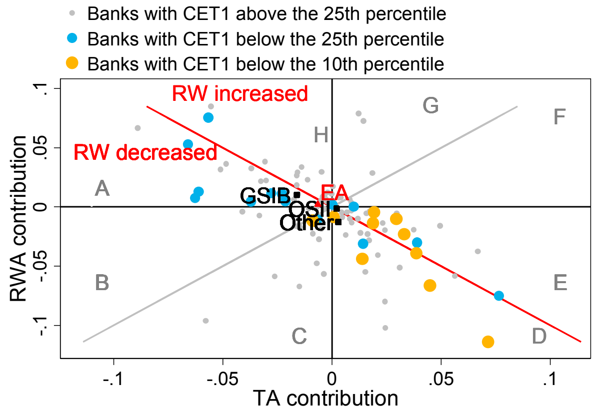
Sources: ECB.
Note: Banks are classified on the basis of their ROA in the fourth quarter of 2014.

Chart 6

Banks with lower CET1 ratio are decreasing both assets and RWAs

Contribution to changes in risk weights in SI's credit risk portfolios by CET 1 ratio

(annual change Q4 2014 - Q4 2015; CET1 ratio Q4 2014)



Specifically, the eight segments capture:

Risk weights decreased:
A = asset increase more than offsetting RWA increase
B = asset increase and RWA reduction (asset increase prevails)
C = RWA reduction and asset increase (RWA reduction prevails)
D = RWA reduction more than offsetting asset reduction

Risk weights increased:
E = asset reduction more than offsetting RWA reduction
F = asset reduction and RWA increase (asset reduction prevails)
G= RWA increase and asset reduction (RWA increase prevails)
H = RWA increase more than the offsetting asset increase

Sources: ECB.
Note: Banks are classified on the basis of their CET1 ratio in the fourth quarter of 2014.

Finally it is tested whether a correlation might exist between the changes in RWs and the level of capital and profitability of individual banks (observed at time t-1 to reduce endogeneity concerns). Banks with a return on assets (ROA) and CET1 ratio below the 25th (10th) percentile at the end of the 2014 are highlighted in light blue (orange) (Charts 5 and 6). The mapping of RWs and ROA adjustments show that banks with lower ROA (orange and light blue) are located in those sections of the graph where a de-risking process is identified (bottom right segment). A similar consideration applies for banks with lower initial levels of capital, even if this is limited to banks in the lower decile of the CET1 distribution. As for SSM SIs that increased their RW (e.g. dots positioned above the red diagonal) there is no overlapping with banks with lower ROA and CET1, so there is no evidence that the increase in RWs was triggered by the need to boost profit and to adjust balance sheets.

Chapter 3 - Macroprudential regulatory issues

High-frequency Trading, Market Volatility, and Regulation: The Role of High-frequency Quoting and Dark Pools[24]

This article considers the impact of new developments in financial markets related to the growth of high-frequency trading on market volatility and resilience to shocks, highlighting the analysis in two recent ECB research products. The first research item investigates the role of high-frequency quoting – which serves as a source of information on current market developments available in real-time to all traders – as a channel through which high-frequency traders impact market volatility, using the foreign exchange market as a case study. [25] *It finds that while in normal times, high-frequency quoting contributes to improved price discovery and reduced price volatility, in times of unusually high volatility it instead amplifies the reaction of exchange rates. This suggests high-frequency quoting may reduce market resilience to shocks. The second research item explores the relationship between trading on dark pools – venues with limited pre-trade transparency, which emerged in part as a reaction to the proliferation of high-frequency trading – and volatility*[26] *The analysis finds that higher levels of dark pool trading are associated with lower price volatility, suggesting dark pools do not amplify market reactions to shocks. The two research items confirm that the emergence of new players and venues in financial markets has implications for market volatility both in normal times and in times of stress, bringing a new perspective on regulation of high-frequency trading activities. Further regulatory constraints on high-frequency trading practices and on the use of dark pools would first warrant a careful investigation of the implications for market resilience.*

1 The increasingly important role of algorithmic and high-frequency trading

Many activities which fall under the category of algorithmic trading share similar financial stability consequences and, accordingly, motivate similar policy needs. At

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[24] Drafted by Romain Lafarguette, with inputs from Monica Petrescu and Michael Wedow.

[25] Lafarguette, Romain (2016), "How High-Frequency Traders Impact Financial Markets? Financial Stability and Regulatory Implications of High-Frequency Quoting", ECB mimeo

[26] Petrescu, M, Wedow, M. & Lari, N. "Do dark pools amplify volatility in times of stress?" Applied Economics Letters, March 2016.

the same time, it is important to: (i) clearly distinguish between algorithmic trading and high-frequency trading (HFT); as well as (ii) to clearly demarcate between different high-frequency trading strategies. MiFID II defines algorithmic trading as "trading in financial instruments where a computer algorithm automatically determines individual parameters of orders such as whether to initiate the order, the timing, price or quantity of the order or how to manage the order after its submission, with limited or no human intervention, and does not include any system that is only used for the purpose of routing orders to one or more trading venues or for the processing of orders involving no determination of any trading parameters or for the confirmation of orders or the post-trade processing of executed transactions".[27]

High-frequency trading represents one specific yet important form of algorithmic trading. MIFID II defines HFT as an algorithmic trading technique that is characterised by: (a) infrastructure intended to minimise network and other types of latencies, including at least one of the following facilities for algorithmic order entry: co-location, proximity hosting or high-speed direct electronic access; (b) system-determination of order initiation, generation, routing or execution without human intervention for individual trades or orders and; (c) high message intraday rates which constitute orders, quotes or cancellations.[28] Depending on the target function of the algorithm (i.e. the trading strategy), HFT may cause very heterogeneous externalities (both positive and negative) for different groups of lower-frequency market participants. HFT strategies are manifold, may be active (i.e. "predatory") or passive in nature and involve the timely incorporation of new information or the exploitation of statistical arbitrage opportunities (usually across different markets).

Technical infrastructure and trading conventions are crucial features of markets, which, depending on their design, can eliminate or intensify high-frequency trading. The existence of automated electronic trading platforms and standardised products are essential preconditions for the evolution of HFT. For that reason, some financial market segments are particularly suited to HFT, while others are unsuited to accommodating HFT. The characteristics of the global foreign exchange market, the US Treasury market and certain equity and commodity futures markets meet these requirements, resulting in high penetration of HFT. In contrast, request-for-quote protocols and manual processes, like in euro area corporate bond and government bond markets, a consequence of the low degree of standardisation of bonds, prevent automated trading strategies. The TABB Group estimates that in 2010 HFT already represented 56% of trading volumes in US equity markets, 38% in European equity markets and 10-30% in Asia-Pacific equity markets.[29] For foreign exchange markets, the BIS estimates HFT turnover to account for 24-30% of the spot market turnover.[30] The BIS further estimates that more than 50% of trading volume in benchmark US

[27] MiFID II, Article 4(1)(39).

[28] MiFID II, Article 4(1)(40).

[29] See TABB Group (2010), "High Frequency Trading Report", technical report.

[30] Bank for International Settlements (2011), "Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity in 2010", BIS report, pp. 1-96.

Treasury bonds can be associated with HFT. European bond markets are believed to be less exposed to HFT.[31]

2 How High-Frequency Traders Impact Financial Markets? Financial Stability and Regulatory Implications of High-Frequency Quoting

The literature on fast and high-frequency trading has so far focused mostly on the impact of HFT on liquidity provision, market efficiency and price discovery, while limited work has been carried out to understand the way high-frequency trading alters information processing on financial markets.[32] A recent study by Lafarguette (2016) fills this gap and studies how fast traders[33] impact the way information is processed in financial markets, and also how they impact market volatility. The paper focuses in particular on the role of high-frequency quoting in processing and creating new information; to do so, it provides a new conceptual framework and a new metric for measuring information available on the market at the high-frequency level.

Traders on the market can exploit the information contained in the pattern of high-frequency exchange rate quotes. Most of the existing literature relates fast and high-frequency trading to *quantity* measures of market microstructure features (e.g. order flows, liquidity provision, price impact, order cancellations, etc.). The above-mentioned study shows that the *pattern* of exchange rate quotes is an important source of information too. The author operationalises this information by measuring the Shannon entropy[34] of high frequency exchange rate quotes. The Shannon entropy of a statistical distribution is a representation of the countable information it contains. It identifies distributions exhibiting a regular statistical pattern, i.e. those with redundant information.[35] Lafarguette (2016) shows that entropy of exchange rate quotes is positively correlated with exchange rate trading returns. This confirms that entropy captures relevant information for traders, which they can trade on. The

31 See Bank for International Settlements (2015), “Electronic Trading in Fixed Income Markets”, BIS Markets Committee Report, pp. 1-45.

32 A central tenet is that fast trading might be beneficial, for example, by providing market making services as in Brogaard et al. (2015). Latza et al. (2014) find that fast trades are associated with smaller execution costs than slow trades. Jiang et al. (2014) investigate high-frequency market and limit orders in the U.S. Treasury bond market around major macroeconomic news announcements and show that high-frequency traders have a negative effect on liquidity around announcements.

33 Note that fast trades are a subset of algorithmic-generated trades and only partially overlap with high-frequency trades. HFT covers a wide range of strategies that go beyond executing quotes faster, for instance cancelling a large number of quotes or arbitraging different electronic platforms at very low frequencies.

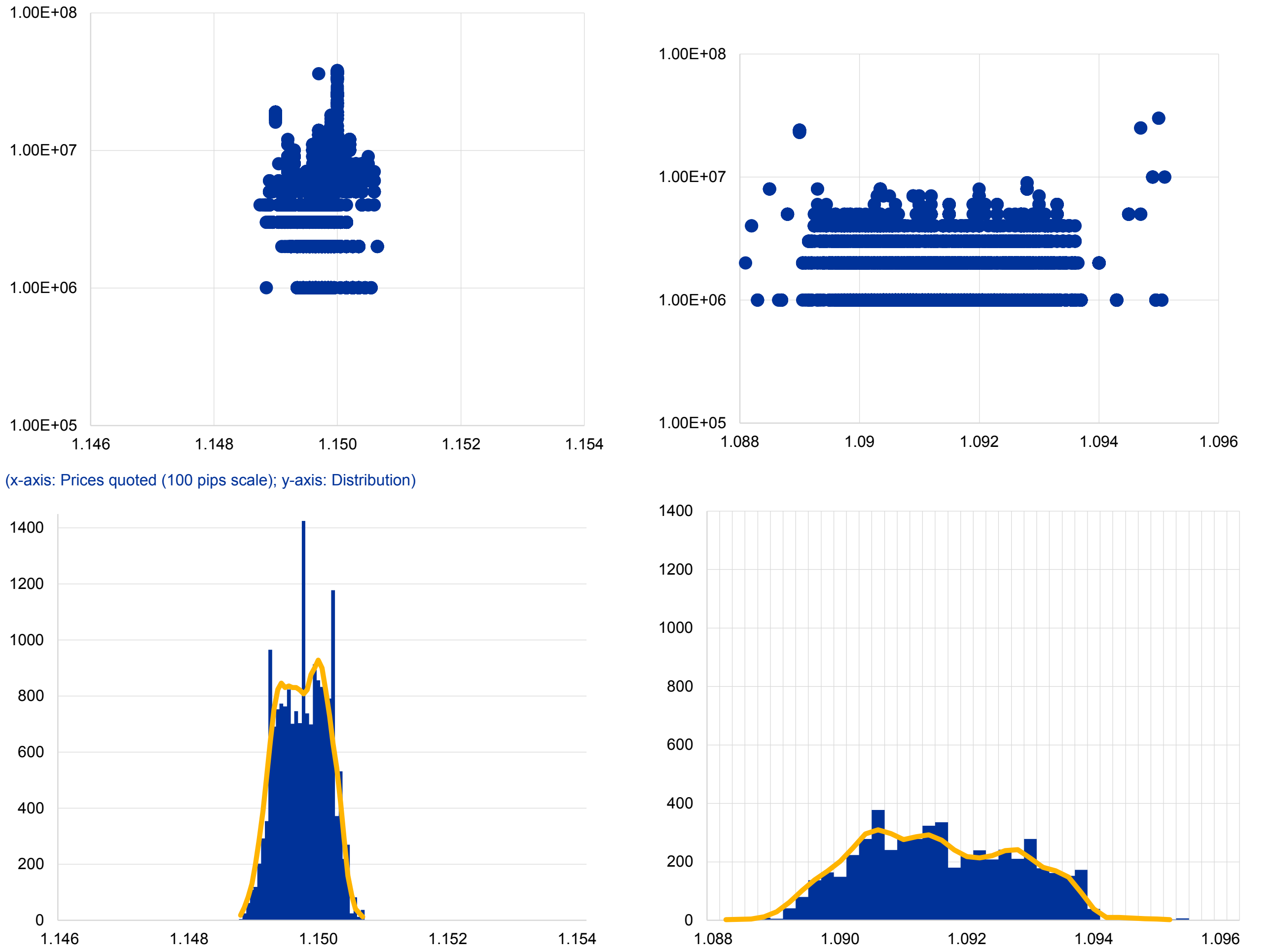
34 See Shannon, Claude and Warren Weaver (1949), “The Mathematical Theory of Communication”, University of Illinois Press.

35 The concept of entropy was originally used by physicists and mentioned for the first time in 1865 by German physicist Rudolf Clausius. It has also been used in information theory, computer science and, more recently, in economics and in finance. Finance researchers have used it to define new portfolio selection and asset pricing strategies – in particular for options – by defining optimisation procedures based, for instance, on the Principle of Maximum Entropy or, in the same vein, on the Minimum Cross-Entropy Principle (see Zhou et al. (2013) for a review). To our best knowledge, the concept of entropy has not so far been used to characterise information sources available at a high frequency, or trading strategies and trader types.

more information available, the more trading opportunities and therefore the more exchange rates react.

Figure 1
Entropy and Quoting Patterns: EUR/USD Case Study

(x-axis: Prices quoted (100 pips scale); y-axis: Volumes quoted (log scale))



Source: Analysis from Lafarguette (2016) based on EBS trading data.

High-frequency traders reduce the entropy of the quotes insofar as they use algorithms to generate their orders and hence create systematic statistical patterns in quotes. In so doing, fast traders impoverish the market information available to all other participants. This mechanism is explained in Figure 1. Using EBS high-frequency data (100ms), the author is able to identify the share of fast trades[36] on the market at a given point in time and investigate how the share of high-frequency traders impacts entropy and quoting patterns. Figure 1 presents a case study of two EUR/USD quote patterns during active trading hours, the first one with low entropy and a high share of fast trading and the second one with high entropy and a low share of fast trading. Both exchange rate quote distributions are sampled at the one-

[36] Using the methodology of Latza et al. (2014), the author identifies fast trades as trades hitting limit orders within 100 milliseconds.

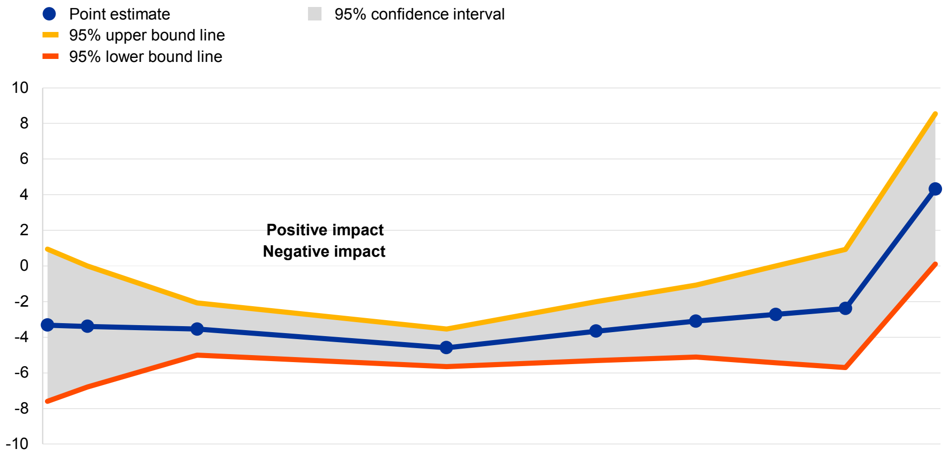
minute frequency immediately after news announcements and contain a similar number of observations (around 7,000). The upper charts present a scatter plot of the prices and volumes quoted, while the lower charts display the distribution of prices. The distribution associated with low entropy and a high share of fast trading is massively concentrated around few values, located in an interval no larger than 10 pips. By contrast, the high entropy distribution associated with a low share of fast trading activity is much more spread out and less concentrated around few price levels.

Fast traders contribute to dampen market reactions during normal times but significantly amplify them during crisis times. The paper shows that a 10 percentage point increase in the share of fast trading dampens median exchange rate volatility by around 4.5%, precisely because fast traders reduce the entropy available, and thus the information available for trading. However, by considering the top first percentile of the exchange rate distribution, the authors find that the impact of fast trading is positive and significant: a 10 percentage point increase in the share of fast trading on the market amplifies exchange rate returns by 4.2%. The results estimated quantile by quantile are presented in Figure 2. At exceptionally high levels of market reaction, fast traders no longer cope with the unusually large amount of information generated by high-frequency quoting and instead contribute to amplify the reaction of exchange rates to economic news. This suggests that high-frequency quoting becomes increasingly erratic in times of high volatility, hence adding to traders' confusion and reducing market resilience to shocks. The results hold when controlling for liquidity and other market microstructure measures, which suggests that the information channel is important and distinct from the other quantity-based channels investigated in the literature (high-frequency market making, liquidity provision, etc.).

Figure 2

Impact of Fast Trading on Different Quantiles of the Absolute Log-Returns Distribution

(x-axis: Percentile of the absolute log-returns distribution; y-axis: Marginal impact of a a10 p.p. increase in fast trading (%))



Source: Analysis from Lafarguette (2016) based on EBS trading data.

3 Avoiding HFT: trading in Dark Pools

The trading strategies of high-frequency traders can encourage institutional investors and other non-HFT traders to seek alternatives to traditional exchanges where high-frequency traders may be operating. For example, investors placing large orders traditionally used special order types so that only part of the volume was displayed in the orderbook, to avoid other traders taking advantage, but now high-frequency traders use pinging – sending out many very small orders for execution – to detect hidden liquidity and trade against it. Some traditional exchanges even “flash” information about supply and demand of orders to HFT traders for a fraction of a second before the information becomes public, enabling HFT to use their latency advantage and trade ahead of other orders. Thus, investors with large orders increasingly prefer “dark pools’, venues with limited pre-trade transparency and additional restrictions to protect against information leakage.

Dark order books, or dark pools, are venues that use pre-trade transparency waivers, as well as additional restrictions on order placement and matching, to protect clients from predatory practices (particularly those of high-frequency traders). As the price and volume of orders are not disclosed pre-trade like in a traditional order book, investors can place orders without revealing trading intent, which could otherwise allow others to take advantage. Unlike traditional exchanges where order placement and execution are strictly regulated, dark pools implement various types of rules to provide additional protection to participants. Orders on dark pools are usually matched and executed at an external reference price, so the price of the order does not depend on the available depth (reducing the market impact of large orders). Some dark pools allow only basic order types, limiting predatory practices based on the use of complex orders, and some dark pools explicitly restrict the participation of HFT traders. Other dark pools only accept orders above a certain size, significantly reducing the presence of HFT.[37] Also some dark pools do not execute orders immediately, but gather liquidity before orders are matched, eliminating the speed advantage of HFT. While dark pools are often a first choice venue for large investors, the probability and speed of execution depends on whether a matching order can be found.[38] Moreover, because the operation of these venues is opaque and not regulated, there can be no certainty operators abide by promised terms.[39]

Dark pools expanded in Europe after the implementation of MiFID, which lifted restrictions on platforms used for equity trading and led to the proliferation of new venues to appeal to various market participants. The growth of FTSE100 stocks traded on dark pools is presented in Figure 3.

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[37] HFT generally occurs in small share lots to gain information.

[38] For a more detailed description of dark pool participation, see Vaananen, J. “Dark Pools & High Frequency Trading for Dummies”. John Wiley & Sons, 2015.

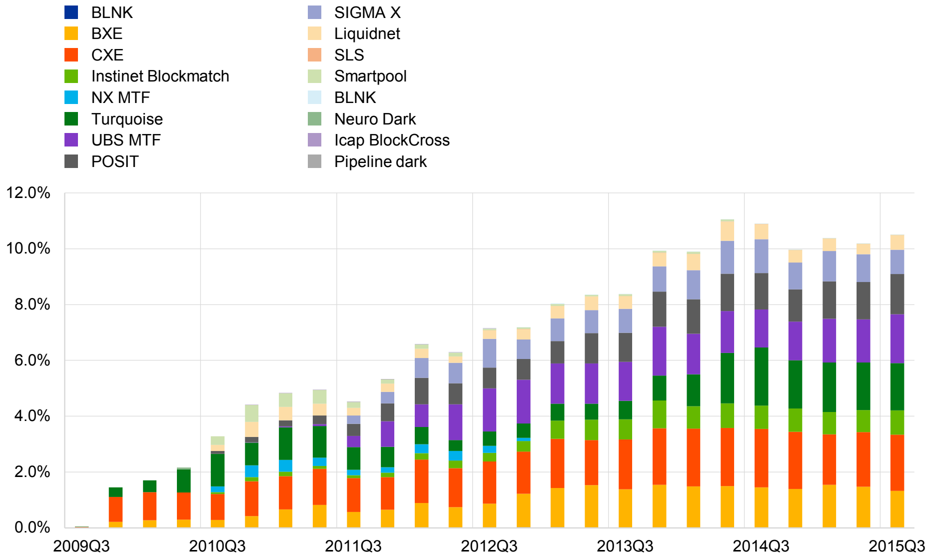
[39] In the United States there has been extensive litigation against several dark pool operators which broke promises to clients, including cases where operators allowed HFT in dark pools .

Petrescu et al. (2016) explore the relationship between trading on dark pools and volatility.[40] While dark pools do not contribute to price formation directly, they can affect price volatility by changing the distribution of the liquidity provided by different types of market participants (investors and HFT traders) across venues. The authors find that the overall effect of dark pool trading on volatility is negative and statistically significant, and the relationship is non-linear: the larger the growth in dark pool market share, the larger the fall in volatility. The authors also find that higher volatility has a negative and significant – but small – effect on the market share of dark pools. This suggests that at times of uncertainty investors are more likely to seek the higher probability and immediacy of execution on lit venues.

Figure 3

Quarterly share of FTSE100 stocks traded on dark pools, 2009-2015

The value of FTSE100 equities traded in select dark pools as a share of value traded in all venues, aggregated at the quarterly level



Source: Analysis from Petrescu et al. (2016), based on BATS Global Markets data.

These results can be seen as evidence against the hypothesis that use of dark pools leads to higher volatility. Despite the possibility that the increased predominance of HFT on lit venues and the increased preference of institutional investors for dark pools could lead to more 'phantom liquidity' on lit venues, which disappears at times of stress, from the empirical analysis it appears unlikely that the prevalence of dark pools amplifies market shocks. The negative relationship observed between dark pools and volatility is supported by theoretical models based on asymmetric information.[41] Because informed traders prefer lit venues offering faster execution,

[40] This is the first empirical study to analyse this relationship in depth, particularly in the context of the potential of dark pools to contribute to instability. Some studies include volatility among several possible determinants of dark pool trading. For US stocks, Ready (2010) finds that orders of stocks with more price volatility are more likely to be routed to dark pools. In contrast, Buti, Rindi, and Werner (2010) find that, for a single stock, dark pool market share is higher on days with lower volatility. In Europe, where the growth of dark pools is more recent, Gomber et al. (2015) find no significant effect of volatility on the share of trading in dark pools for French and German stocks.

[41] See Zhu, Haoxiang (2013) "Do dark pools harm price discovery?" Review of Financial Studies, 27 (3), pp. 747-789

while uninformed traders prefer dark pools to protect against adverse selection, the availability of dark pools leads to a concentration of better informed traders on lit exchanges, which improves price discovery by removing noise in demand and supply on lit venues in normal times. When there is substantial uncertainty or new information (and thus volatility), most informed traders would trade on lit venues, while uninformed traders would reduce their trading across venues to avoid adverse selection; as such, the share of dark pools overall would fall. Therefore, moderate use of dark pools may in normal times reduce volatility in price formation by removing noise due to uniformed traders, while the use of dark pools would likely decrease when market shocks occurred due to changes in expectations or fundamentals (with high levels of private information).

4 Regulatory perspectives

From a regulatory point of view, measures are available to mitigate the negative impact of high-frequency quoting. They broadly fall into the following three categories:

Emergency stop or kill switch: under certain conditions (for instance following erroneous trades or excessive trading volumes), exchanges can suspend an individual firm's trades, a single security trade or multiple securities trades. Such mechanisms can also be extended to suspend quotations in case of erratic quotes.

Quoting limitations on the trading platforms: these regulations include so-called message throttling, order-to-trade ratios and minimum exposure time. Message throttling is the setting of limits on the number of messages and connections that can be processed by trading platforms and they prevent trading firms from overloading the server with too many quotes and disrupting the system. However, these regulations are not designed to regulate high-frequency quoting per se and prevent market manipulation, but rather to preserve the stability of the IT infrastructure. Order-to-trade ratios have a narrower focus: they were implemented by Eurex in 2013 and "introduce limits on the volume of all order-entries (ordered volume) per product and per month generated by quotes sent by the market participants; at the end of the month, if the value of an order-to-trade ratio exceeds the threshold, such instance is considered to be a violation. Such a violation may trigger sanctions against the market participant".[42] This measure is specifically designed to limit the discrepancy between the inflation in quotes and the actual number of trades executed. Friedrich and Payne (2013) show that the implementation of the order-to-trade ratio on the Italian equity market has had somewhat mixed effects on market liquidity, with a deterioration in spread and liquidity on the largest shares (the most liquid), but no effect on the smallest ones. The overall negative effect is therefore limited. Finally, minimum exposure time requirements fix a minimum time limit below which submitted securities orders cannot be cancelled. By doing so, platforms force trading firms to commit to their quotes and prevent them posting bid or ask offers they do not intend to execute. This rule creates strong market discipline and

42 From http://www.eurexchange.com/exchange-en/technology/order-to-trade-ratio

prevents market manipulation, at the cost of higher risks for traders who might not be able to instantaneously adjust their quotes to market developments. However, a proper calibration of the time limit can mitigate this concern.

Ex-post cancellations: A large number of platforms[43] allow for a last-look option, which provides liquidity providers with the ability to reject a trade within a very short period of time. The last-look practice is a legacy of over-the-phone currency trading, when traders would take a final check of the market before executing an order. The purpose is to insure liquidity providers against the risk of being arbitraged in their market making activity. The advantage of the last-look option is to increase the liquidity provided, as market makers can avoid “toxic orders” and so provide more liquidity with tighter spreads. However, last-look options can also be used by some traders to ”test” the market without any real intention to trade, and ultimately to manipulate other traders. Because some market participants have significantly abused the last-look option for manipulation purposes in the past[44], Thomson Reuters and BATS decided in 2015 to restrict the last-look practice significantly, by imposing a maximum number of rejections and by shortening the time for cancellation.

Overall, regulations available to curb high-frequency quoting can easily be either implemented or strengthened at the platform level. Research about the impact of these measures is so far limited, and point to mixed effects on market liquidity and spread. It seems clear that careful calibration is needed in order to mitigate their negative consequences. Our results suggest that kill switch mechanisms should be generalised as they can prevent high-frequency quoting exacerbating liquidity issues in time of stress. In normal times, high-frequency quoting regulations should focus on strengthening the stability of the IT system (with message throttling for instance) but our results do not support more constraining regulations such as order-to-trade ratios or minimum exposure time. Overall, the policy message is to generalise the use of kill-switches and message throttling constraints at the platform level, and investigate carefully whether more constraining measures would be appropriate.

5 Conclusion

Fast traders, and in particular high-frequency traders, profoundly impact the financial market microstructure. Researchers have made significant progress over the last decade on disentangling and comprehending the different mechanisms at stake and their impact on financial markets. Recent research conducted at the ECB contributes to this research agenda by investigating: (i) the channels through which high-frequency traders impact financial market volatility and; (ii) the role of dark pools. Overall, the findings are in line with the general consensus of the literature that finds that fast and high-frequency traders dampen volatility on the market during normal times. However, during crisis times, some practices of these traders might have a very significant detrimental effect. In light of this, more in-depth analysis should be

[43] For a review, see Norges Bank (2015), “The Role of Last Look in Foreign Exchange Market”, mimeo.

[44] See The Wall Street Journal, 27 May 2015, “Forex’s "Last Look" Practice Gets Curbed”

conducted to design regulations able to mitigate the tail risks associated with high-frequency activities, while preserving the benefits associated with technological progress.

From a regulatory perspective, these findings also suggest that regulators should put more emphasis on high-frequency quoting relative to high-frequency trading and seek to mitigate erratic quoting behaviours in times of high volatility using mechanisms available at the trading platform level, such as kill-switches, order-to-trade ratios, message throttling, minimum exposure time and last-look options. Our results would support a gradual implementation of high-frequency regulation, first in relation to quoting behaviour, with a special emphasis on kill switches and message throttling. More constraining measures such as minimum exposure time or order-to-trade ratio seem, in light of our study, not yet necessary and should be used with care as their negative impact on market liquidity, efficiency and resilience might be detrimental to financial stability and market resilience.

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Annex
Macroprudential policy measures at a glance

This Annex provides on overview of the macroprudential policy measures that have been implemented or announced in euro area countries since the publication of the first Macroprudential Bulletin, which was published in March 2016. In each case, a link is given to the public announcement of the macroprudential or regulatory measure issued by national authorities.[45] The summary of all buffers at national and individual bank level is provided in Table 1 and Table 2. The cut-off date for reporting macroprudential measure was 19 September 2016. The aim of each macroprudential policy measure is further described either in the last Macroprudential Bulletin or in the glossary of this issue.

1 Macroprudential policy measures

1.1 Capital conservation buffer

Portugal

On 31 May 2016 Banco de Portugal decided to revoke the front-loading of the CCoB. Among other reasons, Banco de Portugal considered that bringing forward the implementation of CCoB in compliance with SSM capital decisions may jeopardise the principle that national credit institutions operate under the same conditions as most institutions in the euro area.

1.2 Countercyclical capital buffers

Slovakia

The Bank Board of Národná banka Slovenska at its meeting held on 26 July 2016 decided to set the CCyB rate at 0.5 % of total risk exposure amount, which enters into force on 1 August 2017. Thus, Slovakia is the first country in the euro area which has announced the application of a buffer.

[45] Macroprudential policy measures are notified to the ECB, but they are not made public. As the measures are also notified to the ESRB and published on the ESRB website, most of the announcements refer to these ESRB notifications.

All other euro area countries

All other euro area countries announced that they would maintain the countercyclical capital buffer rate at 0%. In these countries, relevant indicators do not signal an increase in financial system vulnerabilities, and thereby advise against setting the CCyB above 0%.

1.3 Other systemically important institutions (O-SII) buffer

Austria

On 29 April 2016, the Austrian Financial Market Authority identified seven O-SIIs (Erste Group Bank; Raiffeisen Zentralbank; Raiffeisen Bank International; UniCredit Bank Austria; Raiffeisenlandesbank Oberösterreich; Raiffeisenlandesbank Niederösterreich Wien; BAWAG P.S.K) and set buffers of between 0.125% and 0.25% of total risk exposure amount (RWAs), to apply from 1 June 2016.

Cyprus

On 17 May 2016 the Central Bank of Cyprus (CBC) published the decision to designate six investment firms (SIB (Cyprus); Renaissance Securities (Cyprus); BrokerCreditService (Cyprus); IronFX Global; Alfa Capital Holdings (Cyprus); Fintailor Investments) as O-SII investment firms and the setting of the level of the additional capital buffer they must maintain. Cyprus is the first country to designate O-SII investment firms. The CBC has set buffers of 0.5% for all O-SII investment firms, except for the biggest firm, which has an O-SII buffer requirement of 2%. The buffer requirements will enter into force without phase-in on 1 July 2016.

Estonia

On 26 April Eesti Pank notified two O-SIIs (Swedbank AS, AS SEB Pank) and a 2% capital buffer requirement that applies to their total risk exposure as of 1 August 2016. Eeste Pank named these two banks as O-SIIs already in 2015, but decided only in April this year on the size of the buffer rate. The reason for having the O-SII buffers is the high level of concentration in the Estonian banking sector, where the two biggest banks hold over 60% of the total assets of the banking sector, with a value equal to 70% of GDP. In calibrating the O-SII buffer rate at 2%, Eesti Pank followed the equivalent rates set elsewhere in the Nordic and Baltic region and the assessment scores of the systemic importance of the banks operating in Estonia. The decision is also linked to the decrease of the systemic risk buffer requirement for all banks (see 1.4. Systemic risk buffer).

Germany

On 15 July, the ESRB published a notification of the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) on the identification of 16 O-SIIs. The O-SII buffer rate will vary between 0.16% and 0.66% of total risk exposure amount (RWAs) in 2017, and will then increase in identical steps in 2018 and 2019.

Slovakia

On 24 May 2016 Národná Banka Slovenska (NBS) decided on the setting of O-SII buffer rates in Slovakia. As some of the parent companies of Slovak O-SIIs are required to maintain an O-SII or G-SII buffer, this is reflected in the calibration of buffers for the Slovak O-SIIs. As a consequence, the O-SII buffer rate is set to 1% for four O-SIIs and 2% for Poštová banka, a.s.. The decision will enter into force on 1 January 2017 and shall be maintained on both an individual and sub-consolidated basis.

1.4 Systemic risk buffer

Estonia

On 26 April Eesti Pank notified the decrease of the SRB from 2% to 1% of their total risk exposure for all banks and banking groups authorised in Estonia as of 1 August 2016. The reasons for maintaining the systemic risk buffer lie in the structural vulnerability of the Estonian economy. The risks from the concentration of the banking sector, which were the second reason behind the systemic risk buffer in 2014, will be covered from 1 August 2016 by a new buffer requirement that will apply to O-SIIs (see 1.3 O-SIIs). In order to increase awareness of the structural vulnerabilities in the Estonian economy and to ensure a level playing field, Eesti Pank is requesting the authorities of other Member States to apply equivalent additional buffer requirements to the banks that provide banking services in Estonia through branches or directly cross-border for their risk exposure in Estonia.

Slovakia

On 24 May 2016, the NBS also decided on the setting of SRB rates in Slovakia. From 1 January 2017 to 31 December 2017 the systemic risk buffers applied to the following banks (also identified as O-SIIs) will be set at 1%: Československá obchodná banka, Slovenská sporiteľňa, Tatra banka, and Všeobecná úverová banka. The rate will increase to 2% as of 1 January 2018 for Slovenská sporiteľňa and Všeobecná úverová banka and to 1.5% for Tatra banka.

1.5 Other macroprudential measures

Finland

On 14 June 2016 the Board of the Financial Supervisory Authority in Finland (FIN-FSA) decided to take measures to introduce a minimum level of 10% for the average risk weight on housing loans to banks that have adopted the Internal Ratings Based Approach. The minimum level would come into force on 1 July 2017 at the latest.

Analyses carried out by the FIN-FSA and the Bank of Finland justify such a calibration to cover possible credit losses arising from housing loans. In setting such a minimum level, the multiplicative effects of possible disruptions in housing and mortgage markets in stressed conditions as well as to other systemic risks related to mortgage lending and the current level of indebtedness of households were taken into consideration.

France

On 15 March, the Haut Conseil de stabilité financière (HCSF) decided on a five percentage point increase in risk weights applied by French credit institutions using the internal-ratings based (IRB) approach to their residential mortgage loans exposures for which the collateral is located in Belgium (Art. 458(9) CRR).

2 Capital requirements at country level

This section provides an overview of the current activated macroprudential policy measures in each of the euro area Member States. It should be noted that all tables are based on publicly available data, and that Pillar 2 requirements have not therefore been taken into account.

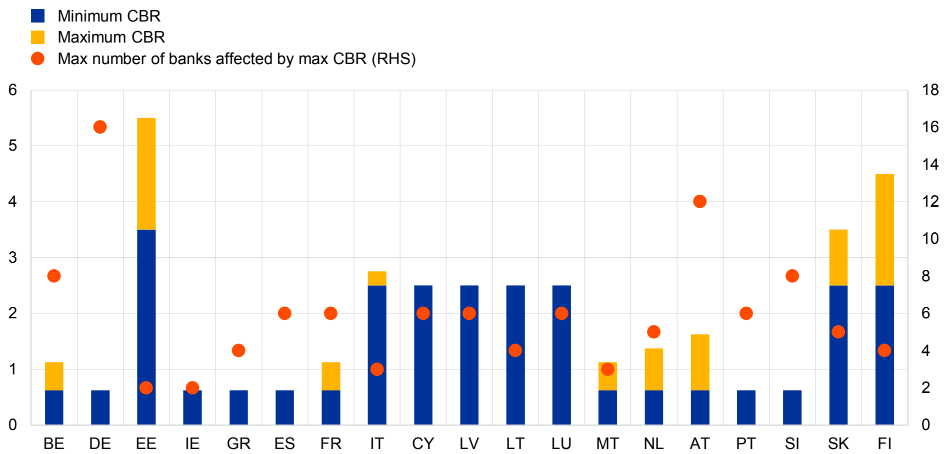
The chart below displays the minimum and the maximum combined buffer requirements (CBR). Whereas the minimum CBR is usually applicable to all banks in one country, taking into account the CCoB and the CCyB, the maximum CBR relates to financial institutions which have to apply the higher of the O-SII, the G-SII or the systemic risk buffer.[46] In some countries, only a few financial institutions are affected by the maximum CBR, e.g. in Ireland, only two institutions are currently designated as O-SIIs. In Germany, 16 institutions are affected as they are designated as O-SIIs. The chart also shows that the minimum CBR ranges in the euro area from 0.625% (the minimum CCoB) to 3.5% (in Estonia, the 2.5% CCoB and a 1% systemic risk buffer applies to all banks). As regards the maximum CBR, it ranges from 0% in ten euro area countries to 2% in Finland. Taking both the minimum and maximum CBR together, the buffer requirements in the euro area are very heterogeneous, depending on the country and the individual institution. It can range from 0.625% to 5.5%.

[46] In one country (EE), the systemic risk buffer applies to all banks. In Estonia and Slovakia, SRB is applied only on the domestic exposures. Thus, the buffer comes in addition to the higher of the O-SII and G-SII buffers.

Figure A

Overview on combined buffer requirements (CBR) as of 19 September 2016

Scale on the left-hand side: % of total risk exposure amount (RWAs); scale on the right-hand side: total numbers



Source: ECB, ESRB and national authorities.
Notes: In some countries, some financial institutions are designated as O-SIIs, but no additional buffer requirement applies yet. Small and medium-sized investment firms are exempted from the CCyB and/or the CCoB in Italy, Lithuania, Luxembourg, Malta and Slovakia.

These differences are justified by the heterogeneous macroeconomic developments in the euro area and by the different levels of systemic risk which individual institutions pose to financial stability. Details of the decisions on the current level of measures are available in the links to national websites and ESRB notifications in Table 1 below (see measures in light blue colour which are underlined). Those measures, which were not covered in the last Macroprudential Bulletin, are shaded in green.

Table 1

Capital requirements at country level, based on publicly announced measures, as of 19 September 2016

The numbers in light blue include links to either the notification of national measures sent to the ESRB or the official website of the national authority. Pillar 2 measures are not included. The real CCyB requirement may diverge from the national CCyB rate, as it depends on the CCyB rates that apply in the countries where the institution-specific credit exposures are located. The CCyB will be assessed every quarter, and the G-SII buffer, the O-SII buffer and the SRB will be assessed once a year.

% of total risk exposure amount (RWAs)	Minimum total capital a)	Combined buffer requirement (CBR)					
				The higher of			Combined buffer requirement (CBR)[f]
		CCoB rate b)	CCyB rate c)	G-SII buffer b)	O-SII buffer	SRB c)	
Filled with	CET1, AT1, T2	CET1	CET1	CET1	CET1	CET1	CET 1
Austria	8%	0.625%	0.0%	n/a	7 banks: 0.125% - 0.25%	12 banks: 0.25% - 1.0%	0.625% - 1.625%
Belgium	8%	0.625%	0.0%	n/a	8 banks: 0.25% - 0.5%	n/a	0.625% - 1.125%
Cyprus[e)]	8%	2.5%	0.0%	n/a	6 banks: 0.0%	n/a	2.5%
Estonia	8%	2.5%	0.0%	n/a	2 banks: 2.0%	all banks: 1.0% h)	3.5% - 5.5%
Finland	8%	2.5%	0.0%	n/a	4 banks: 0.5% - 2.0%	n/a	2.5% - 4.5%
France	8%	0.625%	0.0%	4 banks: 0.25% - 0.5%	6 banks: 0.0625% - 0.375%	n/a	0.625% - 1.125%
Germany	8%	0.625%	0.0%	1 bank: 0.5%	16 banks: 0.0%	n/a	0.625% - 1.125%
Greece	8%	0.625%	0.0%	n/a	4 banks: 0.0%	n/a	0.625%
Ireland	8%	0.625%	0.0%	n/a	2 banks: 0.0%	n/a	0.625%
Italy	8%	2.5% d)	0.0% d)	1 bank: 0.25%	3 banks: 0.0%	n/a	2.5% - 2.75%
Latvia	8%	2.5%	0.0%	n/a	6 banks g)	n/a	2.5%
Lithuania	8%	2.5% d)	0.0%	n/a	4 banks: 0.0%	n/a	2.5%
Luxemburg	8%	2.5% d)	0.0% d)	n/a	6 banks: 0.125% - 0.25%	n/a	2.5% - 2.75%
Malta	8%	0.625% d)	0.0% d)	n/a	3 banks: 0.125% - 0.5%	n/a	0.625% - 1.125%
Netherlands	8%	0.625%	0.0%	1 bank: 0.25%	5 banks: 0.25% - 0.5%	3 banks: 0.75%	0.625% - 1.375%
Portugal	8%	0.625%	0.0%	n/a	6 banks: 0.0%	n/a	0.625%
Slovakia	8%	2.5% d)	0.0% d)	n/a	5 banks: 1.0%	4 banks: 0.0% h)	2.5% - 3.5%
Slovenia	8%	0.625%	0.0%	n/a	8 banks: 0.0%	n/a	0.625%
Spain	8%	0.625%	0.0%	2 banks: 0.25%	6 banks: 0.0% - 0.25%	n/a	0.625% - 0.875%

Sources: ECB, ESRB and national authorities (links provide further information on non-ECB websites).
Notes:
a) This consists of a minimum 4.5% CET1, a maximum 1.5% Additional Tier 1 and a maximum 2% Tier 2 capital.
b) Phasing-in arrangements are applied; please see CRD IV, Article 160 for the CCoB and Article 162 for the G-SII buffer. The G-SII buffer can range from 1% to 3.5%.
c) The CCyB and the SRB can be set at higher levels in certain cases. For more details, see CRD IV, Article 140 and Article 133(13). The maximum capital requirements could therefore also be higher. If the SRB is applied to domestic exposures only, the SRB will be added to the O-SII or G-SII buffer.
d) Small and medium-sized investment firms are exempted.
e) The table includes information only on supervised banks (e.g. O-SII buffer requirements for investment firms in CY are excluded).
f) The CBR does not include the reciprocity for CCyB. If a banking group, on a consolidated basis, is subject to more than one structural buffer (i.e. G-SII, O-SII and SRB) art. 131 (CRD IV) shall apply.
g) Latvian banks are only identified as O-SII, but no O-SII buffer rate has been set yet.
h) In Estonia and Slovakia, SRB is applied only on the domestic exposures, thus, the buffer comes in the addition to maximum of O-SII or G-SII buffer.

3 Capital requirements for O-SIIs

Table 2

Capital requirements for O-SIIs, based on publicly announced measures, as of 19 September 2016

The numbers in light blue include links to either the notification of national measures sent to the ESRB or the official website of the national authority. Pillar 2 measures are not included. The real CCyB requirement may diverge from the national CCyB rate, as it depends on the CCyB rates that apply in the countries where the institution-specific credit exposures are located. The CCyB will be assessed every quarter, and the G-SII buffer, the O-SII buffer and the SRB will be assessed once a year.

% of total risk exposure amount (RWAs)	Bank name g)	Minimum total capital a)	Combined buffer requirement (CBR)					
					The higher of			Combined buffer requirements f) (CBR)
			CCoB rate b)	CCyB rate c)	G-SII buffer b)	O-SII buffer	SRB c)	
		CET1, AT1, T2	CET1	CET1	CET1	CET1	CET1	CET 1
Austria	Erste Group Bank	8.0%	0.625%	0.0%	n/a	0.25%	0.25%	0.875%
	Raiffeisen Zentralbank	8.0%	0.625%	0.0%	n/a	0.25%	0.25%	0.875%
	Raiffeisen Bank International	8.0%	0.625%	0.0%	n/a	0.25%	0.25%	0.875%
	UniCredit Bank Austria	8.0%	0.625%	0.0%	n/a	0.25%	0.25%	0.875%
	Raiffeisenlandesbank Oberösterreich	8.0%	0.625%	0.0%	n/a	0.125%	0.25%	0.875%
	Raiffeisenlandesbank Niederösterreich-Wien	8.0%	0.625%	0.0%	n/a	0.125%	0.25%	0.875%
	BAWAG P.S.K.	8.0%	0.625%	0.0%	n/a	0.125%	0.25%	0.875%
	HYPO NOE Gruppe Bank	8.0%	0.625%	0.0%	n/a	n/a	1.00%	1.625%
	Vorarlberger Landes− und Hypothekenbank	8.0%	0.625%	0.0%	n/a	n/a	1.00%	1.625%
	Hypo Tirol Bank	8.0%	0.625%	0.0%	n/a	n/a	1.00%	1.625%
	Landesbank Oberösterreich	8.0%	0.625%	0.0%	n/a	n/a	1.00%	1.625%
	Sberbank	8.0%	0.625%	0.0%	n/a	n/a	0.25%	0.875%
Belgium	BNP Paribas Fortis	8.0%	0.625%	0.0%	n/a	0.5%	n/a	1.125%
	KBC Group NV	8.0%	0.625%	0.0%	n/a	0.5%	n/a	1.125%
	ING België	8.0%	0.625%	0.0%	n/a	0.5%	n/a	1.125%
	Belfius Bank	8.0%	0.625%	0.0%	n/a	0.5%	n/a	1.125%
	Axa Bank Europe	8.0%	0.625%	0.0%	n/a	0.25%	n/a	0.875%
	Argenta Spaarbank	8.0%	0.625%	0.0%	n/a	0.25%	n/a	0.875%
	Euroclear Bank	8.0%	0.625%	0.0%	n/a	0.25%	n/a	0.875%
	The Bank of New York Mellon SA/NV	8.0%	0.625%	0.0%	n/a	0.25%	n/a	0.875%
Cyprus e)	Bank of Cyprus Plc	8.0%	2.5%	0.0%	n/a	0.0%	n/a	2.5%
	Hellenic Bank Plc	8.0%	2.5%	0.0%	n/a	0.0%	n/a	2.5%
	RCB Bank Ltd	8.0%	2.5%	0.0%	n/a	0.0%	n/a	2.5%
	Cooperative Central Bank Ltd	8.0%	2.5%	0.0%	n/a	0.0%	n/a	2.5%

	Eurobank Cyprus Ltd	8.0%	2.5%	0.0%	n/a	0.0%	n/a	2.5%
	Alpha Bank Cyprus Ltd	8.0%	2.5%	0.0%	n/a	0.0%	n/a	2.5%
Estonia	Swedbank AS	8.0%	2.5%	0.0%	n/a	2.0%	1.0% h)	5.5%
	AS SEB Pank	8.0%	2.5%	0.0%	n/a	2.0%	1.0% h)	5.5%
Finland	Nordea Bank Finland Plc	8.0%	2.5%	0.0%	n/a	2.0%	n/a	4.5%
	OP Group	8.0%	2.5%	0.0%	n/a	2.0%	n/a	4.5%
	Danske Bank Plc	8.0%	2.5%	0.0%	n/a	0.5%	n/a	3.0%
	Municipality Finance Plc	8.0%	2.5%	0.0%	n/a	0.5%	n/a	3.0%
France	BNP Paribas	8.0%	0.625%	0.0%	0.5%	0.375%	n/a	1.125%
	Société Générale	8.0%	0.625%	0.0%	0.25%	0.25%	n/a	0.875%
	Groupe BPCE	8.0%	0.625%	0.0%	0.25%	0.25%	n/a	0.875%
	Groupe Crédit Agricole	8.0%	0.625%	0.0%	0.25%	0.25%	n/a	0.875%
	Groupe Crédit Mutuel	8.0%	0.625%	0.0%	n/a	0.125%	n/a	0.75%
	La Banque Postal	8.0%	0.625%	0.0%	n/a	0.0625%	n/a	0.6875%
Germany	Deutsche Bank AG	8.0%	0.625%	0.0%	0.5%	0.0%	n/a	1.125%
	Commerzbank AG	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	Unicredit Bank AG	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	DZ Bank AG	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	Landesbank Baden-Württemberg	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	Landesbank Hessen-Thüringen Girozentrale	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	Bayerische Landesbank	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	Norddeutsche Landesbank Girozentrale	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	DekaBank Deutsche Girozentrale	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	Volkswagen Financial Services AG	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	HSH Nordbank AG	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	WGZ Bank AG	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	NRW.Bank	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	ING DiBa AG	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	Landwirtschaftliche Rentenbank	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
	Landesbank Berlin Holding AG	8.0%	0.625%	0.0%	0.0%	0.0%	n/a	0.625%
Greece	National Bank of Greece	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Alpha Bank	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Piraeus Bank	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%

	Eurobank	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
Ireland	Allied Irish Banks plc	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	The Governor and Company of the Bank of IE	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
Italy	Unicredit Group S.p.A.	8.0%	2.5% d)	0.0% d)	0.25%	0.0%	n/a	2.75%
	Gruppo Intesa-Sanpaolo	8.0%	2.5% d)	0.0% d)	n/a	0.0%	n/a	2.5%
	Gruppo Monte dei Paschi di Siena	8.0%	2.5% d)	0.0% d)	n/a	0.0%	n/a	2.5%
Latvia	ABLV Bank AS	8.0%	2.5%	0.0%	n/a	identified i)	n/a	2.5%
	Swedbank AS	8.0%	2.5%	0.0%	n/a	identified i)	n/a	2.5%
	AS SEB banka	8.0%	2.5%	0.0%	n/a	identified i)	n/a	2.5%
	Citadele banka	8.0%	2.5%	0.0%	n/a	identified i)	n/a	2.5%
	Rietumu Banka	8.0%	2.5%	0.0%	n/a	identified i)	n/a	2.5%
	AS DNB banka	8.0%	2.5%	0.0%	n/a	identified i)	n/a	2.5%
Lithuania	AB SEB bankas	8.0%	2.5%	0.0% d)	n/a	0.0%	n/a	2.5%
	Swedbank AB	8.0%	2.5%	0.0% d)	n/a	0.0%	n/a	2.5%
	AB DNB bankas	8.0%	2.5%	0.0% d)	n/a	0.0%	n/a	2.5%
	AB Siauliu bankas	8.0%	2.5%	0.0% d)	n/a	0.0%	n/a	2.5%
Luxembourg	Deutsche Bank Luxembourg S.A.	8.0%	2.5% d)	0.0% d)	n/a	0.25%	n/a	2.75%
	Société Générale Bank & Trust S.A.	8.0%	2.5% d)	0.0% d)	n/a	0.25%	n/a	2.75%
	Banque et Caisse d'Epargne de l'Etat LU	8.0%	2.5% d)	0.0% d)	n/a	0.125%	n/a	2.625%
	BGL BNP Paribas S.A.	8.0%	2.5% d)	0.0% d)	n/a	0.125%	n/a	2.625%
	CACEIS Bank Luxembourg S.A.	8.0%	2.5% d)	0.0% d)	n/a	0.125%	n/a	2.625%
	Banque Internationale à Luxembourg S.A.	8.0%	2.5% d)	0.0% d)	n/a	0.125%	n/a	2.625%
Malta	Bank of Valletta Group	8.0%	0.625% d)	0.0% d)	n/a	0.5%	n/a	1.125%
	HSBC Bank Malta plc	8.0%	0.625% d)	0.0% d)	n/a	0.375%	n/a	1.0%
	Medifin Holdings	8.0%	0.625% d)	0.0% d)	n/a	0.125%	n/a	0.75%
Netherlands	ING Bank N.V.	8.0%	0.625%	0.0%	0.25%	0.5%	0.75%	1.375%
	Coöperative Centrale Raiffeisen Boerenleenbank	8.0%	0.625%	0.0%	n/a	0.5%	0.75%	1.375%
	ABN AMRO Bank N.V.	8.0%	0.625%	0.0%	n/a	0.5%	0.75%	1.375%
	SNS Bank N.V.	8.0%	0.625%	0.0%	n/a	0.25%	n/a	0.875%
	N.V. Bank Nederlandse Gemeenten	8.0%	0.625%	0.0%	n/a	0.25%	n/a	0.875%
Portugal	Caixa Geral de Depósitos	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Banco Comercial Português	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Novo Banco	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%

	Santander Totta – SGPS	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Banco BPI	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Caixa Económica Montepio Geral	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
Slovakia	Československá obchodná banka a.a.	8.0%	2.5% d)	0.0% d)	n/a	1.0%	0.0% h)	3.5%
	Poštová banka a.s.	8.0%	2.5% d)	0.0% d)	n/a	1.0%	0.0% h)	3.5%
	Slovenská sporiteľňa a.s.	8.0%	2.5% d)	0.0% d)	n/a	1.0%	0.0% h)	3.5%
	Tatra banka a.s.	8.0%	2.5% d)	0.0% d)	n/a	1.0%	0.0% h)	3.5%
	Všeobecná úverová banka a.s.	8.0%	2.5% d)	0.0% d)	n/a	1.0%	0.0% h)	3.5%
Slovenia	NLB	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	SID	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Unicredit	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Abanka	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	NKBM	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	SKB	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Sberbank	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Banka Koper	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
Spain	Banco Santander	8.0%	0.625%	0.0%	0.25%	0.25%	n/a	0.875%
	BBVA	8.0%	0.625%	0.0%	0.25%	0.125%	n/a	0.875%
	Caixabank	8.0%	0.625%	0.0%	n/a	0.0625%	n/a	0.6875%
	Bankia	8.0%	0.625%	0.0%	n/a	0.0625%	n/a	0.6875%
	Popular	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%
	Sabadell	8.0%	0.625%	0.0%	n/a	0.0%	n/a	0.625%

Sources: EBA, ECB, ESRB and national authorities.
Notes:
a) This consists of a minimum 4.5% CET1, a maximum 1.5% Additional Tier 1 and a maximum 2% Tier 2 capital.
b) Phasing-in arrangements are applied; please see CRD IV, Article 160 for the CCoB and Article 162 for the G-SII buffer. The G-SII buffer can range from 1% to 3.5%.
c) The CCyB and the SRB can be set at higher levels in certain cases. For more details, see CRD IV, Article 140 and Article 133(13). The maximum capital requirements could therefore also be higher. If the SRB is applied to domestic exposures only, the SRB will be added to the O-SII or G-SII buffer.
d) Small and medium-sized investment firms are exempted.
e) The table includes information only on supervised banks (e.g. O-SII buffer requirements for investment firms in CY are excluded).
f) The CBR does not include the reciprocity for CCyB. If a banking group, on a consolidated basis, is subject to more than one structural buffer (i.e. G-SII, O-SII and SRB) art. 131 (CRD IV) shall apply.
g) The bank names are taken from EBA's list of O-SIIs (link). For this table, it is assumed that the O-SII entity is the one to which all buffers apply.
h) In Estonia and Slovakia, SRB is applied only on the domestic exposures, thus, the buffer comes in addition to the maximum of O-SII or G-SII buffer.
i) Latvian banks are only identified as O-SII, but no O-SII buffer rate has been set yet.

Glossary

Table 1
Regulatory framework

Name	Link	Description
SSM Regulation	Council Regulation (EU) No 1024/2013	This Regulation gives the ECB responsibility for specific tasks related to policies on the prudential supervision of credit institutions. This includes macroprudential policy (Article 5).
SSM Framework Regulation	Regulation (EU) No 468/2014 of the ECB	This ECB Regulation established the framework for cooperation between the ECB and national authorities within the Single Supervisory Mechanism (SSM).
Capital Requirements Directive (CRD IV) Capital Requirements Regulation (CRR)	Directive 2013/36/EU of the European Parliament and of the Council Regulation (EU) No 575/2013 of the European Parliament and of the Council	The CRD IV package (CRR/CRD IV) transposes the global standards on bank capital (the Basel III agreement) into EU law. Since 1 January 2014, stronger prudential requirements have been introduced for credit institutions and investment firms, requiring them to keep higher capital reserves and sufficient liquidity. The benefits of robust capital requirements include: reducing bank moral hazard and thereby improving the quality of lending decisions; increasing banks' ability to lend throughout the financial cycle; and protecting taxpayers and society from having to bear banks' unexpected losses. Some of the new provisions are being phased-in between 2014 and 2019.
Bank Recovery and Resolution Directive (BRRD)	Directive 2014/59/EU of the European Parliament and of the Council	The BRRD established a framework for the resolution of credit institutions and investment firms. It introduced harmonised tools and powers relating to prevention, early intervention and resolution for all EU Member States.
Deposit Guarantee Schemes (DGS) Directive	Directive 2014/49/EU of the European Parliament and of the Council	The main measures introduced by the DGS Directive related to: the harmonisation and simplification of rules and criteria applicable to deposit guarantees; a shorter time limit for repayment; and improvements to the financing of deposit guarantee schemes in all EU Member States. In November 2015, the European Commission proposed a euro area wide deposit insurance scheme (EDIS) for bank deposits.

Table 2
Capital-based macroprudential policy instruments

Name	Legal basis for ECB action	Size	Description
Capital conservation buffer (CCoB)	CRD Article 129, CRR Article 458	The CCoB is a capital buffer of up to 2.5% of a bank's total exposures. The capital used to meet this required level must be the highest quality of capital (i.e. CET1 capital). Phasing-in arrangements: 2016: 0.625%, 2017: 1.25%, 2018: 1.875%, 2019: 2.5% of RWAs, but earlier introduction is possible. If a credit institution's capital buffer is below the minimum level required, it will be subject to restrictions on its discretionary distributions.	The CCoB was introduced by the Basel III framework and has been implemented via CRD IV. The CCoB requirement is in addition to the minimum 4.5% CET1 capital requirement. The aim is to avoid breaches of minimum capital requirements during periods of stress when losses are incurred.
Countercyclical capital buffer (CCyB)	CRD Articles 130 and 135 to140	0-2.5% of total risk exposure amount (RWAs), but this can be set at a higher level if certain procedures have been followed. The buffer is institution specific and is calculated as a weighted average of the countercyclical buffer rates that apply in the countries where an institution's credit exposures are located.	The CCyB ensures that credit institutions accumulate a sufficient capital base during periods of excessive credit growth to be able to absorb losses during periods of stress.
Global systemically important institutions (G-SII) buffer	CRD Article 131	1-3.5% of total risk exposure amount (RWAs), depending on the degree of systemic importance of an institution. Phasing-in arrangements: 2016: 25%; 2017: 50%; 2018: 75%; 2019: 100%.	The G-SII buffer aims to reduce the moral hazard created by the implicit state support and guarantee of bail-out using taxpayer money that such institutions enjoy due to their size, cross border activities and interconnectedness. The FSB publishes a list of G-SIIs on an annual basis. The buffer is a mandatory requirement and must be met with CET1 capital.
Other systemically important institutions (O-SII) buffer	CRD Article 131	0-2% of total risk exposure amount (RWAs).	CRD IV allows this buffer to be applied to domestically important institutions and to institutions important at EU level. The O-SII buffer aims to reduce the moral hazard created by implicit support.
Systemic risk buffer (SRB)	CRD Articles 133 to 134	1-5% of total risk exposure amount (RWAs), but this can be set at a higher level if certain procedures have been followed or can be applied only to domestic exposure. As of 2015, a special authorisation procedure must be followed in order to set the buffer at rates between 3% and 5%. Buffer rates above 5% are possible, but also require special authorisation (e.g. a Commission implementing act).	CRD IV allows this buffer to be applied to the financial sector or to one or more subsets of the sector, in order to prevent and mitigate long term non-cyclical systemic or macroprudential risks.
Leverage ratio	Basel III leverage ratio framework	The Basel III leverage ratio is defined as Tier 1 capital divided by the bank's total exposure, expressed as a percentage. The BCBS is currently testing a minimum level of 3% until 1 January 2017, with a view to migrating to a Pillar 1 requirement on 1 January 2018. At European level, the EBA is preparing a report on the impact and calibration of the leverage ratio. Based on the results of this report, the European Commission will submit a report on the impact and effectiveness of the leverage ratio to the European Parliament and the Council by the end of 2016.	The leverage ratio is intended to restrict the build-up of leverage in the banking sector and to strengthen the risk-based requirements by adding a simple, non-risk based backstop.
Sectoral capital requirements	CRR Articles 124 and 164	Stricter requirements for loss given default (LGD); higher real estate risk weights.	The prudential rules for the EU banking system provide for the use of more targeted capital based tools designed to address vulnerabilities that can appear at sectoral level.

Table 3
Liquidity-based instruments

Name	Legal base for ECB action	Size	Description
Liquidity coverage ratio (LCR)	CRR Part VI, Article 458	Institutions are required to hold sufficient liquid assets to be able to accommodate any possible imbalance between liquidity inflows and outflows that may occur under severely stressed conditions, over a period of thirty days. The LCR entered into force in October 2015, with a starting level of 60%, and will be increased gradually to reach 100% in 2018. Under the Basel III agreement, the LCR would need to reach 100% by 1 January 2019. The European Commission may, however, delay full implementation by one year, subject to a report by the EBA in June 2016 (Article 461 of CRR).	The main purpose of the liquidity-based instruments is to increase banks' resilience to liquidity shocks. Provisions requiring a steady funding level to be maintained can weaken banks' dependence on short-term funding sources and consequently lessen the risk of unexpected funding losses. Buffers of this type also improve banks' capacity to deal with such outflows, should they occur. At the same time, liquidity-based instruments may influence credit provision, as they may cause banks to shift from illiquid to liquid asset holdings. In addition, they can restrict the excessive credit growth typically driven by less stable funding sources.
Net stable funding ratio (NSFR)	Basel NSFR CRR Article 458	The NSFR will require banks to maintain a stable funding profile in relation to the composition of their assets and off-balance sheet activities. This ratio should be at least 100% on an ongoing basis. The Basel minimum standard will be introduced in 2018. The EBA conducted a comprehensive impact and calibration assessment of the NSFR for the EU. The European Commission will decide in 2016 if and how the NSFR will be implemented in the EU.	

Table 4
Asset-based measures

Name	Legal base	Size	Description
Limits on loan-to-value (LTV) ratio; loan-to-income (LTI) ratio; debt service-to-income (DSTI) ratio	National legal framework		Lending limits impose direct restrictions on the quantity of credit banks can issue and have the potential to affect the credit cycle. They mainly increase borrowers' resilience by lowering their probability of default and/or increase banks' resilience by lowering the loss given counterparty default.
Large exposure limits	CRR Article 458	A large exposure value is an exposure value equal to or exceeding 10% of a bank's eligible capital	

Table 5
Supervisory measures and powers

Name	Legal base for ECB action	Size	Description
Pillar 2 measures	CRD Articles 102 to 106	Higher requirements for capital, liquidity and disclosure are possible.	National competent authorities may apply similar or identical supervisory measures to institutions with a similar risk profile, e.g. having a similar business model or similar geographical location of exposures, or which might be exposed to similar risks or pose similar risks to the financial system.

National law can provide for additional macroprudential measures.

Abbreviations

Countries

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

Others

ABS	Asset-backed security
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
CBR	Combined buffer requirements
CCyB	Countercyclical capital buffer
CCoB	Capital conservation buffer
CDS	Credit default swap
CET1	Common Equity Tier 1
CMU	Capital Markets Union
EAA	Euro area accounts
EBA	European Banking Authority
ECB	European Central Bank
Ecofin Council	Council of Economic and Finance Ministers
EEA	European Economic Area
EFSF	European Financial Stability Facility
EIOPA	European Insurance and Occupational Pensions Authority
EMIR	European Market Infrastructure Regulation
EMU	Economic and Monetary Union
ERF	European Resolution Fund
ESA	European Supervisory Authorities
ESCB	European System of Central Banks
ESM	European Stability Mechanism
ESMA	European Securities and Markets Authority
ESRB	European Systemic Risk Board
EU	European Union
FSB	Financial Stability Board
ICPF	Insurance corporations and pension funds
IMF	International Monetary Fund
IOSCO	International Organization of Securities Commissions
ISDA	International Swaps and Derivatives Association, Inc.
MFI	Monetary financial institution
MiFID	Markets in Financial Instruments Directive
MMF	Money market fund
NCA	National competent authority
NCB	National central bank
NDA	National designated authority
OECD	Organisation for Economic Cooperation and Development
OJ	Official Journal of the European Union
SRA	Single Resolution Authority
SRM	Single Resolution Mechanism
SSM	Single Supervisory Mechanism
SSMR	Single Supervisory Mechanism Regulation

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