Statistics Paper Series

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European macroprudential database

No 32 / December 2019

Contents

Abstract

This paper describes the Macroprudential Database (MPDB) of the European Central Bank (ECB), which is an important component of the ECB's Statistical Data Warehouse. After explaining the rationale for creating the MPDB, the paper illustrates how it supports the macroprudential analysis conducted by the European System of Central Banks (ESCB), the European Systemic Risk Board (ESRB) and the national authorities of the Single Supervisory Mechanism (SSM) and the European Union. The structure of the database and a broad overview of available indicators are then presented, with a description of the relevant confidentiality issues. Examples illustrate how the MPDB is used for monitoring purposes and econometric modelling. Finally, the paper discusses remaining data gaps and expected future enhancements of the database.

1 Introduction

The financial crisis revealed the importance of monitoring the emergence of systemic risks in the financial system and led to the establishment of macroprudential policy as a new key policy area. Systemic risk can be described as the risk that the ability of the financial system to provide its services will be impaired to a point where economic growth and welfare may be materially affected.[1] Such risks can arise from three sources: an endogenous build-up of financial imbalances, possibly associated with a booming financial cycle; large aggregate shocks hitting the economy or the financial system; and contagion effects across markets, intermediaries or infrastructures.[2] Whatever their origin, a primary role of macroprudential authorities is to identify, measure and monitor these systemic risks as early as possible and to consider macroprudential policies to mitigate them. Macroprudential policy is aimed at preserving financial stability by (1) preventing the excessive build-up of risk resulting from external factors and market failures, thereby smoothing the financial cycle (time dimension); (2) increasing the resilience of the financial sector and limiting contagion effects (cross-sectional dimension); and (3) encouraging a system-wide perspective in financial regulation to create the right set of incentives for market participants (structural dimension).[3]

The early detection of systemic risks and the design of suitable macroprudential policy need to be supported by new monitoring tools and models as well as a reliable and comprehensive common European statistical basis to support macroprudential analysis and to stimulate research. This is particularly relevant for the European Central Bank (ECB), to enable it to fulfil its macroprudential mandate, for the European Systemic Risk Board (ESRB), to enable it to conduct macroprudential oversight of the EU financial system, and for the prevention and mitigation of systemic risk. In addition, shared responsibility for macroprudential policies between national authorities and the ECB further motivates the establishment of a common basis for macroprudential analysis. Such a comprehensive and unique Macroprudential Database (MPDB) is therefore essential to underpin quantitative and policy-oriented analyses for both internal and external publications, and for a consistent cross-country analysis of systemic risk (see Box 1 for a comparison of the MPDB with the International Monetary Fund (IMF)'s Financial Soundness Indicators).

The MPDB became operational in October 2015, since when it has been accessible through the ECB's Statistical Data Warehouse (SDW).[4] The public version currently comprises around 300 relevant country-level indicators grouped into seven domains related to the macro economy and financial markets, debt and credit, residential and commercial real estate, the banking sector, the non-banking sector and

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[1] On the definition of systemic risk and the aim of macroprudential policy, see Constâncio et al. (2019).

[2] Financial Stability Review, ECB, November 2016.

[3] See "Macroprudential policy strategy", ECB.

[4] The MPDB can be accessed in the public SDW on the ECB's website.

interconnectedness. The MPDB indicators[5] are a collection of the most frequently used standard indicators for macroprudential policy analysis, as well as indicators calculated on the basis of various requirements for the purpose of risk identification and monitoring of euro area countries. In order to meet continuously evolving user needs, the MPDB is regularly reviewed, making it an evolving and adjustable product.

This paper is structured as follows: Section 1 is the introduction; Section 2 explains the motivation for setting up the MPDB and the increasing user needs that triggered the project; Section 3 describes the structure and key features of the database; Section 4 points out directions for future enhancements of the database; and, finally, Section 5 provides concluding remarks.[6]

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[5] Underlying series, definitions and calculation steps for all indicators are listed in the MPDB catalogue, which is available in the public SDW on the ECB's website.

[6] A preliminary version of this paper was presented at the Irving Fisher Committee (IFC) – National Bank of Belgium Workshop on "Data needs and Statistics compilation for macroprudential analysis", Brussels, 18-19 May 2017. The current version elaborates on the policy, analytical and institutional motivations for setting up the MPDB, expands the description of some of the database domains (e.g. commercial real estate variables) and continues the discussion on future enhancements.

2 Motivation for setting up the MPDB and user needs

The financial crisis showed that microprudential supervision alone may not be sufficient to guarantee the financial system's resilience to systemic risk and highlighted the need to establish a framework granting prudential authorities the mandate to address such risks using macroprudential instruments.[7] Originally, macroprudential powers in the European Union were established primarily at the national level.[8] However, in an economic entity such as the European Union, characterised by strong trade and financial linkages, an international approach to safeguarding financial stability was warranted.[9] A new European architecture for financial supervision was therefore created, conferring on the ESRB responsibility for macroprudential oversight as well as for the prevention and mitigation of systemic risks to the financial system. The ECB also makes a significant contribution to the macroprudential surveillance of the European financial system and supports the ESRB in the collection and processing of statistical information as well as financial stability-related analysis. The Single Supervisory Mechanism (SSM) Regulation[10] further strengthened the consistency of macroprudential policy across the jurisdictions belonging to the SSM, conferring specific powers and responsibilities in the field of macroprudential policy on the ECB and the national competent authorities or national designated authorities. The Eurosystem is now able to strengthen coordination and address potential cross-country spillovers of macroprudential policies at the national level.[11]

The role of the ECB in the context of macroprudential policy is twofold. First, the ECB is involved in the decision-making process of macroprudential policy in euro area countries. National authorities are required to notify the ECB before implementing or changing a national measure provided for in EU law.[12] The ECB is then required to assess the envisaged macroprudential measure and, if necessary, raise objections, which must be considered by the national authorities. Second, the ECB has the right to apply more stringent measures at the national level for the instruments included in the EU legislation. For example, the ECB may apply higher capital buffer requirements[13]

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[7] ECB (2016).

[8] This is, for example, reflected in Recommendation ESRB/2011/3 of 22 December 2011 on the macro-prudential mandate of national authorities.

[9] Detken and Nymand-Andersen (2013).

[10] Council Regulation (EU) No 1024/2013 of 15 October 2013 conferring specific tasks on the European Central Bank concerning policies relating to the prudential supervision of credit institutions (OJ L 287, 29.10.2013, p. 63).

[11] Macroprudential Bulletin, Issue 1, ECB, March 2016.

[12] Capital Requirements Directive (CRD IV) – Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC (OJ L 176, 27.6.2013, p. 338) – and Capital Requirements Regulation (CRR) – Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012 (OJ L 176, 27.6.2013, p. 1).

[13] Countercyclical capital buffer, systemic risk buffer, capital buffers for global systemically important institutions (G-SIIs) and other systemically important institutions (O-SIIs).

than those set by national authorities. These decisions are taken jointly with the central banks of the Eurosystem and need to be based on a detailed analysis, for which comprehensive and consistent data are a prerequisite.

The establishment of a European framework for financial stability required a solid, harmonised and commonly agreed database to support macroprudential surveillance and macroprudential analysis for EU countries. The MPDB was therefore developed jointly by the ECB and the ESRB to collect in one place the statistical information necessary for consistent cross-country analysis of systemic risk in EU countries, as well as to underpin analytical and policy-oriented analysis supporting the policy discussion. As systemic risks can originate from different parts of the financial system and from imbalances in the macroeconomic environment, macroprudential analysts and policymakers require a comprehensive and high-quality set of economic and financial time series to detect and monitor such risks, including those which stem from developments across borders. In this context, the development of the MPDB constitutes a useful complement to the ongoing efforts at national and international level to build and develop the statistical basis for macroprudential analysis and policymaking, by collecting all the information in a single dataset.

The MPDB has the unique feature of including a wide range of indicators encompassing several domains. In addition to macroeconomic and financial variables, the database includes indicators pertaining to the banking and non-banking sector, as well as indicators covering developments in specific sectors, such as the residential and commercial real estate markets. Given the multifaceted nature of systemic risk, the database includes different transformations of the indicators, making it possible to capture both cyclical and structural developments.

In addition to providing a sound statistical underpinning for risk identification, the MPDB also serves as input for the estimation of models for risk and policy assessment. For example, early-warning models have become a very common tool for predicting vulnerabilities in the run-up to financial crises. In addition to information on financial crisis periods, the estimation of these models requires relatively long time series on macro-financial, credit and banking indicators. The MPDB therefore allows the performance of different early warning methods to be estimated and compared on the basis of a common and harmonised database.[14] Many of these data requirements are relatively recent. Traditional macro-models (e.g. dynamic stochastic general equilibrium (DSGE) models) were mainly used to understand the impact of economic policies by focusing on explaining the economic growth and business cycles. As such, these models did not generally cover banking sector indicators, and even less so the wider financial system. For this reason, the databases developed in the past to support such models were not really suitable to address the needs of data for macroprudential purposes.

Finally, the MPDB also stimulates macroprudential analysis and research both within and outside the European System of Central Banks (ESCB), and should prove relevant for market participants and academics (see Box 2 for confidentiality issues).

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[14] Ongoing work within the ESB and the ESRB is aimed at including information on financial crises in EU countries (Lo Duca et al., 2017) in the MPDB.

Current uses of the MPDB include, among others, the identification of cyclical, real estate and structural risks, the assessment of macroprudential policies, the estimation of early warning models and methods to measure the financial cycle.

Indicators listed in the MPDB have been included in numerous analyses in various flagship ECB and ESRB publications, covering topics ranging from financial stability to risk assessment, macroprudential policy, stress-testing and country monitoring. The most frequent ECB and ESRB publications which regularly rely on MPDB indicators are the Financial Stability Review[15], the Report on Financial Structures[16], the Macroprudential Bulletin[17], Stamp€[18] and the ESRB risk dashboard[19].

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[15]   The Financial Stability Review is available on the ECB's website.

[16]   The Report on Financial Structures is available on the ECB's website.

[17]   The Macroprudential Bulletin is available on the ECB's website.

[18]   See Dees, S., Henry, J. and Martin, R. (eds.), "Stamp€ Stress-test Analytics for Macroprudential Purposes in the euro area", ECB, February 2017.

[19]   The ESRB risk dashboard is available on the ESRB's website.

3 Structure and key features of the database

The MPDB provides a comprehensive set of harmonised, relevant and fit-for-use indicators to analyse the build-up of both cyclical and structural systemic risks. The list of indicators included in the MPDB draws from the relevant academic literature, experience gained through macroprudential analyses and on the indicators used in the ESRB's quantitative risk analysis tools, such as the ESRB risk dashboard. The choice of the set of indicators best suited to meet the needs of macroprudential analysts and policymakers was guided by a number of minimum criteria. First, the envisaged indicators should ensure cross-country comparability. In other words, all the data should be collected according to harmonised reporting requirements across all EU countries. This is a fundamental feature of the MPDB indicators and ensures comparability in the assessment of financial stability risks across the EU. Second, and very much linked to the first criterion, the selected indicators should have large cross-country availability in order to support the macroprudential oversight function covering all EU countries. Third, the indicators should, insofar as possible, also feature a sufficiently long history to enable time series analysis and provide the right characteristics to feed econometric models.

The MPDB integrates a relatively large number of indicators covering user needs for macroprudential analyses, while at the same time satisfying the requirements as regards data quality. The resulting database is structured around the following seven domains:[20]

- Macroeconomic and financial market variables

- Debt and credit variables

- Residential real estate variables

- Commercial real estate variables

- Bank sector variables

- Non-bank variables

- Interconnectedness variables

Unlike all the other ECB datasets, the MPDB was designed as a virtual dataset of selected indicators that are sourced from more than 30 different datasets already available in the SDW with the purpose of gathering in one place the indicators deemed relevant for macroprudential analysis. As such, MPDB data are not per se subject to a dedicated data collection from national central banks (NCBs) or reporting agents based on an ECB regulation or guideline, but simply a repository including selected

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[20] See Annex 1 for an overview of the full MPDB structure.

indicators sourced from their primary datasets (e.g. Balance Sheet Indicators, Monetary financial institutions Interest Rate, Consolidated Banking Data, etc.). Many indicators were already available in the SDW, in databases of other international institutions (the Bank for International Settlements (BIS)[21], the Organisation for Economic Co-operation and Development (OECD)[22], Eurostat[23], IMF[24]) or in platforms provided by commercial data providers (Bloomberg, Thomson Reuters, iBoxx, etc.), whereas a significant number of indicators were also complied (first within their primary dataset) specifically for the purposes of being included in the MPDB.

These unique features imply that the MPDB inherits all characteristics of the underlying datasets from which it sources its indicators. This means that for each MPDB indicator new observations and revisions become available as soon as they are released in the indicator's primary dataset. On the other hand, the heterogeneity of the data sources brings a wide range of data frequencies, from daily (e.g. in the case of some financial market indicators) to annually (e.g. in the case of some commercial real estate indicators). The same heterogeneity applies with respect to the lengths of the time series: for some more traditional indicators, like GDP, data go back as far as the 1950s for some countries, but for other indicators, like forborne exposures (and many other banking indictors), data are available only since the fourth quarter of 2014.

The MPDB significantly increased users' access to the relevant indicators. Macroprudential analysis requires the use of data from many different statistical datasets, as can also be seen from the high-level domains listed above. For this reason, and also because the SDW contains around 19 million time series, it is essential to be able to easily find the relevant data for macroprudential purposes in one place.

Considering that the MPDB comprises around 300 relevant country-level public variables and indicators, grouped along the aforementioned seven domains, a catalogue encompassing all indicators together with underlying SDW codes and indicator calculations is available for download in the SDW. In addition, separate catalogues are also available at domain level. These catalogues also include references to a few time series that cannot be shown in the SDW, but are available in the other data sources mentioned above (BIS, IMF, Bloomberg, and Thomson Reuters).

It should also be noted that the MPDB does not encompass all the quantitative information used within the ECB or ESCB for macroprudential analysis. For instance, macroprudential analysis also makes use of several sources of microdata that are relevant for identifying risks that may arise at the firm level with possible system-wide dimensions and may not necessarily be identified through aggregated data. In fact, looking only at macro aggregates may increase the risk of missing pockets of vulnerability in the system. Moreover, a more granular analysis is often required, even when vulnerabilities are detected at the macro level, to calibrate macroprudential

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[21]   The BIS Statistics Warehouse is available on the BIS website.

[22]   OECD statistics are available on the OECD's website.

[23]   The Eurostat database is available on Eurostat's website.

[24]   IMF data are available on the IMF's website.

tools. Microdata are also relevant for contagion analysis (the horizontal dimension of systemic risk).

The following sections present a summary of the main features of the various MPDB domains.

3.1 Macroeconomic and financial market variables

This first domain covers a very wide range of macroeconomic and financial market variables that can be used to measure the build-up of cyclical and structural systemic risks in the financial system or in the real economy, both at the national and at the European level (euro area or EU). As the indicators included in this domain are intended to cover financial stability risks stemming from macroeconomic developments and imbalances (inflation, growth, current account, competitiveness), from household, corporate and public sector debt or from financial markets (equity, bond, foreign exchange), they include time series related to:

- Macroeconomic aggregates (monetary and real variables)

- Financial market variables

- Risk and uncertainty variables

- Financial condition indicators for the main economic sectors (government sector, households, non-financial corporations)

- Borrowing and lending conditions

These indicators can be used to characterise and estimate financial cycles for European countries and the euro area as a whole. The financial cycle is a widely used measure in financial stability analysis and macroprudential policy, summarising the (co-)movement over time of a range of financial sector variables, covering quantities and prices.[25] The identification of financial cycles takes into account common cyclical fluctuations of total credit, residential property prices, equity prices and benchmark bond yields. More specifically, credit, house prices, equity prices, bond yields, real GDP, unemployment and inflation are used for estimating the financial cycle and identifying how its components contribute to the cycle, from a national or a euro area-wide perspective. The indicators used for estimating the financial cycle are included in the MPDB.

The estimation of the financial cycle requires long time series on all indicators entering the model, to enable the user to identify the movement of the financial cycle and its key components over time. This user need was taken into account in the creation of the MPDB, which therefore contains several indicators with significant historical data. In addition, the full euro area country coverage of MPDB indicators allows for a

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[25] See Schüler, Y., Hiebert, P. and Peltonen, T. (2015), "Characterising the financial cycle: a multivariate and time-varying approach", *Working Paper Series*, No 1846, ECB, September; and Schüler, Y., Hiebert, P. and Peltonen, T. (2017), "Coherent financial cycles for G7 countries: Why extending credit can be an asset", *Working Paper Series,* No 43, ESRB, May.

decomposition of the cycle, as well as of its components, at the individual country level. Charts 1 and 2 illustrate the euro area financial cycle and its components, as well as the minimum-maximum range across euro area countries. The computed financial cycle and its components are calculated on the basis of the time series included in the MPDB.

Chart 1

Euro area financial cycle and range of 19 euro area country cycles

(x-axis: quarters; y-axis: euro area financial cycle deviation from historical median)
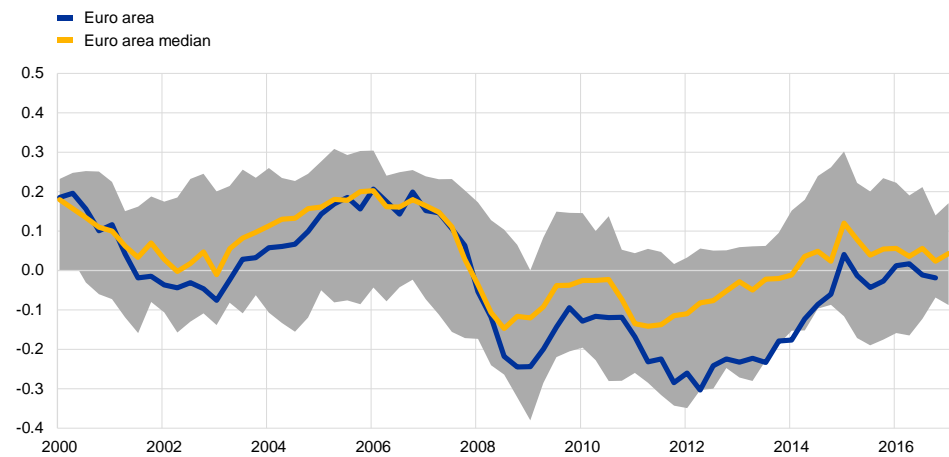
Source: ECB calculations following the methodology in Schüler, Hiebert and Peltonen (2017).
Notes: Latest observation Q1 2017. One-step smoothing procedure: six-quarter moving average with decaying weights. The yellow-shaded area represents the min-max range across the 19 euro area countries.

Chart 2

Euro area financial cycle and its components
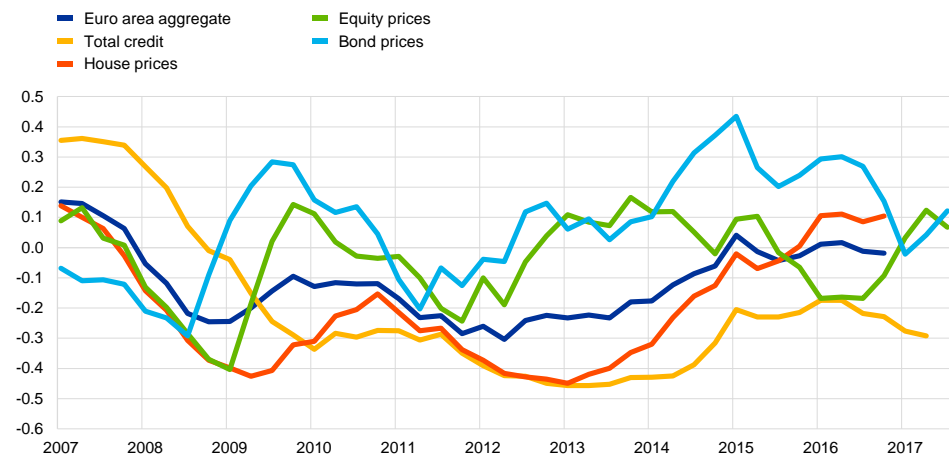
(x-axis: quarters; y-axis: cycle deviation from historical median)

Source: ECB calculations following the methodology in Schüler, Hiebert and Peltonen (2017).
Notes: One-step smoothing procedure, six-quarter moving average with decaying weights. Latest observations: euro area aggregate and house prices Q3 2017; total credit, equity and bond prices Q1 2017.

3.2   Debt and credit variables

According to the Basel Committee on Banking Supervision (BCBS, 2010), an important goal of macroprudential policy relates to the prevention of periods of excess aggregate credit growth that have often been associated with the build-up of leverage and system-wide risk. Several studies find that variables related to the cyclical dimension of credit are among the best performing indicators in signalling crises (including banking crises) in a broad set of countries, in particular during the upswing of the economic cycle.[26] Such indicators include, for example:

- the credit-to-GDP gap[27] (e.g. Babecký et al., 2014; Drehmann and Juselius, 2014; Detken et al., 2014; Behn et al., 2016);

- the deviation of household credit to GDP from its long-run trend (e.g. Detken et al., 2014; Anundsen et al., 2016);

- the deviation of non-financial corporation credit to GDP from its long-run trend (e.g. Anundsen et al., 2016);

- total or bank credit growth (e.g. Schularick and Taylor, 2012; Anundsen et al., 2016; Behn et al., 2016);

- household credit growth (e.g. Büyükkarabacak and Valev, 2010; Detken et al., 2014);

- non-financial corporation credit growth (e.g. Büyükkarabacak and Valev, 2010).

While excessive cyclical credit developments can reflect growing optimism in economic boom periods, potentially leading to risk illusion and excessive risk-taking by financial actors, high indebtedness of the non-financial private sector increases vulnerability to economic shocks. The importance of these variables is also confirmed by empirical findings which emphasise the ability of indicators such as the credit to GDP ratio (e.g. Behn et al., 2016) and the debt service ratio (e.g. Detken et al., 2014; Drehmann and Juselius, 2014) in signalling banking crises well in advance.

Against this background, and complementing the indebtedness variables included in the first domain, the debt and credit domain includes a wide range of variables aimed at the early detection of the build-up of periods of excessive credit growth or the possible emergence of credit bubbles, such as:

- Total credit (loans plus debt securities) granted to households, non-financial corporations and the (private) non-financial sector;

- Bank credit (loans) to various types of counterparty;

- Cross-border exposures;

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[26]   For further details, see Borio and Lowe (2002, 2004), Borio and Drehmann (2009), Behn et al. (2013), Drehmann and Juselius (2014), BCBS (2010), Detken et al. (2014), and Alessi and Detken (2014).

[27]   The credit-to-GDP gap is defined as the deviation of the credit-to-GDP ratio from its long-run trend.

- Information on credit exposures in banks' balance sheets (data from the consolidated prudential COREP and FINREP reports);

- Bank lending survey (BLS) indicators related to banks' credit standards and lending conditions and their expectations regarding future credit standards and lending conditions.[28]

Credit variables are particularly relevant in the context of the setting of the countercyclical capital buffer (CCyB). This macroprudential instrument, which was introduced into EU law by the Capital Requirement Directive (CRD IV), is aimed at reducing the pro-cyclical amplification of financial shocks through the banking system by building up additional capital buffers during boom times, which can be released during episodes of financial stress to mitigate negative effects on the real economy. National designated authorities are required to assess the calibration of the CCyB at quarterly frequency on the basis of a set of indicators used for monitoring cyclical systemic risk. Among these, the credit-to-GDP gap, as suggested by the BCBS, plays the most prominent role, although it is not supposed to drive any automatic setting of the buffer.

The MPDB contains credit and GDP series which are required for the calculation of national credit-to-GDP gaps. In addition to the aggregate credit series, its sectoral components can also be analysed to better understand credit dynamics at the national level and identify whether credit growth is being driven by the household sector, the corporate sector or both. Chart 3 illustrates, as an example, indebtedness of households and non-financial corporations in euro area countries. In the chart, the horizontal and vertical lines represent the estimated macroeconomic imbalance procedure (MIP) benchmarks.[29] The left panel shows the indebtedness of euro area countries across the household and non-financial corporate sectors as a percentage of GDP. The right panel shows an enlarged version of the cluttered area in the left panel. Apart from a comparison with historical values, the cross-country dimension of the database can also be used to compare developments in cross-country and cross-time dimensions.

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[28] The euro area BLS is available on the ECB's website.

[29] The macroeconomic imbalance procedure (MIP) is aimed at identifying, preventing and addressing the emergence of potentially harmful macroeconomic imbalances that could adversely affect economic stability in a particular Member State, the euro area, or the EU as a whole.

Chart 3

Indebtedness across sectors

(percentages of GDP (Q4 2018); x-axis: household indebtedness; y-axis: non-financial corporate indebtedness)
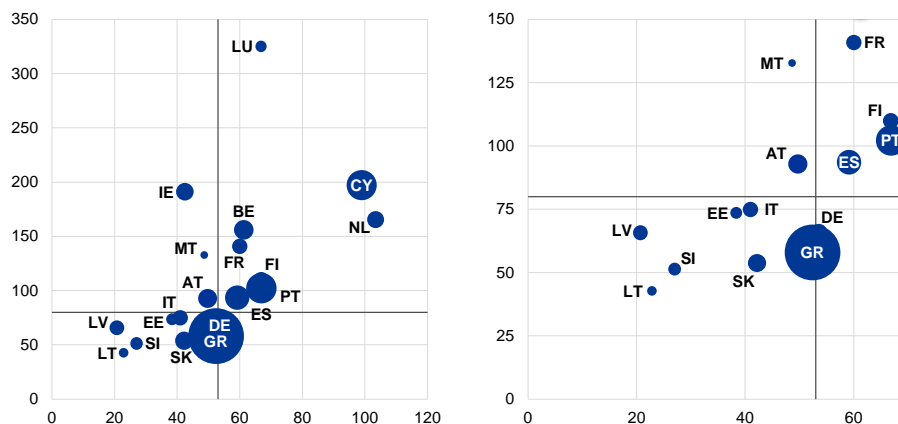
Source: ECB.
Notes: The size of the bubble reflects the level of general government debt as a share of GDP. Non-financial corporate debt is consolidated. Consolidated non-financial corporate debt figures include cross-border inter-company loans, which tend to account for a significant part of debt in countries where a large number of foreign entities, often multinational groups, are located (e.g. Belgium, Cyprus, Ireland, Luxembourg and the Netherlands). The horizontal and vertical lines represent the estimated macroeconomic imbalance procedure (MIP) benchmarks of 80% of GDP for consolidated non-financial corporate debt and 53% of GDP for household debt.

As the dynamics of the credit-to-GDP gap can be heterogeneous over time and across countries, it is important to use a broader set of indicators, including qualitative information, to cross-check and review the buffer guide calculated on the basis of the credit-to-GDP gap. Recommendation ESRB/2014/1[30] requires authorities to monitor an additional set of indicators covering seven categories. In the absence of data availability constraints, this additional set of variables should encompass measures of real estate price valuations, credit developments, external imbalances, strength of bank balance sheets, private sector debt burden, potential mispricing of risks, and measures derived from models which combines the credit-to-GDP gap and a selection of the above measures. Many of these indicators used at the national level can be found in the MPDB.

In addition to the recommended core indicators for setting the CCyB, the Bank of England also proposed a set of non-core indicators to complement the credit-to-GDP gap, encompassing bank and non-bank balance sheet indicators and indicators of market terms and conditions.[31] Furthermore, the BCBS recommends national authorities to consider a broad set of information when taking CCyB decisions, for example information from credit conditions surveys and non-financial entities debt obligations.[32] Most of these indicators are included in the MPDB.

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[30] Recommendation of the European Systemic Risk Board of 18 June 2014 on guidance for setting countercyclical buffer rates (ESRB/2014/1).

[31] See Bank of England (2016), "The Financial Policy Committee's approach to setting the countercyclical capital buffer", policy statement, April.

[32] See BCBS (2010), "Guidance for national authorities operating the countercyclical capital buffer", December.

3.3 Residential real estate variables

Imbalances in residential real estate (RRE) markets have played a significant role in several past financial crises.[33] Often, housing booms have coincided with (broad-based) credit booms, as a result of strong feedback effects between rising house prices and the increased ability of borrowers to borrow against the value of the residential real estate collateral. As documented in Crowe et al. (2013), almost all of the countries that experienced a "twin boom" in real estate and credit markets ended up suffering a financial crisis or a severe contraction of GDP. The severe impact on the real economy of financial and economic crises related to real estate stems from the central role of the real estate sector in the economy and the predominance of bank credit in financing real estate purchases.

Several empirical studies have confirmed the importance of indicators related to residential real estate as useful early-warning indicators of banking crises or vulnerabilities related to real estate markets (e.g. Barrell et al., 2010; Reinhart and Rogoff, 2013; Detken et al., 2014; Ferrari et al., 2015; Anundsen et al., 2016; Behn et al., 2016; and Ciocchetta et al., 2016). Imbalances in real estate markets are therefore also used as input for the more general assessment of cyclical systemic risks (see Section 3.2).

The potentially important role of RRE markets in the build-up of financial vulnerabilities also helps to explain why several macroprudential instruments have been implemented to target risk originating from RRE. These include instruments targeting banks (e.g. sectoral capital requirements) and borrowers (e.g. loan-to-value (LTV), loan-to-income (LTI) and debt-service-to-income (DSTI) caps).[34] Indicators related to credit conditions (LTV, LTI and DSTI ratios) could also be useful to signal the emergence of vulnerabilities in the real estate sector driven by too lax lending standards. In fact, Crowe et al. (2013) find that LTV ratios are significantly associated with real estate price developments. However, empirical testing of the signalling properties of such indicators has so far been hampered by significant data gaps and a lack of harmonised definitions.

The MPDB therefore includes times series on variables that have been identified as potential leading indicators for RRE crises and/or that are the basis for the above-mentioned macroprudential instruments. Some of these areas are, however, still characterised by important gaps in the availability of comprehensive and comparable data for various countries (see Section 4).[35]

Against this background, the MPDB has identified four sets of indicators for the RRE domain:

- Indicators that look at the domestic household sector's balance sheet and its mortgage liabilities.

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[33] See, for example, Crowe et al. (2013) and Hartmann (2015).

[34] For a detailed discussion of macroprudential instruments targeting the real estate sector, see ECB (2019), "Macroprudential analysis of residential real estate markets", *Macroprudential Bulletin*, Issue 7, March.

[35] See, for example, ESRB (2015), Report on residential real estate and financial stability in the EU, December.

- Indicators covering time series that provide information on key features of mortgage loans, such as the interest rate cost of these loans. In future, these should be complemented with comprehensive and comparable data on mortgage loan maturities and on LTV, DSTI and LTI ratios.

- Indicators that focus on time series providing information on house prices and house price valuation.

- Indicators relating to time series that provide information on the supply side of the residential real estate market.

The MPDB puts a strong emphasis on cross-country comparability and therefore provides a good basis for the horizontal analysis of vulnerabilities across European countries, both at the ECB[36] and at the ESRB.[37]

Table 1 presents the residential real estate scoreboard for European countries for the third quarter of 2016, as published in November 2016 in the ESRB report on "Vulnerabilities in the EU residential real estate sector". The indicators are grouped into three different categories according to the type of vulnerability they aim to capture, namely a "collateral stretch" (reflecting house price developments and measures of potential overvaluation of prices), "lending conditions" (signalling availability and pricing of mortgages), and "household stretch" (capturing the households' financial situation and ability to service its debt). In addition to the individual indicators, summary measures are constructed to facilitate a comparison and ranking across countries and to arrive at composite vulnerability scores.[38]

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[36] For an overview of the ECB's framework for assessing financial stability risks stemming from residential real estate markets and for designing macroprudential policy responses, see ECB (2019), *Macroprudential Bulletin*, Issue 7, March.

[37] See ESRB (2016), "Vulnerabilities in the EU residential real estate sector", November.

[38] For a description of the methodology underlying these results, see Box 1 and Annex B in ESRB (2019), "Vulnerabilities in the EU residential real estate sector", November.

Table 1

Residential real estate scoreboard for European countries

Country	Indicators										Summary measures			
	Price Indicators				Lending Indicators			Household Balance Sheet						
	Residential real estate price index, 36m real growth, av. %	Residential price index relative to trend	House price to income ratio (deviation from average in percent)	Econometric model (overvaluation in percent)	Loans to HH for house purchases, 36m real growth, av. %	Loans to HH for HP relative to trend	HH Loan spread	HH debt, % of income	HH financial assets to debt, %	Debt service to income ratio for HH, %	Average rating across indicators	Average rating across Price Indicators	Average rating across Lending Indicators	Average rating across HH BS Indicators
AT	3.6	1.07	29.0	26.0	3.3	0.98	1.6	84.2	351.9	9.8	1.1	2.3	0.7	0.3
BE	1.0	0.94	15.0	-4.0	5.3	1.11	2.0	106.5	481.0	10.6	0.9	0.5	1.0	1.3
CY	0.2	0.88	-11.0	-12.0	-9.4	0.68	1.6	164.5	221.6	21.4	1.1	0.0	0.3	3.0
DE	5.6	1.17	5.0	0.0	2.9	1.03	1.8	84.9	346.1	9.1	0.8	1.8	0.3	0.3
EE	3.6	1.14	4.0	-11.0	3.8	1.12	2.0	71.8	326.4	7.5	0.8	1.3	1.0	0.0
ES	4.9	0.99	9.0	2.0	-3.6	0.75	1.8	97.0	302.3	11.4	0.8	0.8	0.3	1.3
FI	0.1	0.94	5.0	0.0	1.1	0.93	0.6	114.9	210.4	11.7	1.3	0.5	1.0	2.3
FR	1.3	0.93	13.0	3.0	4.5	1.01	1.3	95.5	383.4	10.0	1.0	0.8	1.0	1.3
GR	-0.4	0.90	-17.0	-9.0	-6.1	0.72	2.5	83.1	253.5	18.8	0.7	0.0	0.0	2.0
IE	9.5	1.14	1.0	-3.0	-0.6	0.79	3.0	125.6	272.0	15.2	1.3	1.5	0.0	2.3
IT	-1.4	0.88	-6.0	-6.0	0.4	0.89	1.2	61.2	577.8	10.9	0.3	0.0	0.7	0.3
LT	2.7	0.95	-4.0	-9.0	5.5	0.97	2.0	36.6	407.9	4.7	0.2	0.3	0.3	0.0
LU	5.6	1.07	45.0	-7.0	5.9	1.06	1.8	170.7	248.8	11.7	1.6	1.8	1.0	2.0
LV	7.2	1.32	-2.0	.18.0	-4.8	1.07	2.3	37.0	531.9	4.4	0.5	1.3	0.3	0.0
MT	4.1	1.06	-11.0	-20.0	7.7	1.05	1.9	91.1	450.5	11.4	1.0	0.8	1.3	1.0
NL	6.9	1.04	9.0	2.0	2.6	0.96	1.8	207.2	316.0	19.1	1.3	1.5	0.3	2.0
PT	8.5	1.21	8.0	7.0	-2.6	0.79	1.3	98.3	302.1	13.0	1.5	2.3	0.7	1.7
SI	11.1	1.31	10.0	6.0	2.8	0.89	2.2	45.2	370.3	5.6	0.8	2.5	0.0	0.0
SK	4.5	1.07	-2.0	-13.0	12.4	1.08	1.1	68.9	196.2	9.8	1.3	0.8	2.0	1.0
EA average	4.1	1.05	5.3	-3.47	1.6	0.94	1.8	97.1	344.7	11.4	1.0	1.1	0.6	1.2
EA median	4.1	1.06	5.0	-4.00	2.8	0.97	1.8	91.1	326.4	10.9	1.0	0.8	0.7	1.3
Low	2.5	1.00	4.0	0.0	3.0	1.05	2.0	75.0	280.0	10.0	1.0	1.0	1.0	1.0
Medium	5.0	1.04	10.0	6.0	6.0	1.10	1.5	85.0	260.0	12.0	1.2	1.2	1.2	1.2
High	7.5	1.08	16.0	12.0	9.0	1.15	1.0	95.0	240.0	14.0	1.7	1.7	1.7	1.7

Sources: ECB and ECB calculations.

Notes: For methodology, see the report of the ESRB Working Group on Real Estate Methodologies on "Methodologies for the assessment of real estate vulnerabilities and macroprudential policies: residential real estate", September 2019. Data as at Q1 2019. Colour coding: a discrete risk rating with four categories is applied to each indicator based on whether the indicator value exceeds certain indicative threshold values. The threshold values, which are reported in the lower part of the table (Low, Medium and High), are based on early warning model thresholds and/or the views of experts, after checking the overall distribution of the indicator across time and countries. The risk ratings are as follows: 0 – no risk, no colour; 1 – low risk, yellow; 2 – medium risk, orange; 3 – high risk, red. In addition, the average risk rating is computed both across all the groups of indicators and across indicators in the same category (last four columns). It ranges from 0 to 3 and is calculated as the average across indicators after they are transformed into ratings on the basis of the thresholds. For information on the valuation metrics, see Box 3 in *Financial Stability Review*, ECB, June 2011, and Box 3 in *Financial Stability Review*, ECB, November 2015. The latest observation Q1 2019. HH stands for household.

It should be noted that an indicator-based horizontal analysis of vulnerabilities can only serve as a starting point for a more detailed analysis which takes into account country-specific structural and institutional factors as well as expert judgement.

3.4   Commercial real estate variables

Excessive developments in the commercial real estate (CRE) sector can harm the stability of the financial sector and have negative consequences for the real economy. CRE markets are inherently more pro-cyclical than RRE markets owing to more inelastic supply conditions, stronger co-movements with broad macroeconomic developments and a more international investor base (ESRB, 2015). Furthermore, providers of CRE financing are diverse, encompassing both bank and non-bank entities, such as insurance companies and asset managers. In addition, the CRE sector is heterogeneous, both with respect to the type of property being financed (e.g. retail, industrial, office, residential) and the underlying purpose of the purchase. Commercial property is more often bought as a speculative investment by professional investors than residential property.

Given the significant data gaps in the CRE domain, the MPDB currently covers only a very limited number of CRE-related variables, encompassing mainly available CRE price indicators and information on CRE-related exposures in the financial sector (even if these exposures may only be considered to be broad proxies of what would fall under a more precise definition of CRE).[39] It is likely that ongoing work on closing data gaps in real estate (see Section 4.1) will eventually also allow an extension of the number of CRE-related indicators in future versions of the MPDB.

3.5   Bank sector variables

Indicators related to the banking sector are of the utmost importance for monitoring the emergence of vulnerabilities. The great financial crisis showed that the financial system in general, and the banking sector in particular, can be an important source of and propagation channel for shocks. In fact, while vulnerabilities can materialise within the banking sector, the degree of banks' resilience determines the degree to which adverse developments affect the real economy and are potentially amplified by characteristics of the banking sector itself. A banking sector characterised by high capitalisation, low leverage and a low degree of liquidity mismatch is better able to withstand negative shocks and to limit their propagation to the real economy.

Several studies in the early-warning literature reveal that the probability of banking crises is reduced when the banking sector is characterised by:

- low leverage (e.g. Barrell et al., 2010; Anundsen et al., 2016; Behn et al., 2016)

- lower liquidity mismatch (e.g. Barrell et al., 2010; Drehman and Juselius, 2014; Anundsen et al., 2016),

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[39]   See, for example, ESRB (2015).

- a high capital ratio (Betz et al. 2014).

Betz et al. (2014) find that, at the country level, rapid growth in non-core liabilities,[40] a high debt-to-equity ratio and a large banking sector are associated with higher probabilities of bank distress. The role of the banking sector in both originating and transmitting adverse shocks is the subject of a vast body of theoretical studies. According to the literature, two important transmission channels are the bank balance sheet and the liquidity channel. While the former emphasises the role of bank net worth and equity position in influencing credit conditions, the latter focuses on the role of liquidity in influencing banks' ability to provide credit to the economy.[41]

The MPDB includes several indicators used to measure banking sector performance and vulnerabilities in the different EU countries as well as at the EU and euro area level. These indicators are grouped into the following categories:

- Banking structure: This set of indicators provides information on the degree of financial intermediation and banking concentration to support the identification of structural risks.

- Main elements of the income statement: These indicators show basic components of the profit and loss account.

- Profitability: Based on the main elements of the income statement, these indicators include various ratios concerning profitability and efficiency.

- Main elements of the balance sheet: These indicators cover the structure of assets and liabilities on a detailed basis.

- Liquidity and funding: These indicators are aimed at assessing the resilience of banks' liquidity position, the diversification of funding sources and maturity mismatches between assets and liabilities. For instance, the loan-to-deposit ratio provides information on the banking sector's reliance on funding sources other than customer deposits. A high value of this ratio, implying that the financing of the stock of loans has to rely on additional wholesale funding, could signal higher aggregated liquidity risk for those banking systems, since wholesale funding tends to be more volatile than customer deposits.

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[40] Non-core liabilities are bank liabilities other than retail deposits.

[41] See BCBS (2011).

Chart 4

Loan-to-deposit ratio of EU banking sector

(percentages)

- Q2 2019
- Q2 2018
- ● Three-year average
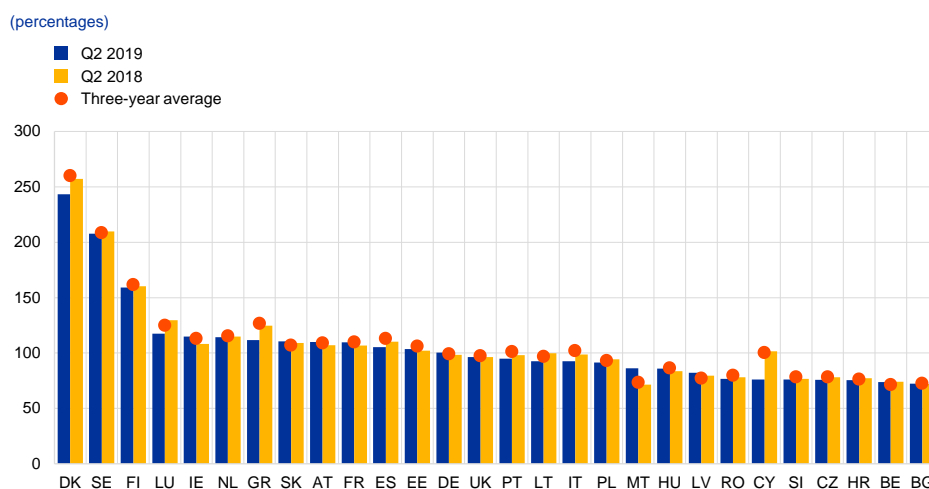
Sources: ECB, ESRB risk dashboard.
Notes: Monetary financial institution (MFI) sector excluding the ESCB. Data refer to the ratio between total loans and total deposits vis-à-vis domestic and euro area households, non-financial corporations (NFCs) and non-MFI residents excluding the general government. Mortgage banks in Denmark, which represent around 55% of total MFI loans to domestic NFCs, are not allowed to take deposits, owing to regulations, but must fund their lending solely through the issuance of covered bonds.

- Lending and leverage: Indicators in this category allow the assessment of different types of exposure related to the provision of credit to the real economy, such as risks from lending in foreign currency, variable rate loans, large exposures and loan concentration per sector, as well as potential vulnerabilities related to the degree of balance sheet leverage (leverage indicator).

Chart 5

EU banking sector leverage

(ratio of total assets to capital)

- Q1 2019
- Q1 2018
- ● Three-year average
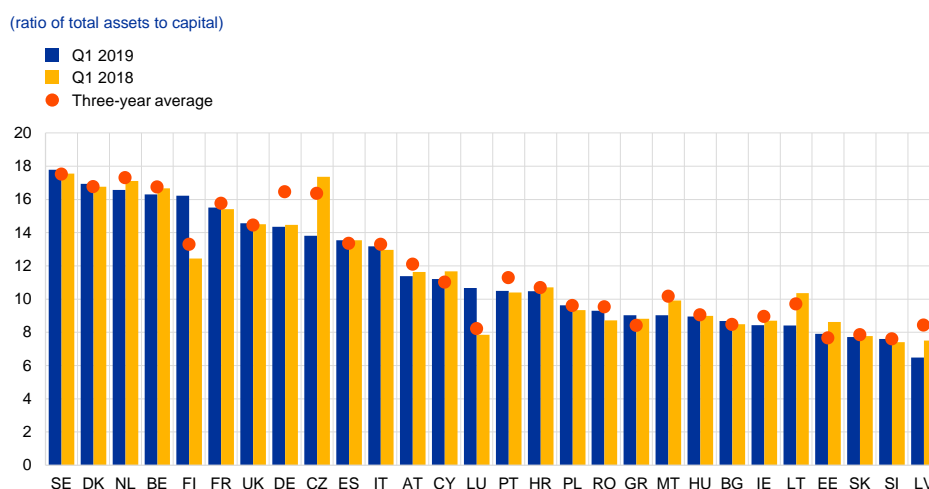
Source: ECB.
Notes: Total assets as a multiple of capital for domestic banking groups and stand-alone credit institutions. Consolidated Banking Data.

- Capital: This category assesses the capacity of the financial sector to absorb losses. Capital adequacy can be viewed as a measure of financial soundness since lenders need to have sufficient capital to absorb shocks on both the asset and the liability sides of their balance sheets. Indicators cover the main regulatory

capital ratios, the quantity and quality of regulatory capital and the composition of the risk-weighted assets (broken down by type of risk).

- Asset quality: The indicators assess the credit quality of the loan portfolio and banks' related provisioning.

- Locational funding indicators: This category complements indicators provided in other categories.

3.6 Non-bank variables

As systemic risks can also emerge outside the banking sector, macroprudential monitoring must also encompass the other segments of the financial system. This is even more relevant given current developments, including the shift to market-based financing or to more lightly regulated intermediaries.[42] Identifying the build-up of systemic risk in the "shadow banking" sector is a priority on the international policy agenda, as clearly illustrated by the work of the Financial Stability Board (FSB).[43]

Monitoring the non-bank sector is not an easy task, principally because of the very heterogeneous entities and activities which it encompasses. Besides insurance companies and pension funds, the non-bank sector also comprises entities such as money market funds, real estate investment funds, special purpose vehicles and hedge funds. Therefore, to assess risks stemming from this sector, policymakers have to consider both the type of intermediary and the nature of risks inherent in the intermediary's activities and balance sheet. As outlined by Doyle et al. (2016), potential risks in the non-bank sector might arise from liquidity and maturity mismatches, excessive leverage and pro-cyclicality of margins and haircuts. In addition, Calimani et al. (2017) explain how asset managers can exacerbate risk contagion, triggered by the liquidity shock to the banking network.

The MPDB includes a domain dedicated to indicators useful for assessing risks to financial stability originating from outside the banking sector. The indicators deal, for example, with structural features of insurance corporations and pension funds and their exposures to sovereigns. It also covers information on financial vehicle corporations (FVCs).

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[42] See Doyle et al. (2016).

[43] "Shadow banking" can broadly be defined as credit intermediation carried out by intermediaries and activities outside of the regulated banking system. See, for instance, the FSB's Global Shadow Banking Monitoring Report 2015.

Growth of components of the EU financial sector

(percentages; total assets annualised growth rates)

- Credit institutions
- Insurance corporations and pension funds
- Investment funds and OFIs
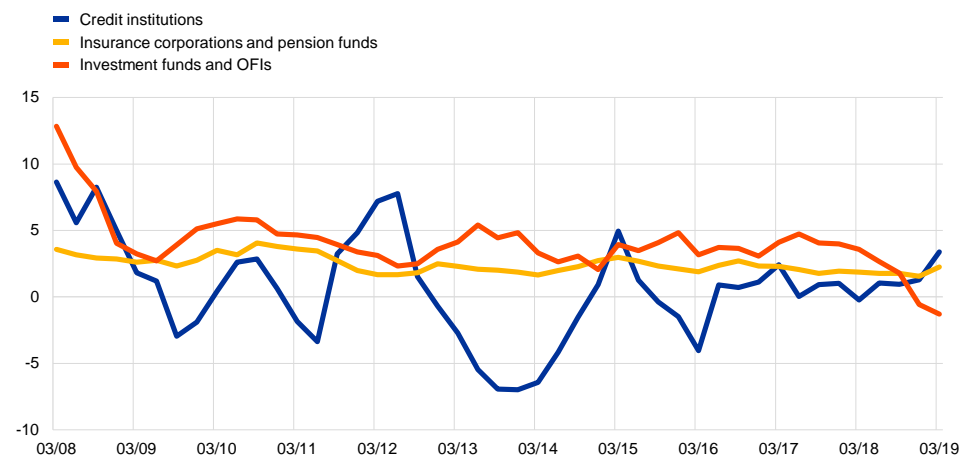
Source: ECB.
Notes: Data based on financial accounts and monetary statistics. Data refer to the non-consolidated balance sheets of the respective entities. OFIs stands for other financial institutions. Latest observation Q1 2019.
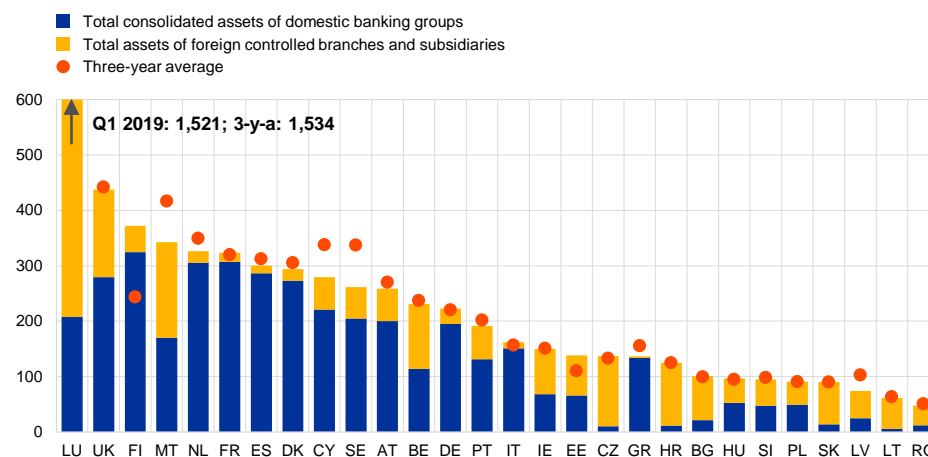
3.7 Interconnectedness variables

Interconnectedness plays a major role in the propagation of financial distress, both within the financial sector and across countries. The financial crisis made clear that direct and indirect financial linkages (i.e. bilateral contractual obligations or exposures to common assets) may result in a contagion cascade with the potential of spreading financial distress worldwide. Accordingly, in the aftermath of the crisis, both academics and policymakers have devoted research efforts to the study of the relationship between interconnectedness and systemic risk, i.e. the cross-sectional dimension of systemic risk, mostly by means of network models. Recent studies have concluded that the network structure matters in both the origination (Allen et al., 2011) and the transmission of systemic risk (e.g. Gai and Kapadia, 2010; Georg, 2013; Greenwood, Landier and Thesmar (2015)). Even though network literature applies primarily micro (institution-level) data in the analysis, certain types of risk related to interconnectedness can be monitored on the basis of the macro variables.

The MPDB includes variables that capture interconnectedness within the financial system, such as, among others, the ratio of total bank assets to GDP (see Chart 7), banks' interbank liabilities (in addition to their interbank assets) and positions in derivatives. As noted above, these macro variables do not allow for granular modelling of interlinkages within the financial system and should be considered as proxies. Nevertheless, they can provide useful insights into the actual structure of the network and help to assess the approximate level of interconnectedness. Most of these indicators are also used in the ESRB's quantitative risk analysis tools.

Chart 7

Banking sector size

(percentages; share of nominal GDP)

- ■ Total consolidated assets of domestic banking groups
- ■ Total assets of foreign controlled branches and subsidiaries
- ● Three-year average

Q1 2019: 1,521; 3-y-a: 1,534

Sources: ECB and Eurostat.
Notes: Based on Consolidated Banking Data. Latest observation Q1 2019.

Box 1
Comparison between the MPDB and the IMF's Financial Soundness Indicators (FSI)

The IMF's Financial Soundness Indicators (FSIs) project was the first structured initiative aimed at compiling a database specifically tailored to macroprudential statistical needs and analysis. The regular data collection started in 2008, following two preliminary implementation phases: a) the development of the compilation guide meant to set the methodological standards to derive the FSIs, and b) an initial pilot data collection exercise that began in 2006.

The main characteristics of the MPDB and FSIs are summarised in Table A below. FSIs currently cover around 40 indicators (52 in the revised list of indicators which has yet to be implemented), mainly focused on the financial system and their corporate and household counterparties. The MPDB is much broader in scope (around 300 indicators), also encompassing the macroeconomic environment, financial markets, debt/credit developments and the government sector. Such broader coverage results from the availability of a large variety of in-house statistics. On the other hand, the country coverage is significantly higher in the FSIs than in the MPDB (103 countries vs 28 EU countries).

Another notable difference is that all data in the MPDB are fully harmonised across countries in terms of statistical methodologies. In the case of the FSIs, given the much higher coverage of countries, there is still scope for enhancing the comparability and homogeneity of data across all countries, and the FSIs compilation guide is playing an important role in this respect.

Table A

Comparison of the MPDB and FSIs

	MPDB	FSIs
Country coverage	28 (EU countries)	103
Number of indicators	300	40
Overlapping	~30 indicators	~30 indicators
Harmonisation	Fully harmonised data	Scope to enhance comparability of cross-country data
Data collection	Selected data already available at the ECB	Dedicated data collection
Frequency	Depends on the underlying data (generally monthly or quarterly)	Quarterly
Release year	2015	2006 pilot exercise/2008 regular reporting

Sources: ECB, IMF.

Box 2

Confidentiality regime and the three layers of the MPDB

The MPDB follows the dissemination policy in place for the datasets already available in the SDW, thereby being fully compliant with the confidentiality features of the underlying data.

In this regard, the MPDB has three different layers, which differ in terms of data availability:

- ECB internal MPDB

- ESCB layer of the MPDB

- Public MPDB

ECB internal MPDB

ECB users can access the entire content of the MPDB, including data sourced from commercial data providers. In some cases, authorisation to access particular datasets is based on the business-related "need to know" principle to ensure that information system resources are only accessed by authorised individuals who need those resources to carry out their work. Moreover, in this first layer, some of the data from commercial data providers are not available to users, as the contracts forbid the sharing of these data outside of the ECB. However, the sharing of tickers for specific variables is allowed. If the information is not visible to users directly, the tickers are included in the MPDB catalogues, which are available in the node descriptions.

ESCB layer of the MPDB

Data are visible to the ESCB and also to associated institutions for which a memorandum of understanding is in place: the European Banking Authority (EBA), the European Commission, the European Insurance and Occupational Pensions Authority (EIOPA), the European Securities and Markets Authority (ESMA), the European Stability Mechanism (ESM), the European Systemic Risk Board (ESRB) and the Bank for International Settlements (BIS). Also in this layer, some of the data from commercial data providers are not available to users (see above for more detail). If the variables coming from third institutions (e.g. the OECD and the BIS) are not available in this layer, the MPDB catalogues gives clear instructions on where and how to obtain them.

Public MPDB

Since the start of the project, much effort has been put into making as much data as possible available to a wider audience, be that the ESCB or the general public. A review took place to reassess the confidentiality classification of selected time series. As a consequence, around 100 additional variables previously only available in the ECB internal or ESCB layer are now included in the public MPDB.

Admittedly, the coverage of the MPDB available to the general public is limited compared to the ECB layer, or even the ESCB layer, as a significant amount of data reported to the ECB from national authorities is flagged as non-publishable and thus can only be shared within the ESCB.

Nevertheless, the public layer of the MPDB is expected to be a useful reference, providing as much information as possible in one place. As in the ESCB layer, the MPDB catalogue provides clear instructions on where and how to obtain certain time series from commercial providers or other institutions (e.g. the OECD and the BIS).

4 Future enhancements

4.1 Closing remaining data gaps

Notwithstanding the effort put into creating a comprehensive dataset, some data gaps still exist. Data gaps mostly affect indicators related to the residential and commercial real estate sectors and non-banking intermediaries.

The analysis of risks and vulnerabilities in the residential and commercial real estate sectors is still hampered by severe data gaps and, until recently, by the absence of commonly agreed definitions of RRE and CRE. These data gaps are the result of a lack of harmonised definitions as well as the absence of harmonised standards for the production and collection of statistical information. On the RRE side, gaps mainly affect the availability of comparable, high-quality data for RRE credit standards indicators, such as the loan-to-value (LTV) ratio, the loan-to-income (LTI) ratio, the loan service-to-income (LSTI), the debt-to-income (DTI) ratio and the debt service-to-income (DSTI) ratio. This hampers both the monitoring of emerging vulnerabilities in the RRE sector and the calibration of borrower-based macroprudential instruments to address them.

On the CRE side, ESRB work[44] concluded that the absence of a harmonised working definition of commercial property and the lack of a granular and consistent data framework to capture broader market developments made the analyses of systemic risks problematic. Data gaps for CRE encompass several dimensions, such as the physical market, the exposures of funding providers and lending standards – i.e. indicators such as the interest coverage ratio (ICR) and the debt service coverage ratio (DSCR).[45]

An important first step towards closing real estate data gaps was achieved with the publication of Recommendation ESRB/2016/14,[46] which lay the foundations for establishing national frameworks for monitoring developments in residential and commercial real estate markets based on a set of harmonised and granular indicators. Due to the endeavour needed to produce such a wealth of information and to collect it, the closure of real estate data gaps can only be envisaged for the medium to long term. Data gaps in the area of residential and commercial real estate are difficult to bridge in a satisfactory fashion through ad hoc surveys. A good and comparable dataset on very important parameters for the macroprudential analysis of RRE (such as LTV ratios) will require moves towards common definitions and co-ordinated collections of data that are at least representative for the domestic mortgage and housing markets, which is exactly what the ESRB Recommendation on closing real estate data gaps aims to do.

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[44] ESRB (2015).

[45] Dierick et al. (2017).

[46] Recommendation of the European Systemic Risk Board of 31 October 20 on closing real estate data gaps (ESRB/2016/14).

While the production of data is progressing on the national authorities' side, some enhancements of the real estate indicators in the MPDB can be expected as a result of newly available information. First, in compliance with the Recommendation ESRB/2016/14, the European Supervisory Authorities (the EBA, EIOPA and ESMA) have published data already available on RRE and CRE. In April 2018 the EBA included an additional page in its updated risk dashboard[47] to disclose aggregated exposures to real estate activities (NACE code L) and the construction sector (NACE code F). Second, information on the insurance sector's exposures to RRE and CRE can be sourced from EIOPA's expanded set of Solvency II statistics. In addition to the potential addition of these indicators, further improvements towards the closing of data gaps in the real estate sector could be expected in 2021 following the implementation of the ESRB Recommendation on closing real estate data gaps and in connection with the AnaCredit[48] project, which will provide granular loan information covering the non-financial corporation sector.

Data gaps also constitute an obstacle for the monitoring of risks in the non-bank sector, but important improvements are being made in this respect. An important step forward in the monitoring of the shadow banking sector was made in 2016 with the publication of the ESRB's first "EU Shadow Banking Monitor"[49] and a paper on this subject by Grillet-Aubert et al. (2016). In addition, oversight of the EU insurance sector has been significantly improved recently by the availability of new data based on Solvency II reporting.[50]

4.2   Enhancing coverage in the area of non-banks

Currently, the MPDB gives prominence to the banking sector in line with the focus on the ECB's role in macroprudential policy. While many systemic crises are characterised by bank failures or bail-outs, experience shows that financial instability is not always caused or triggered by traditional banking intermediation. As the Regulation establishing the ESRB[51] gives it a mandate to oversee systemic risk in the financial system as a whole, a further development of the MPDB to allow for the monitoring of financial stability risks stemming from outside the banking sector would support the ESRB in its tasks. One example of the direct application of the non-banking data is the ESRB Heatmap – a risk analysis tool currently under development. The Heatmap will help policymakers and financial stability analysts to monitor the EU financial system and the potential build-up of systemic risks. Once finalised, the tool will allow a comprehensive cross-country and cross-sectoral analysis of the financial system. To achieve this, the input of high-quality data covering non-banking sectors is essential.

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[47]   Risk Dashboard – Data as of Q4 2017, EBA, April 2018.

[48]   "AnaCredit" stands for Analytical Credit dataset. Information about AnaCredit is available on the ECB's website.

[49]   EU Shadow Banking Monitor, No 1, ESRB, July 2016.

[50]   These data are available to the ESRB on an aggregated basis, based on an agreement with EIOPA. The first transmission, comprising insurance data for the third quarter of 2016, took place in March 2017.

[51]   Regulation (EU) No 1092/2010 of the European Parliament and of the Council of 24 November 2010 on European Union macro-prudential oversight of the financial system and establishing a European Systemic Risk Board (OJ L 331, 15.12.2010, p. 1).

Non-bank entities and activities contributed to the propagation of the global financial crisis. The securitisation of mortgage loans prior to the crisis increased vulnerabilities and led to over-borrowing. Following the failure of Lehman Brothers, money market funds played an amplifying role in the global financial crisis. So too did the near-failure of AIG, an insurer which had become "too big to fail". These examples from recent events show that institutions other than traditional banks can contribute to financial instability – both in their own right and through interconnectedness with banks.

Identifying and addressing such risks and assessing the resilience of the financial system are becoming ever more important with the sizeable growth of the non-bank financial system in the EU.

In addition, the drive toward greater market financing – a key goal of the EU capital markets union (CMU) initiative[52] – is likely to spark further growth among non-banks.[53]

The materialisation of systemic risks emanating from non-banks can be understood in similar terms to those from banking. The impact, sources and transmission channels, however, may vary substantially across sectors:

- Credit growth and leverage – by providing services to the real economy some financial firms may take on leverage and undertake maturity transformation. Excessive leverage amplifies the financial cycle, allowing more borrowing to take place, and may lead to a reduction in the resilience of market players. In addition, in the event of a dry-up, reliance on short-term and unstable funding may lead to fire sales, market illiquidity and contagion as firms seek to meet withdrawals.

- Interconnectedness – links between financial institutions can help manage risk and distribute funds to where they can be deployed more effectively. Interlinkages between entities may also reduce the system's ability to withstand stress, given direct and indirect contagion channels. Risks may also materialise when banks provide financial support to non-bank financial entities beyond contractual obligations (step-in risk).

- Too big to fail – in some cases non-bank entities can become systemically important. For example, mandatory clearing of standard derivatives through central counterparties (CCPs) has the potential to increase transparency and the stability of the network, but it also creates new networks and concentrates risks at CCPs. Owing to their central position in the network, CCPs can be considered to be systemically important.

- Granular data will be increasingly important in the further development of the MPDB, especially for the non-bank sector where the data gaps are relatively significant. EMIR[54] data will play a central role in these developments, as they provide in-depth coverage of the derivatives markets in the EU. In particular,

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[52] See "Capital markets union – A plan to unlock funding for Europe's growth", European Commission.

[53] For more information on the main structural features of and developments in the broader euro area financial sector, please see Report on financial structures, ECB, October 2017.

[54] The European Market Infrastructure Regulation (EMIR) implements in EU law the global initiatives pursued after the financial crisis to make derivatives markets safer by, among other things, imposing an obligation to report all details of derivatives transactions to trade repositories.

derivative contracts of all EU-located legal persons covering all derivatives classes, including credit, commodity, equity, interest rate and foreign exchange derivatives, are subject to EMIR data reporting obligations. The ESRB has already published a number of papers using EMIR data on topics such as credit default swap (CDS) usage, interest rate risk in banking, discriminatory pricing, central clearing, and portfolio compression, and it is currently involved in other projects on developing systemic risk indicators and maps of EU financial system interconnectedness. Once work in this area has been completed and relevant macroprudential indicators have been made available in the SDW, the MPDB will also capture them in the relevant domains.

4.3 Regular view of the MPDB and future enhancements

- In order to ensure that the MPDB evolves to meet users' changing needs and encompasses all indicators that are useful for macroprudential analysis, the database is regularly reviewed. Following its first publication in September 2017, the MPDB was enriched with 27 new indicators, mainly related to the banking sector. In 2018, a comprehensive review of the database was conducted and a number of enhancements are currently being implemented.

- First, the MPDB will be enhanced by adding indicators of credit flows. The database currently covers a wide selection of debt and credit variables, bank credit indicators being of particular use and importance. Most of the existent bank credit indicators in the MPDB refer to outstanding amounts at the end of the period (stocks). However, for risk identification and analysis, information on financial transactions between institutional units and rest of the world are also important.

Second, indicators of foreign bank assets will be added, given their importance for macroprudential policy analysis. Currently, the MPDB includes a foreign bank assets indicator sourced from the BIS which covers bank assets of domestic banks for all countries combined. The country coverage of BIS, as a counterparty, provides a very complete image of foreign bank assets of euro area countries. Unfortunately, the sample of EU countries is very limited in the BIS data, covering only 11 countries. In order to cover all EU countries, and for easier access of data from the SDW, Consolidated Banking Data (CBD) series covering foreign bank assets will also be included in the MPDB.

Third, a panel version of the crises database developed by the ECB and the ESRB will be added to the MPDB and will be made available in the SDW. The "database for financial crises in European countries"[55] provides precise chronological definitions of financial crisis events to support the calibration of models in macroprudential analysis and policy. As such, it provides information for all European countries on the start and end dates of financial crises, the length of the post-crisis adjustment period, a detailed classification of crises based on their origin and nature and, finally, qualitative

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[55]   See Lo Duca et al. (2017).

information about crisis events and policy responses. The ECB/ESRB crises database is a natural complement to the MPDB for macroprudential surveillance and policy assessment. In fact, while the crises database provides historical information on distress events and allows vulnerable periods preceding financial crises to be identified, the MPDB includes a wide range of indicators that can be used in an early-warning framework for the early identification of vulnerabilities. In other words, while the crises database provides the "left-hand side" dependent variable of a regression equation, the MPDB provides the "right-hand side" explanatory variables. Currently, the crises database is publicly available for download in the form of an Excel file.[56] However, this format suffers from a number of drawbacks. First, it is not ready to be imported into statistical/econometric software. Second, it is not accessible from the SDW. Third, while complementing the information in the MPDB, the information on crisis dates is not included in the MPDB.

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[56] The file is available on the ECB's website.

5   Conclusions

To provide a suitable statistical basis for macroprudential analyses and policies, a comprehensive set of high-quality data and indicators is required. Given that systemic risk can originate from different parts of the financial system and from imbalances in the macroeconomic environment, a wide set of statistics on macroeconomic variables, financial and real estate markets, credit, debt and funding patterns is needed. This paper describes a major initiative undertaken by the ECB and ESCB, in cooperation with the ESRB, to assemble a comprehensive statistical repository in the form of the Macroprudential Database (MPDB). The paper sets out the rationale for setting up the MPDB, describes the structure of the database and provides a broad overview of its indicators. Relevant confidentiality issues are also dealt with. The development and implementation of the MPDB has shown once more how cooperation and the involvement of financial stability experts and statisticians can create synergies and add value in terms of conceptual analysis, technical infrastructures and the collection and compilation of data.

With the creation of the MPDB, an important first step was taken, but more remains to be done. Data gaps still exist, especially in certain domains of the MPDB, and they will have to be filled, always being conscious of the burden on data compilers and the need to balance the benefits and costs of additional data. Progress in removing data gaps will, of course, be aligned with the developments in the main international standards and initiatives, such as the G-20 Data Gaps Initiative.[57] Data gaps appear to still be particularly relevant in the area of residential and commercial real estate. A further important challenge will be continuing to expand coverage of non-bank credit intermediation, given the growing relevance of the "shadow-banking" sector. Progress in the EU-driven project aimed at developing a capital markets union will make this area even more relevant. More generally, the MPDB will be reviewed regularly to ensure it remains a robust and harmonised data system capable of satisfying the information needs of macroprudential analysts and policymakers.

The potential of existing aggregate statistics has largely already been incorporated into the development of the MPDB. However, the closing of the above-mentioned data gaps will have to wait for the availability of new indicators derived from granular datasets like AnaCredit, Securities Holding Statistics (SHS), MMSR (Money Market Statistical Reporting) and EMIR data, which are all currently in the early stages of data collection. Therefore, it is expected that, in the coming years, a whole battery of new indicators based on transaction-level data will further enrich the MPDB.

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[57]   More information about the G-20 Data Gaps Initiative is available on the IMF's website.

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Annex 1: MPDB structure

The database consists of seven domains with various sub-domains and has the following structure:

- Macroeconomic and financial market variables

    - Monetary indicators

    - Macroeconomic indicators

    - GDP indicators

    - Foreign exchange indicators

    - Financial market indicators

    - Risk and uncertainty indicators

    - Financial condition indicators

    - Borrowing and lending indicators

- Debt and credit variables

    - Total credit and debt service indicators

    - Bank credit indicators

    - Financial sector credit by sub-sector (whom-to-whom accounts)

    - Cross border / currency / securities exposures

    - Credit exposure of banks (FINREP data)

    - Credit exposure of banks (COREP data)

    - Credit conditions according to the BLS

- Residential real estate variables

    - Mortgage debt and household balance sheet

    - Mortgage loan features / credit standards

    - House price and house price valuation indicators

    - Housing transactions and supply side

- Commercial real estate variables

    - CRE market: risk indicators

- Financial sector exposure to CRE

- Bank sector variables

  - Banking structure

  - Main elements of the profit and loss account

  - Profitability

  - Main elements of the balance sheet

  - Liquidity and funding

  - Lending and leverage

  - Capital

  - Asset quality

  - Locational funding indicators

- Non-bank variables

  - Insurance companies and pension funds

  - Other financial institutions

- Interconnectedness variables

  - Interconnectedness variables

Annex 2: Members of the MPDB Workstream

Member of the MPDB Workstream of the Macroprudential Analysis Group of the ESCB/SSM Financial Stability Committee

Member	Organisation
Thomas Schepens (c)	Nationale Bank van België/Banque Nationale de Belgique
Martin Völpel (c)	Deutsche Bundesbank
Vasiliki Nydrioti	Bank of Greece
Javier Delgado	Banco de España
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Geoffrey Devost	Banque de France (ACPR)
Antoine Lalliard	Banque de France
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Note: Domain coordinators are indicated with (c).

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Annex 3: List of abbreviations

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

Other	
BCBS	Basel Committee on Banking Supervision
BoE	Bank of England
BIS	Bank for International Settlements
CCP	Central counterparty
CCyB	Countercyclical capital buffer
CMU	Capital markets union
CRD IV	Capital Requirement Directive
CRE	Commercial real estate
DSTI	Debt service-to-income
EA	Euro area
ECB	European Central Bank
ESCB	European System of Central Banks
ESRB	European Systemic Risk Board
EU	European Union
FSI	Financial Soundness Indicators
GDP	Gross domestic product
IMF	International Monetary Fund
LTI	Loan-to-income
LTV	Loan-to-value
MPDB	Macroprudential Database
OECD	Organisation for Economic Co-operation and Development
RRE	Residential real estate
SDW	Statistical Data Warehouse
SSM	Single Supervisory Mechanism

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