Methodologies for the assessment of real estate vulnerabilities and macroprudential policies: residential real estate

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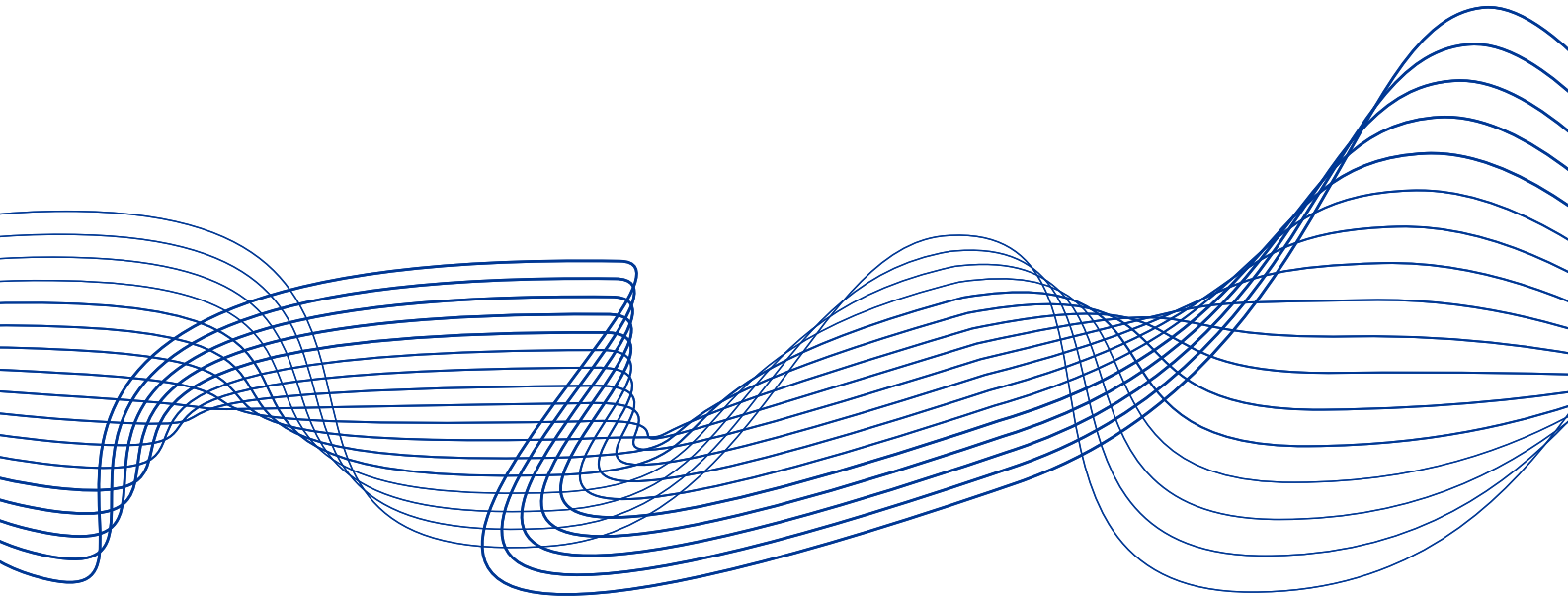
by
Working Group on Real Estate Methodologies



ESRB
European Systemic Risk Board
European System of Financial Supervision

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1 Executive summary

This Report documents the quantitative framework developed by the Working Group on Real Estate Methodologies (WG-REM) for the assessment of both residential real estate (RRE) vulnerabilities and the related macroprudential policies across EU countries, in terms of appropriateness and sufficiency. The framework is structured in three modules that come in a sequence, which allows exploiting the increasing stock of information gathered as the process moves forward. The final outcome is a collection of three templates that are meant to enhance the ESRB communication strategy, as they are designed to explain the underlying elements of the combined ratings in the intensity of the RRE vulnerabilities, in the degree of appropriateness and in that of sufficiency of the macroprudential tools activated in a country.

A fully-fledged framework requires a set of consistent guidelines regarding: i) the detection of the sources and the intensity of systemic vulnerabilities stemming from RRE developments; ii) the assessment of the appropriateness of the related macro-prudential policies activated in a country; iii) the assessment of the sufficiency of the same policies, namely the tool calibration and the monitoring of the ensuing impact on the intensity of the identified vulnerabilities.The latter task is currently challenging since the understanding of the operativeness of macroprudential policies is still limited due to the short, although recently increasing, experience cumulated so far around the world, and in particular in Europe. Following high level reflections on a conceptual definition of policy sufficiency, the WG-REM developed a set of criteria to turn it operative and to provide concrete assessment guidance.

1.1 Risk assessment

The RRE risk assessment methodology consists of three steps.

Step 0 – Analysis of the cyclical position of residential real estate markets

Characterising the cyclical position of RRE markets and their connection with the financial and business cycles is an important element in both the risk assessment and policy discussion. The information content of statistical indicators and the timing of materialisation of vulnerabilities may differ depending on the cyclical position. The phase of the housing cycle needs to be identified based on a variety of indicators, in particular house price growth, mortgage lending and estimates of house price overvaluation. In the field of macroprudential policies, the assessment of the cyclical position also needs also to be casted in a forward-looking perspective, by understanding the driving forces of the cyclical phases and their potential duration. This report provides a characterisation of the cyclical position in four phases, by stressing the changing interplays between RRE, lending and the general business cycles.

Step 1 – Evaluation of scoreboard (horizontal assessment)

The risk assessment starts with a "mechanical" (or horizontal) risk classification based on a small selection of key risk indicators common across countries, referred to as the "scoreboard". The selection of indicators is motivated by the literature on real estate bubbles and early warning models.

Indicators are grouped into three broad categories which are relevant for assessing risks in RRE markets: the collateral stretch, which covers pricing indicators; the funding stretch, which covers lending indicators; and the household stretch, which covers the balance sheet conditions of households. The set of indicators attempts to strike a balance between cross-country coverage and completeness, relying as much as possible on common and consistent data sources. The scoreboard takes the form of a heat map, where each indicator is assessed against critical thresholds. These thresholds are guided by model evidence and the distribution of the indicators, and their plausibility is checked on the basis of expert judgement.

Step 2 – Integration of additional information (vertical assessment) and adjusted risk ratings

This step is meant to adjust the initial horizontal risk rating based on the scoreboard by integrating other relevant (country-specific or "vertical") information on the basis of expert judgement. This ensures that the final risk assessment is informed by a further set of country-specific indicators that convey information on a range of cyclical, structural and institutional drivers of the domestic RRE market. This is important in view of the large heterogeneity of RRE markets across EU countries. To this end, the report provides a reference set of indicators to assess the systemic importance of RRE across countries and guidance on the structural features that can be considered in the assessment. In order to preserve transparency and accountability in the adjustment, a template reports all the information eligible to enter into the assessment, the weight that this information receives and the way in which the information is used to adjust the initial outcome.

The risk assessment may also be informed by a further set of country-specific indicators conveying information on the structural and institutional drivers of domestic RRE. This helps to gain a full understanding of the intensity and build-up of vulnerabilities in view of the large heterogeneity across EU countries in an operative RE context. The indicators cover supply-side characteristics, demand-side factors and the intensity of spillovers of shocks from RRE to the rest of the economy and to the financial sector. Since their impact on RRE vulnerabilities is not unequivocally determined ex ante, possible adjustments to the risk rating based on the structural indicators should be limited in size and discussed case by case.

The final outcome of Steps 1 and 2 is an adjusted risk rating which highlights the potential for macroprudential action. Specifically, four rating categories are envisaged: "no", "low", "medium" and "pronounced" exposure. When a country is classified as having "medium" or "pronounced" exposure to RRE risks, the risk assessment highlights the existence of vulnerabilities that should be addressed by macroprudential policies.

1.2 Macroprudential policy assessment

The ultimate objective of macroprudential policy is to contribute to safeguarding the stability of the financial system as a whole, by strengthening its resilience and by containing the build-up of systemic risks, thereby ensuring a sustainable contribution of the financial system to economic growth.

In the framework outlined by the WG-REM, the assessment of macroprudential policies is conditional on the identified vulnerabilities and it benefits from the discussions already held on risk detection, the cyclical position and the role of structural and institutional features. The operative guidelines are structured along three steps, which are designed in the same spirit as in the risk assessment framework; they move from general reflections on the tool possibility set to a horizontal assessment of the activated policies, based mainly on the analysis of the transmission mechanism and finally adjusted for country-specific considerations.

The policy assessment is founded on two separate but mutually consistent pillars: (a) the **appropriateness** of the activated measures, in terms of the selection of tools and their timing; (b) the **sufficiency** of the activated measures, if appropriate, in terms of calibration and effectiveness with respect to the policy objectives.

1.2.1 Assessment of policy appropriateness

The operative framework envisaged by the WG-REM for assessing the appropriateness of RRE macroprudential policies consistently links the outcomes of risk detection to the choice of policy instruments.

Step 3 – Macroprudential instruments to address real estate-related risks

The macroprudential toolkit available to national macroprudential authorities in European countries encompasses two main categories of instruments to address real estate risks: capital-based measures and borrower-based measures. Capital-based measures determine regulatory capital requirements for the exposures of lenders to real estate either directly, by imposing higher capital requirements, or indirectly, by affecting variables such as probability of default (PD) and loss given default (LGD) that enter into the calculation of capital requirements. Borrower-based measures affect the terms and conditions of lending by imposing limits on the volume of credit granted in relation to the collateral value (loan-to-value (LTV) ratio), to the debt service payments of borrowers in relation to their income (debt-service-to-income (DSTI) ratio), to the borrower's total indebtedness or the volume of credit granted in relation to income (debt/loan-to-income (D/LTI) ratio), to the loan repayment schedule (amortisation requirements) or to the maximum loan maturity (maturity limits). Unlike the former set of instruments, the latter is not included in the EU harmonised legal framework, and their use is governed by national law, with different institutional set-ups prevailing across Member States.

Other instruments designed to counter broader-based vulnerabilities can also mitigate spillover risks from real estate to the wider economy. Large exposure limits, liquidity measures

or additional general capital requirements such as the countercyclical capital buffer (CCyB), the systemic risk buffer (SyRB) or capital requirements for systemic banks (G-SII and O-SII buffers) would raise loss absorption and could limit the extent and propagation of shocks.

Step 4 – Assessment of selected macroprudential instruments given the identified risks

The assessment of a policy's appropriateness is, to a great extent, informed by the strength and timing of the different transmission channels of macroprudential instruments targeting RRE risks. This report reviews the multiple and complex channels through which borrower- and capital-based measures have a separate impact on the resilience of banks and households, as well as the real estate and general business cycles depending on the reaction by banks, households and markets. In general, although instruments may be designed to achieve a specific policy objective, either increasing the resilience of the financial system or addressing risks stemming from exuberant real estate market developments, they may also have an impact on other key variables through the interactions of their effects with banks' and borrowers' balance sheets.

The timing of policy intervention also influences the choice of instruments to be activated, which may reflect the phase in the real estate cycle as well as lags in implementation. In the early stages of the real estate cycle, when the real estate market is expanding and vulnerabilities are building up, borrower-based measures acting on the flow of new lending should be the preferred policy option, while in more mature cyclical phases, when risks have already accumulated, strengthening resilience becomes a key priority, calling for measures targeting the stock of existing loans. The timing and choice of policy intervention also needs to take into account lags in the policy process, from the moment vulnerabilities are identified to the moment policies are enforced. Policy lags are a less immediate concern in the early stages of the cycle, but when vulnerabilities are more pronounced and/or the cycle is maturing, policy lags may heavily affect the appropriateness and effectiveness of the enacted policies.

Moreover, the appropriateness of a policy response depends on the nature of the identified risk or vulnerability as well as on the policy objective(s), under a proper consideration of the cyclical position (see Table 4 in Section 4). The framework provides guidance for assessing policy appropriateness for each of the three stretches identified in the risk scoreboard, and identifies the main considerations that drive in general the expected best choice of macroprudential measures.

Finally, a combination of instruments may not only allow the policymaker to better target the existing vulnerabilities, but also to address shortcomings related to individual instruments as well as to prevent their potential circumvention. In practice, determining the mix of actual instruments is highly contingent on pragmatic considerations and country-specific circumstances.

Step 5 – Additional country-specific considerations

In addition to the general considerations that hold true ex ante across all countries, the assessment of appropriateness needs to take into account the country-specific factors that condition the implementation of the preferred policy option in a given jurisdiction. From an

EU perspective, the selection of instruments should reflect the various legal conditions set out in the Capital Requirements Directive (CRD IV) and Capital Requirements Regulation (CRR). The possibility to implement the appropriate instrument may also be constrained by the prevalent national institutional framework and legislation, as is particularly the case for borrower-based instruments. In addition, even when a legal framework for their implementation exists, political considerations (especially relevant for instruments entailing distributional effects) might limit policymakers' ability to activate the most appropriate policy instruments.

Legal and institutional limitations might therefore induce policymakers to opt for a "second-best" policy or alternative forms of policy intervention. Taking into account the conditioning factors at the country level facilitates the understanding of possible divergences between the actual tools and the most appropriate tools. This is not to diminish the scrutiny of missing elements in the policy response, but it helps to formulate a more efficient communication of the final assessment of appropriateness by addressing the possible pitfalls in the legal and institutional framework that need to be reviewed to enhance the design of macroprudential policies.

The choice of macroprudential measures is also influenced by other policies which are not under the control of macroprudential authorities as well as by structural features of the real estate market that condition the room for policy action. For example, monetary and fiscal policies, urban planning influencing the supply of housing or the depth of the rental market can each influence the choice (and effectiveness) of macroprudential tools. Moreover, the interplay between microprudential policy mandates and objectives can also influence the choice of macroprudential measures. In order to monitor the intensity of country-specific factors that can affect the actual choice of policy tool, potentially deviating from the options identified at a horizontal level, the report provides a summary table including a selection of reference indicators for each of the different categories of country-specific considerations.

Further, the structure of the banking sector and cross-border banking activities will have implications for potential leakages and cross-border spillovers, thus affecting the appropriate choice of instruments. Cross-border spillovers may differ between instruments for which reciprocity is mandatory or voluntary. This could inform the choice of instrument, as an appropriate choice involves foreign authorities reciprocating macroprudential measures imposed by the domestic macroprudential authority where reciprocation is an issue. Arbitrage and substitution opportunities could also render alternative instruments more appropriate.

As a final outcome, the policy appropriateness is assessed using a three-level rating, with the following interpretation:

- **Fully appropriate,** when the following four conditions are jointly met: (a) the policy objectives are consistent with the identified vulnerabilities according to the proposed framework (see Table 4 in Section 4); (b) the policy mix meets the policy objectives according to the proposed framework; (c) leakages and circumvention are duly considered and, to the extent possible, addressed; and (d) interactions with other policy areas are taken into account;
- **Partially appropriate,** when conditions (a) and (b) are met; either (c) or (d) or both are not, or (a) is met but (b) is not because country-specific conditioning factors constrain the feasibility of policy instruments;

- **Not appropriate,** when the conditions for partial appropriateness are not met, or no policy is in place to address the identified vulnerabilities.

1.2.2 Assessment of policy sufficiency

The concept of sufficiency of appropriate policies is closely linked to the overall objectives of macroprudential policies and to the effects expected over time on key target variables. In the ESRB framework, macroprudential policies are aimed at two main intermediate objectives, namely increasing the resilience of the financial system and decreasing the build-up of systemic risks, in order to ensure a sustainable contribution of the financial sector to economic growth. In this context, the assessment of policy sufficiency in practice is conditional on the identification of the target variables that are expected to affect the conditions likely to contribute to the intermediate objectives and on the ability to monitor how the balance between the expected gains and costs of a given policy may change over time depending on the calibration of the policy itself.

Accordingly, a policy instrument that has been assessed to be appropriate is then assessed as regards sufficiency on the basis of a twofold criterion: (i) whether it delivers a substantial contribution to mitigating the identified vulnerabilities (effectiveness); and (ii) whether it delivers, over time, reasonably higher benefits than costs against the stated policy objectives (efficiency).

In this vein, an appropriate policy (along the lines discussed in Section 4) can be considered sufficient if it affects the target variables driving the policy goals in such a way as to maximise the desired benefits over time while minimising the unintended costs. Accordingly, the sufficiency assessment includes a review of any quantitative and qualitative evidence that was or should have been used in the calibration of policy against the intensity of the identified risks, as well as the expected net benefits projected in the short, medium and longer term. Section 5.3 offers additional guidelines on how to operationalise benefits and costs for the models used for calibrating ex ante the macroprudential measures.

The high-level definition of sufficiency needs to be translated into an operative framework. Specifically, policy objectives translate into a desired pattern of financial and economic indicators related either to cyclical developments in the housing and financial markets (credit, house prices, etc.) or to lenders' and borrowers' resilience, while policy action is implemented by affecting key target variables (e.g. bank capital ratios or lending standard distributions) that drive the identified vulnerabilities. An instrument should therefore be considered sufficient ex ante if, within the adopted analytical framework and compared with a no-policy scenario, it is calibrated in such a way as to deliver the desired improvement in the target variables underpinning the policy objectives with minimum costs. The desired improvement is conditional on policymakers' preferences and needs to be predefined.

Step 6 – Informing the sufficiency assessment on the basis of existing empirical evidence and analytical methods

It is part of the sufficiency assessment to review the standards of methods adopted in the policy calibration as well as in the monitoring of the net benefits projected over time. Measuring the costs and benefits of macroprudential tools is not an easy task in practice. Useful hints could be gained by reviewing the available literature since it could provide a soft guidance on the range of reasonable values for the size of the policy impact on specific variables. More generally, the development of a suitable kit of analytical methods and statistical inputs is a key aspect for the sufficiency assessment, and enhancing efforts to achieve substantial progress in this direction should be a priority for most European countries. Section 5.3 provides guidance to make operative the net benefit approach to policy sufficiency based on methods suitable for ex ante calibrating macroprudential measures (the ex post perspective is reviewed, mostly in the same lines, in Section 5.5). Key ingredients are: (i) listing a set of principles for a sound selection of methods; (ii) discussing appropriate methods for calibrating capital-based and borrower-based measures.

Step 7- Additional considerations at the country level

In order to assess the sufficiency of macroprudential RRE policies, a number of important additional factors must be considered. First, the calibration of individual instruments should consider the impact of other instruments that could target either the same or a different objective. Second, the task of measuring costs and benefits in practice is not easy, not least because of the difference in time horizons (see also Section 5.1.1). Third, there is a minimum data requirement for indicator-based and (especially) model-based instrument calibration. Fourth, interactions with other economic policies (monetary, fiscal and structural) can often be of paramount importance, as these could act as amplifiers or mitigation factors on the transmission channel. The sufficiency of measures is therefore dependent on the mix of policies that can have an impact on the macroeconomic framework by either exacerbating or mitigating the risk outlook and hence the potential costs and benefits of instruments. Fifth, an assessment of the timeliness and ease of policy implementation needs to consider the stage of the cycle (which may increase inaction bias) and any legal and political constraints.

Step 8 – Guidance on ex post sufficiency assessment

Country specific considerations based on possible discrepancies between ex-ante and ex-post assessment largely contribute to inform the criteria for policy sufficiency. Indeed, there are limits to what macroprudential instruments could deliver, and sufficiently assessed (ex-ante) measures could still face a delivery gap when assessed ex-post. Exploring the reasons behind the deviation of the ex-post from the ex-ante assessment would provide valuable ideas on the ways the activated policy measures are actually working, with particular reference to the impact on the targeted variables. In addition, the ex-post policy sufficiency informs the need for further action in terms of recalibration or further fine-tuning of the policies in place.

One particular feature relates to the enforceability of borrower based measures. If the policy instruments are not legally binding or not enforceable, this fact should be taken into account in the sufficiency assessment, in addition to inform the policy appropriateness. An ex-post assessment will evaluate whether instruments were sufficiently calibrated regardless their legal basis. For example, if key target or risk indicators move in the right direction, this could be signs of the instruments' effectiveness. However, if non-binding measures prove ineffective, a potential corrective action could be to turn them binding, thus addressing the non-compliance of the institutions providing mortgages with the non-binding measures, or to activate complementary action that enhance the impact of the overall tool mix.

As a final outcome of the combined blocks on the soundness of the tool calibration and the magnitude of the expected net benefits of the enacted measures, policy sufficiency can be assessed using a three-level rating, with the following interpretation:

- **Fully sufficient:** Conditional on policy objectives and related target variables, an appropriate policy has been calibrated in such a way that systemic risks stemming from the RRE sector are mitigated to a large extent, and that the expected benefits exceed to a large extent the expected costs over time (see Table 7) on the basis of methods ideally meeting most of the listed principles (Section 5.3) and other considerations.
- **Partially sufficient:** Conditional on policy objectives and related target variables, an appropriate policy has been calibrated in such a way that mitigates systemic risks stemming from the RRE sector to a significant extent, and that the expected benefits exceed to a significant extent the expected costs over time (see Table 7) on the basis of methods ideally meeting most of the listed principles (Section 5.3) and other considerations.
- **Not sufficient:** The conditions for full or partial sufficiency are not met.

1.3 The communication strategy

A pivotal component of the framework for the RRE risk and policy assessment is an efficient and transparent communication strategy. In view of the complex relationships between RRE, credit markets, macroeconomic trends and, more generally, politically sensitive issues such as welfare and equity targets, it is crucial that the key reasons underlying the final rating of a country be documented in a sequence of templates. This is meant to facilitate a full and widespread understanding of the outcomes of the overall assessment process made by the ESRB, as well as the implications for future policy action.

The WG-REM has envisaged three templates that provide an in-depth review of the individual building blocks making up a country rating in the RRE risk detection and in the assessment of appropriateness and sufficiency of the related policies. In addition to the final rating and its interpretation, the templates report in a non-technical narrative the key elements underpinning the rating, the assessment of cyclical positions and the implications for the timing of the possible materialization of the identified vulnerabilities and/or the policy measure to be activated, as well as other country-specific considerations that may affect the intensity of risks and/or the feasibility of the best policy action. The full sequence of the risk, policy appropriateness

and policy sufficiency templates delivers a fully-fledged and consistent framework to deal with systemic vulnerabilities stemming from RRE across EU countries. Importantly, the templates are only meant to enhance the communication strategy of the ESRB and do not necessarily entail any implication for the current communication rules followed by the national authorities within their own countries and with respect to the ESRB or the European Central Bank (ECB).

Finally, every single module within the framework is meant to be flexible as new data, analytical methods and empirical evidence may become available in the near future. Moreover, the framework is expected to be fine-tuned based also on the experience progressively gained in its practical implementation. In this vein, the guidance was preliminarily tested in dry run sessions carried within the WG REM on a selected number of countries; additional fine-tuning indications came from the ESRB vulnerability analysis of the European residential real estate sectors[1], which was conducted by applying the assessment framework that is now documented in full details in the Report.

[1] ESRB Report – Vulnerabilities in the residential real estate sectors in the EEA countries (2019)

2 Introduction

Boom and bust conditions are recurrent features of real estate (RE) markets, and, historically, RE-related crises demonstrate the severe losses that can arise for the financial system as well as for the real economy, especially in situations where property investment is highly leveraged. Accordingly, both main segments of the RE market, namely residential real estate (RRE) and commercial real estate (CRE), play an important role in preventing the build-up of financial vulnerabilities. In the academic and institutional debate, there is now widespread consensus that the timely detection of the sources of RE imbalances, the activation of proper policy measures to counteract their negative effects, and the regular monitoring of prospective developments in the intensity of vulnerabilities and of the effectiveness of targeted policies, are crucial ingredients in preserving financial market conditions that support economic growth and welfare. Although an increasing number of authorities throughout the world have activated measures to address systemic RE-related risks in recent years, experience in the detection of vulnerabilities as well as in the selection and calibration of policies is still very limited, and many challenges still need to be addressed in order to develop a sound and coherent operative framework.

In March 2016, the General Board of the European Systemic Risk Board (ESRB) supported the establishment of the Working Group on Real Estate Methodologies (WG-REM), which was to operate on a medium-term time horizon with the aim of gradually developing a quantitative and operative framework for a country-based assessment of both RE vulnerabilities and the effectiveness of the related prudential policies.

The WG-REM would first focus on the RRE market and then explore any possible extension to CRE markets, in line with the following mandate:

(a) review and evaluate the existing methodologies for the detection of RR vulnerabilities, and to the extent possible, CRE, focusing on their nature, origin, possible triggers and timing of building-up;

(b) provide new insights and concrete proposals in the above field in order to further improve and expand the existing joint ECB/ESRB methodology over the medium term;

(c) review and evaluate the existing policy assessment frameworks and best practices of Member States and relevant authorities;

(d) provide operational guidelines to assess the sufficiency and appropriateness of RE-related prudential policies consistently with the identified vulnerabilities. The guidelines would be mostly based on the use of a limited set of key macroeconomic variables and RE indicators, conditional on country-specific features in the structural, fiscal and regulatory domains.

In view of the challenging tasks, the WG-REM was expected to achieve incremental progress in the development of a sound and operative framework, with periodic reports on the intermediate outcomes to be submitted for discussion within the ESRB. The Working Group's mandate was set to expire in June 2018, with scope for an extension if deemed valuable and depending on the progress made.

This Report documents in details the overall framework that has been finalized by the WG-REM in order to achieve a consistent assessment of systemic risks coming from the RRE and the related macroprudential policies. In particular, the overall assessment of RRE-related policies is founded on two pillars: (a) appropriateness, which implies a suitable match of the policy objectives and the selected tools with the nature and timing of the identified vulnerabilities; and (b) sufficiency, which implies that the policy tools are calibrated so that they effectively maximise the net social benefits against the stated policy objectives, The framework is structured in three modules that come in a sequence, which allows exploiting the increasing stock of information gathered as the process moves forward. The final outcome is a collection of three templates that, in order to enhance the ESRB communication strategy, are designed to explain the combined ratings in the intensity of the identified RRE vulnerabilities, in the degree of appropriateness and in that of sufficiency of the macroprudential tools activated in country.

The WG-REM has also discussed possible lines to extend the RRE assessment framework to CRE, operating in close cooperation with a dedicated ESRB Task Force. Results on this subject are not covered in this report, and they will be finalised in a dedicated CRE Report in the next few months in line with the mandate.

Interestingly, the WG-REM has addressed some background elements on differences, commonalities and interactions between RRE and CRE that are useful to inform an ideal framework in which the overall RE risks and related policies are comprehensively assessed.

Among the main lines of reflection in this respect, the two market segments first play an important role in the smooth functioning of the financial system that goes well beyond their relative size in the total economy. Both RRE and CRE property act as collateral for granted credit, which amplifies the impact of a residential estate sector crisis on the financial system and the general economy through the financial accelerator mechanism (via consumption by households or investment, mostly by non-financial corporations).

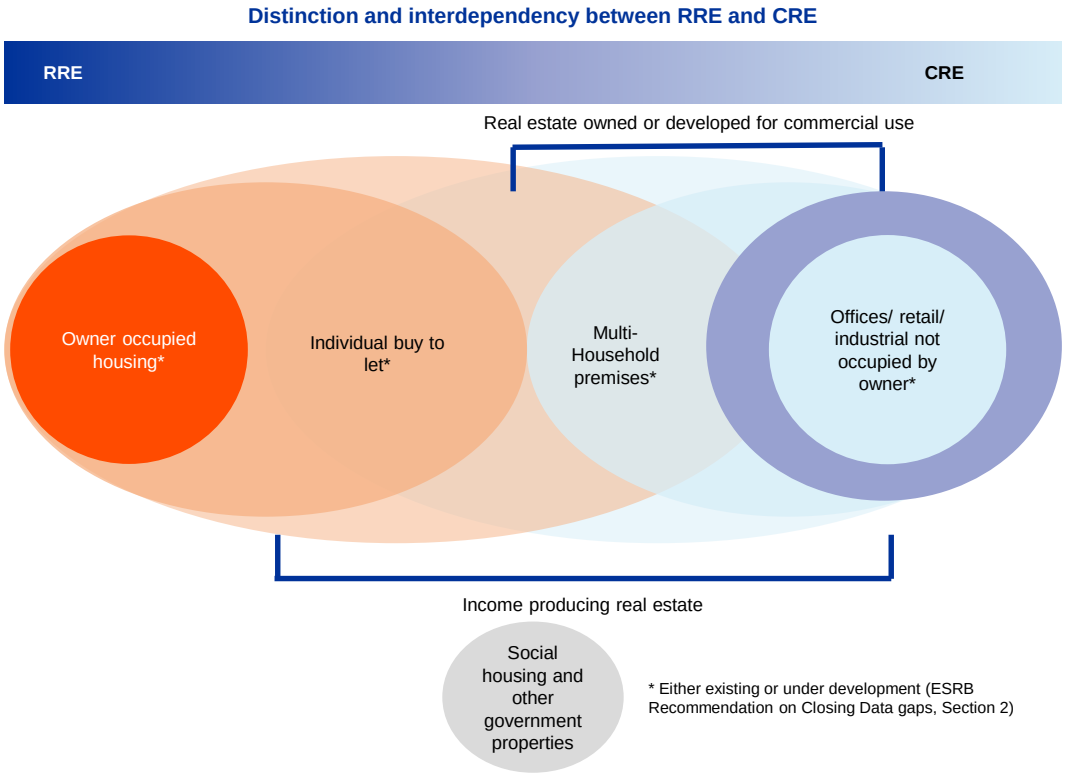
Second, large-scale investments in income-producing dwellings may attract the same type of investors as traditional CRE investments (i.e. office, retail and industrial), but from a pricing/valuation perspective the impact of such investments is likely to be felt in the prices and rents of residential property, too. In this line, Recommendation ESRB/2019/3 on closing real estate data gaps, which amended a former version approved three years earlier, now captures non-dwelling property purchased/constructed by end users as CRE: it is reasonable to assume that the purchase/construction of a property to be owned by the end user will have an impact on the CRE market in the same way as the purchase/construction of a property to be held as an income-producing asset. From a credit risk perspective, the valuation of collateral is unlikely to relate to whether it is held as an income-producing asset or owned by the end user. Such reflections reinforce the opportunity for a risk assessment of the overall real estate market, by taking into account the variety of transmission channels across RRE and CRE (see Figure 1).

Third, the main actors differ on the two markets due to the different importance of the income generation purpose. On the one hand, the key borrowers in the RRE market are households that buy a house (mostly for consumption) and, to a lesser extent, developers that apply for credit to extend the supply of houses. On the other, in view of the ESRB definition that CRE is any income-

generating real estate, although conditional on some qualifications[2], the CRE market relates to the balance sheet of a large sub-group of operators depending on how the income-generating activity is structured according to (i) offices; (ii) retailers and shopping centres; and (iii) logistics (including industrial premises/warehouses). The CRE market revolves around three main aspects: the rental process, the investors and the construction developers; this makes CRE dynamics more cyclical, from a risk perspective, than RRE.

Figure 1

Possible overlapping of CRE and RRE



Sources: ESRB, WG-REM.

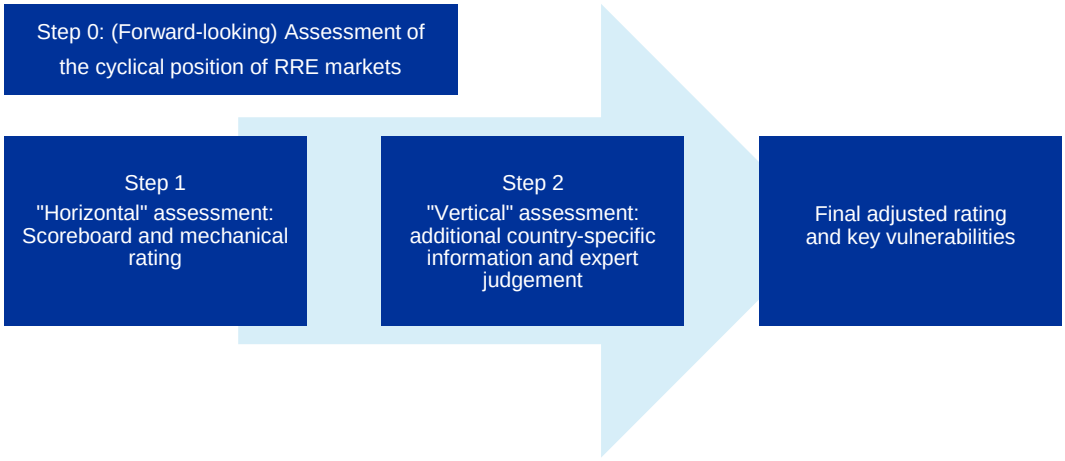
Fourth, in a downturn both the income-generating ability of CRE and its value as collateral will be significantly diminished. This contrasts somewhat with RRE dynamics, where even under rises in unemployment, the value of the real estate as collateral may not be affected. Furthermore, the lower granularities in CRE than in RRE, due to the typically larger size of projects in the first compared with the second market, are important: even just a few developers can represent relatively large exposures in the balance sheets of financing institutions, so that only a handful of developers might need to become insolvent for problems to emerge.

2 The original Recommendation ESRB/2016/14, which has been amended in March 2019, formally defined CRE as any income-producing real estate, either existing or under development, and excluded (a) social housing, (b) property owned by end users, and (c) buy-to-let housing. If a property has a mixed CRE and RRE use, it should be considered as different properties (based for example on the surface areas dedicated to each use) whenever it is feasible to make such a breakdown; otherwise, the property can be classified according to its dominant use.

3 Residential real estate – risk identification framework

The RRE risk assessment methodology consists of an assessment of the cyclical position of RRE markets (Step 0) and an integrated approach to quantify risks and summarise them with a rating system. The integrated approach to reach the final risk rating is achieved in two steps (Figure 2). Step 1 ("horizontal" step) is based on a common set of benchmark indicators to calculate an initial "mechanical" risk classification of RRE markets across countries. Step 2 ("vertical" step) adjusts the outcome of Step 1 by integrating other relevant (country-specific) information on the basis of expert judgement to reach a final "adjusted" risk rating.

Figure 2
Overview of steps in the RRE risk identification framework



Final adjusted ratings have the following interpretation:

- **No exposure:** The risk assessment does not provide material evidence of vulnerabilities that are relevant for macroprudential policy from a leaning-against-the-wind perspective.
- **Low exposure:** The risk assessment indicates the need for close monitoring of RRE developments. Nevertheless, the nature and magnitude of the identified vulnerabilities does not call for immediate macroprudential policy action.
- **Medium exposure:** The risk assessment highlights the existence of vulnerabilities that are worth to be addressed by macroprudential policies.
- **Pronounced exposure:** The risk assessment indicates widespread vulnerabilities that need to be addressed by macroprudential policies.

3.1 Analysis of cyclical position of residential real estate markets (Step 0)

The assessment of the cyclical position of RRE markets and its connection with the financial and business cycles is an important step in the risk assessment and a crucial input for the policy discussion. The information content of statistical indicators and the timing of materialisation of vulnerabilities may differ depending on the cyclical position of the markets. For example, a mature RRE market close to a turning point may require more attention to be paid to a given increase in house prices, as the associated probability of price trend reversal in the near future is higher.

A number of stylised facts emerge from the empirical literature on housing cycles. Besides describing the phases in the housing cycle, the empirical literature has made efforts to characterise these cycles in terms of, notably, duration and amplitude. First, the amplitude of the bust phase appears to be well correlated with the previous boom episode (Agnello and Schuknecht, 2011). Second, the boom and bust phases do not appear to be symmetric, with boom phases being longer and somewhat stronger than bust phases (Claessens et al., 2011). More specifically, looking at house price cycles in 19 OECD countries, Bracke (2011) finds that the mean duration of an upturn is close to six years, while downturns last four and a half years. However, much of the asymmetry owes to the recent cycle. Indeed, the duration and amplitude of the house price boom experienced in the EU prior to the global financial crisis was unprecedented (Girouard, 2006). Finally, housing cycles are closely interlinked with general business cycles as well as with the credit cycle (Barras, 1994). More specifically, Agnello and Schuknecht (2011) point out the role of interest rates, credit and mortgage market deregulation in the occurrence of booms and busts. Claessens et al. (2009) concur that housing busts are more severe and longer when they are associated with a credit crunch.

This section proposes a common qualitative characterisation of RRE cycles to inform the macroprudential risk and policy assessments. The approach consists in cross-checking the information from a number of indicators that are relevant in assessing the strength and breadth of the cycle. Further, the information from the indicators should be complemented by model evidence. This can help shed light on the nature of the drivers of observed developments, thereby contributing to an assessment of the potential phase and expected duration of the RRE cycle. To this end, this section highlights a number of models and approaches that can help policymakers to identify the cyclical position of RRE markets, with a focus on the forward-looking assessment that is essential for macroprudential policy.

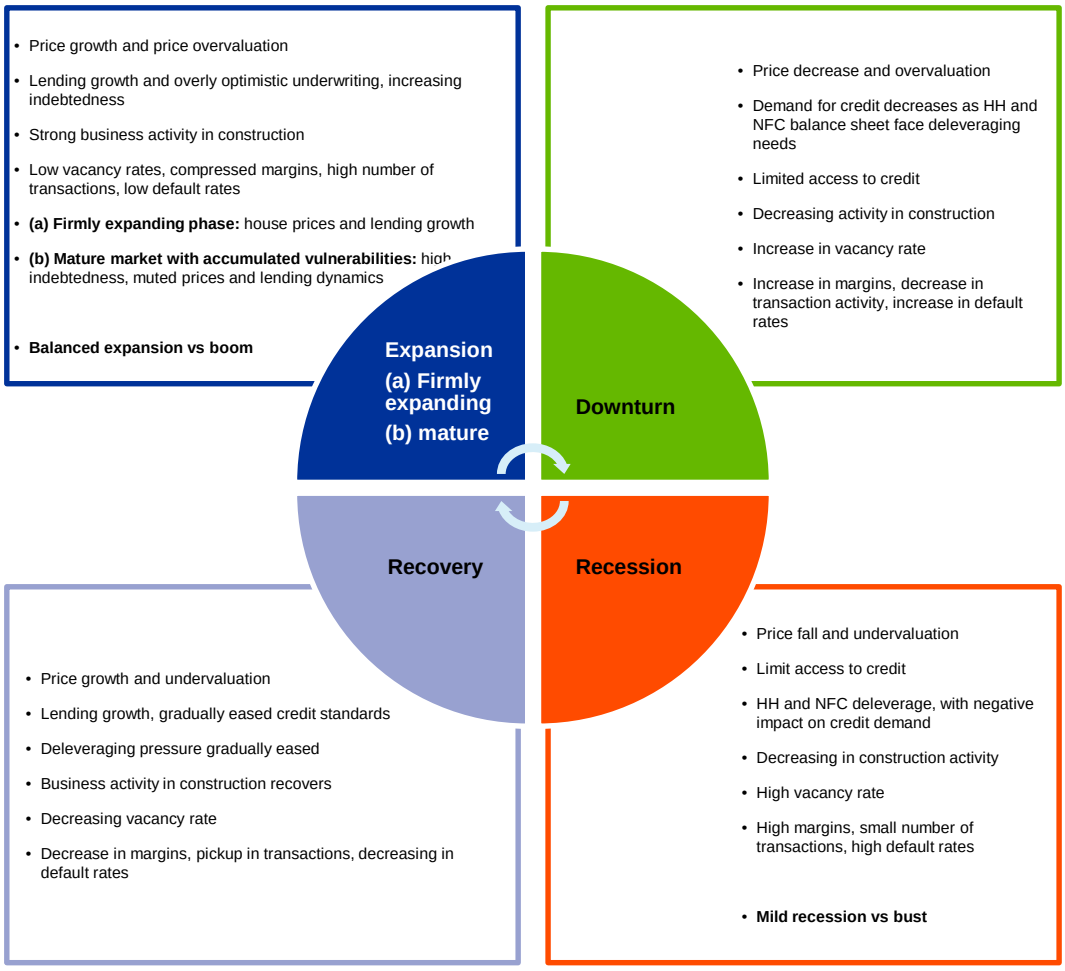
3.1.1 Characterising the cyclical features of RRE markets with key indicators

A well-established feature of the housing market is cyclicality. The empirical literature has employed various approaches to identify phases of housing cycles, but these typically rely on only a limited number of variables or solely on house price dynamics. Nevertheless, considering a wider range of indicators and their co-movements (e.g. dynamics of mortgage loans and their interactions with house prices) is important when analysing the RRE cycles from a macroprudential policy

perspective. The following stylised description builds on the existing literature (Mueller and Laposa, 1994, Pyhrr et al., 1999 and Lee, 2011) and qualitatively distinguishes four cyclical phases of RRE markets (see Figure 3).[3]

Figure 3

Proposed characterisation of RRE cycles



House price growth, mortgage lending and valuations should play a primary role in the assessment of cyclical phases. Nevertheless, additional indicators should also be taken into account, as concordance across indicators allows for a more precise identification of the cycle as well as its strength and breadth. Additional indicators cover the volume and number of transactions in the housing market, new lending volumes (net of repayments), lending standards, the health of household balance sheets, and construction activity.

[3] The prevalent approach in the empirical literature is to distinguish only two phases (boom and bust). However, four phases are considered here, as the macroprudential policy mix might be different in the recovery and expansion phases.

From a forward-looking perspective, it is important to understand the driving forces of the cycle in order to improve the assessment of cyclical phases and their potential duration. Structural factors such as the elasticity of housing supply and demand, construction lags, zoning restrictions and tax incentives may have an effect on the amplitude and duration of housing cycles. They are thus important for an assessment of the potential persistence of cyclical dynamics (Wheaton, 1999). Further, the role of expectations needs to be taken into account as they may contribute to the self-reinforcing feedback loop between prices and mortgage loans, aggravating the amplitude of the cycle as lenders extrapolate past gains in property price and supporting unsustainable price rises (Case et al., 2012).

During the expansion phase, RRE prices and mortgage lending normally grow and a number of indicators co-move, pointing to increasing activity in the sector.[4] Increasing demand for housing and rising prices are typically accompanied by growing transaction volumes and decreasing vacancy rates. Signs of price overvaluation gradually emerge as price expectations build up. Mortgage lending growth might be accompanied by an easing of lending standards, rising household indebtedness and increasing debt service ratios. As a consequence, banks' exposures to RRE also generally increase in relation to both GDP and bank assets. Housing demand might result in an increase in the supply of housing and activity in the construction sector.

The expansion phase can be further separated into a "firm expansion" and "late/mature" cycle to indicate the potential proximity of turning points. During the firmly expanding phase, house prices and lending grow robustly but vulnerabilities remain modest. By comparison, mature markets are characterised by accumulated vulnerabilities, for example in the form of high indebtedness or price overvaluations, and by the flat growth of prices, a smaller number of transactions and weaker/weakening mortgage lending. Distinguishing between these two phases is important in informing the risk assessment and policy debate since macroprudential policy actions might be different depending on the maturity of the cycle.

Further, from a macroprudential perspective, the cyclical expansion can be assessed from the point of view of its balance and considering the risks it poses. A persistent rise in housing prices might generate expectations that future house prices will further appreciate. This could affect lending policies and housing demand, in turn feeding back into housing prices and housing supply and resulting in misallocations. Such self-fulfilling expectations regarding house price growth can lead to a significant overvaluation of prices, the deterioration of lending standards and a weakening of household balance sheets. The measurement of imbalances and risks during the expansion phase of RRE markets is addressed in Steps 1 and 2 of the risk assessment (Section 3.2).

During the downturn phase, house prices decline towards fundamental values, while mortgage lending decelerates and starts contracting. In countries where the construction sector represents a large share of value added and employment, the contraction in house prices can have a severe impact on households' disposable income, resulting in a significant household balance sheet stretch. This potentially creates a negative feedback loop between credit supply, the macroeconomy (initially via the collateral channel), credit risk and housing demand.

[4] Whenever possible, "old" and "new" dwellings should be assessed separately as they may not have exactly the same determinants, levels and evolutions as regards timing, quality and magnitude, even if they should be closely related.

During the recession phase, expectations that prices will continue to decrease can result in prices falling below fundamental values. The downward adjustment in prices can also be driven by a contraction in credit supply stemming from several factors. These include lower collateral values, the deterioration in banks' balance sheets and lower household creditworthiness linked to both large credit overhangs and uncertainties about future income. The adverse macroeconomic implications of the housing recession peak in this phase, leading to instability in the financial sector due notably to low credit demand and deteriorated asset quality. According to the severity of the decrease in prices, one can further distinguish between mild recessions and busts.

Once they have reached a trough, house prices generally experience a gradual recovery phase along with the macroeconomic recovery. In the initial phase of the recovery, credit growth can remain muted as headwinds to credit supply and credit demand persist against the backdrop of depressed collateral values and unemployment.

3.1.2 Other considerations on the definitions of cyclical phases

The proposed stylised characterisation of cyclical phases cannot encompass all situations that might arise because many different factors may influence real estate cycles. In particular, although situations in which RRE price increases are not accompanied by mortgage credit growth are not of primary importance from the macroprudential perspective as they do not signal excessive credit growth developments, they should nevertheless be monitored to assess whether or not systemic risks are building up despite muted credit dynamics. These cases might be classified as recovery phases (in cases where property prices are undervalued) or might arise due to country-idiosyncratic shocks and structural characteristics. Cerutti et al. (2015) identify 18 episodes of real estate booms that occurred without any type of credit boom, documenting the examples of the house price boom in Germany during 1990-92 that was due to post-reunification fiscal measures and the price boom in Canada during 2002-08, where the conservative residential mortgage market and lack of tax deductibility of mortgage interest may explain the absence of a credit boom (see also Poland's experience in Box 1). Further, institutional features of national mortgage markets such as housing taxes, subsidies and transaction costs, foreclosure and insolvency procedures, interest rate fixation and amortisation characteristics may affect RRE cycles, and should also be taken into account in the proposed characterisation of the cyclical phases.

Alternatively, RRE cycles might be driven by global factors, meaning the role of capital inflows should be taken into consideration. Richter and Werner (2016) distinguish four channels of transmission of international capital flows in housing markets: (i) the transaction channel, (ii) the direct credit channel, (iii) an indirect credit channel with regard to cross-border transactions of securitised housing loans, and (iv) the interest rate channel. Generally, the effects of capital flows are heterogeneous across countries and are found to affect the housing sector to a greater extent if they are accompanied by high mortgage debt-to-GDP ratios, the possibility of mortgage equity

withdrawal or a high LTV ratio.[5] Regarding the transaction channel, house prices might increase in the absence of mortgage credit dynamics due to foreign investors' activity in local real estate markets, e.g. via investment funds. In particular, the easing of rent controls, better access to residence permits for non-EU buyers, changes in tax regime and tourist booms can fuel demand for RRE properties among foreign investors.[6]

3.1.3 Models for assessing the cyclical position in real time

In order to track and characterise the cyclical position of RRE markets in real time, various analytical tools and models can be considered. First, models estimating deviations in house prices from their fundamental values are important as they help distinguish between recovery and expansion phases of the cycle. Examples include estimates based on deviations from long-term averages of the price-to-income or price-to-rent ratio, asset pricing approaches based on the user cost of housing, inverted demand models and cointegration models. Nonetheless, the estimates from these models are subject to a considerable degree of uncertainty and should be interpreted with caution. Second, useful information may be available from models decomposing house price developments into structural shocks (supply vs. demand shocks, permanent vs. transitory shocks, etc.), for example using structural vector autoregression models. Third, due to lags in the effects of macroprudential policies, the forward-looking information from models that predict developments in RRE markets is important.[7] These include models estimating the probability of the turning point, i.e. maturity of the phase of expansion (Markov switching models, probit models, duration dependence models). Finally, models that are able to exploit large numbers of time series reflecting the plethora of potential drivers of RRE cycles and at the same time cope with the curse of dimensionality (e.g. Markov switching factor models) could be further investigated. The focus should be on the information provided by models that can be used in a forward-looking assessment of the cyclical position.

Box 1
Drivers of the cyclical position of real estate markets in Poland

The indicators used by Narodowy Bank Polski to assess RRE market tensions in Poland include real house price growth, the dynamics of new construction, mortgage growth, the number of primary housing transactions and the increase in pre-sale contracts for housing. The indicator analysis is augmented with econometric models such as the four-equation model based on the work of Mayer and Somerville (2010), Steiner (2010) and Augustyniak et al. (2014).

5 See Sá, F., Towbin, P. and Wieladek, T. (2014), "Capital Inflows, Financial Structure and Housing Booms", *Journal of the European Economic Association*, Vol. 12, Issue 2, pp. 522-546 and Richter, M. and Werner, J. G. (2016), "Conceptualising the Role of International Capital Flows for Housing Markets", *Intereconomics*, Vol. 51, Issue 3, pp. 146-154. See also the literature regarding the relationship of the current account and housing market developments, which may increase the systemic risks of a housing market boom-bust cycle in the case of a combination with large current account deficits (Bunda and Ca'Zorzi, 2009, Davis et al., 2016, Aizenman and Jinjarak, 2008, Punzi, 2013) Tomura, 2010).

6 Sá (2016) finds that foreign investment has had a significant positive effect on house price growth in the UK in the last 15 years, both in terms of expensive property and spillover effects on less expensive property.

7 There may be some leading information from prices and credit to estimate GDP. See Chen and Ranciere (2016), "Financial Information and Macroeconomic Forecasts", *IMF Working Paper Series*, No 16/251, International Monetary Fund, December.

The main players, that is buyers and housing producers, as well as the housing and financial markets are analysed. On the demand side are households, who buy housing for consumption and sometimes investment purposes, and whose actions are affected by monetary, fiscal and housing policy. The public sector also has a significant effect on the supply and funding of housing units through regulations and monetary policy. The new construction market, the existing dwellings market, the rental market, the land market, the mortgage market and the deposit/savings market are all analysed in detail. The housing purchase and rental markets are analysed locally for the country's 16 largest cities, using data collected by the local branches of Narodowy Bank Polski and the Central Statistical Office of Poland.

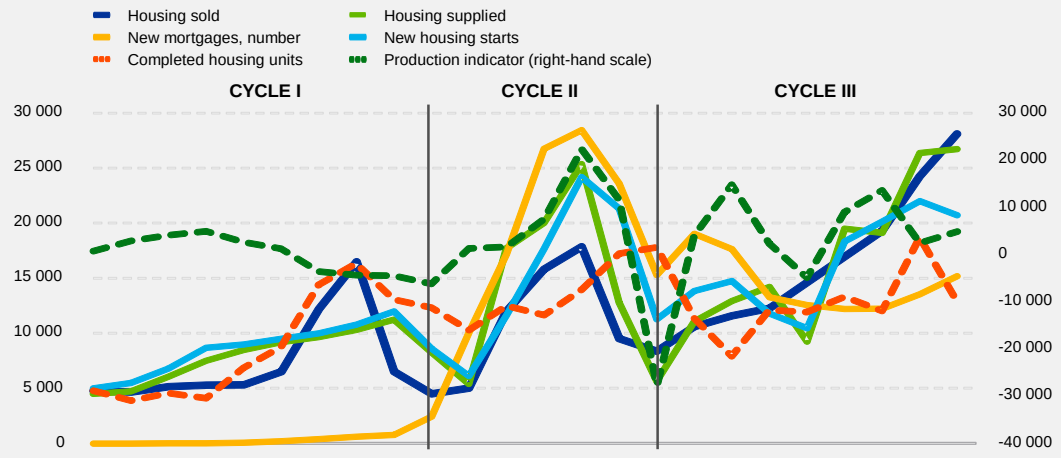
The examination of cycles is an important part of Narodowy Bank Polski's analysis, particularly cycles in the housing market and their connection to financial market and real business cycles. The main purpose is to detect tensions and assess the risk of sectoral cycles affecting the market as a whole.

The housing market in Poland underwent three cycles in the 1994-2017 period (Table A). Despite considerable construction booms, none of the cycles resulted in a crisis because the sector accounts for only a small share of GDP and housing finance is relatively low by comparison. Each cycle was driven by different factors, had a different shape and resulted in different price reactions.

The first cycle was only observed in Warsaw and was the result of an abrupt end to subsidies. Prices increased only as fast as income growth, and the construction boom was possible as for the first time private firms could operate on the market. The first cycle was a classic example of oversupply, which materialised when the Government announced an end to a very broad subsidy programme and an increase in VAT on building materials at the end of 2001. The second cycle was observed in the five biggest cities and was driven by a mortgage boom resulting from very low foreign-denominated mortgage rates. The second cycle began when Poland entered the EU in 2004. Many economic factors were at play, affecting the behaviour of consumers, investors, developers and banks. Price increases were abrupt, and signs of a bubble could be observed in some markets. The third and current cycle was triggered by monetary policy, leading to increases in supply and demand while prices remained rather stable. The third cycle started in 2010, when the Government increased the limit on housing subsidies. Income grew continuously, while interest rates declined. Some people started to purchase housing for investment purposes in order to rent it to others.

Figure A

Housing market volume and credit cycles in Warsaw, 1994-2017



3.2 Step 1 – The Scoreboard and "mechanical" ratings

The scoreboard for the mechanical step (Step 1) of the risk identification (Table 1) presents a selection of key risk indicators and takes the form of a heat map, where each indicator is assessed against three key risk thresholds. The scoreboard is based on a small set of key indicators that provide a fair (but not final) picture of RRE risks, which is then complemented by other information (Step 2 of the risk assessment) and expert judgement. Composite indicators in the form of risk ratings summarise the information in the scoreboard and provide a reference point for the subsequent step of the risk assessment.

The indicators in the scoreboard are grouped into three risk categories called "stretches".[8] The collateral stretch covers RRE pricing indicators, the funding stretch covers lending conditions and the household stretch covers household balance sheet indicators (Table 2). The set of indicators currently included in the scoreboard can be revised and extended over time as new relevant data become available, provided they are harmonised and reliable in quality in order to minimise the risk of statistical noise.

The selection of indicators is motivated by the literature on real estate bubbles and early warning models, and attempts to strike a balance between cross-country coverage and completeness. The common indicators in the scoreboard rely as much as possible on common data sources. Overall, the focus of the scoreboard is predominantly on cyclical aspects. Other aspects of a more structural nature, including the systemic importance of RRE and the exposures

[8] See"Vulnerabilities in the EU residential real estate sector", ESRB, November 2016. Compared with an earlier version of the scoreboard, the category "banking stretch" has been renamed "funding stretch" to better reflect the focus of this category on flow concepts. Bank exposures are included in the complementary table on the potential for spillovers.

of financial intermediaries to RRE, are covered separately in the subsequent steps of the framework. The indicators in the scoreboard can be mostly linked to the ESRB's intermediate macroprudential policy objective of "mitigating and preventing excessive credit growth and excessive leverage", and to a lesser extent the objective of "limiting direct and indirect exposure concentrations."[9]

The collateral stretch provides information to facilitate the detection of unwarranted price developments and potential price misalignments.[10] Excessive price developments may provide early signs of the formation of price bubbles. Furthermore, large and persistent price increases and price misalignments heighten the risk of a sudden reversal, leading to financial instability and deeper recessions (Barrell et al., 2010, Borio and Drehmann, 2009, Cerutti et al., 2015, to mention a few of the several articles discussing the issue). Therefore, "exuberant" price developments and price misalignments could be linked to the potential for credit risk to materialise in the future and inform an assessment of bank and borrower resilience, including scenario analyses. Indicators in this stretch cover price-based indicators, such as, the average three year real growth of house prices, residential price index relative to trend, the house price-to-income ratio, and overvaluation estimates based on an econometric model (inverted demand equation).[11] Overall, the pricing and valuation indicators included in the scoreboard display early warning properties in predicting the timing and the intensity of financial crises and housing downturns.

The funding stretch provides information to facilitate the detection of "exuberant" developments in lending conditions. From a policy perspective, the indicators in this stretch could be linked to the need of closely monitoring credit standards to counter the risk of self-enforcing and excessive price and lending dynamics. This is especially the case when price indicators in the collateral stretch and lending indicators jointly indicate exuberant dynamics. Strong lending dynamics and compressed margins could also inform the activation of policy instruments which can affect bank resilience and potentially the lending decisions of banks and bank risk taking.[12] These include risk weight policies and other bank capital instruments. Indicators in the scoreboard cover the average three year real growth of loans to households for house purchase, deviation of the loans to households for house purchase from the trend, and household loan spread. The selection of indicators was based on early warning properties (loan growth and deviation from trend) and on economic considerations (loan spread).[13]

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9 See the Recommendation of the ESRB of 4 April 2013 on intermediate objectives and instruments of macro-prudential policy (ESRB/2013/1).

10 Targeting RRE prices is not the goal of macroprudential policy. The focus on price misalignments stems from their link with the materialisation of credit risk, while the focus on excessive price dynamics stems from the potential consequences for credit standards. Excessive price increases might lead to speculative demand and to a deterioration of credit standards, which could fuel self-enforcing price/lending spirals.

11 For details of the methodology used in the scoreboard, see the box entitled "Tools for detecting a possible misalignment of residential property prices from fundamentals", *Financial Stability Review*, ECB, June 2011 and the box entitled "A model-based valuation metric for residential property markets". *Financial Stability Review*, ECB, November 2015. Alternative approaches include Muellbauer and Murphy (1997), Gattini and Hiebert (2010) and Philiponet and Turrini (2017).

12 Misalignments in some of these indicators have been identified as good predictors of asset price booms and busts (Alessi and Detken, 2011, Agnello and Schuknecht, 2011, Gerdesmeier, Reimers and Roffia, 2010, Claessens, Kose and Terrones, 2011) and have been documented to have a negative impact on financial stability and the macroeconomy (Beck et al., 2012). They are therefore also associated with the potential for credit risk to materialise and can inform policy decisions on bank resilience.

13 Time series for loan spreads are too short to assess early warning properties.

The household stretch provides information to facilitate the detection of fragilities in household balance sheets. From a policy perspective, indicators in this stretch capture the potential for credit risk to materialise in the future and could be linked to the need of strengthening bank resilience. Empirical evidence suggests that when households have accumulated high levels of debt, housing busts are more likely to be associated with longer recessions (Glick, et al. 2010, Jordà et al. 2014, Mian and Sufi 2011, Mian and Sufi 2014). Among these indicators, Drehmann and Juselius (2012) find that the debt-service ratio tends to increase before the occurrence of a systemic banking crisis and, hence, seems to be a good vulnerability predictor.[14] Variables in this stretch cover household debt in relation to disposable income, household financial assets in relation to debt and the aggregate DSTI ratio.

Risk thresholds for indicators are guided by model evidence and by the distribution of the indicators, and plausibility is checked on the basis of expert judgement (Table B in the technical annex). Where possible, the thresholds are selected based on early warning models by pooling the distribution of the indicators across time and countries, and by using the ATC and FSC crisis database (Lo Duca et al., 2017) to identify crisis periods. Where the estimation of early warning thresholds is possible[15], the medium risk threshold is based on balanced preferences between type I (missed crises) and type II errors (false alarms), according to the Alessi and Detken (2011) method. The high and low thresholds are set as the medium threshold +/- 2 standard deviation of the change in the indicator.[16] In other cases, thresholds are set on the basis of the percentile of the pooled distribution of the individual indicators or on the basis of expert judgement.

Mechanical ratings summarising the level of vulnerabilities across stretches are used to facilitate an initial country assessment. On the basis of the principle of "guided discretion", the mechanical ratings should be used as a starting point for deepening the risk assessment by incorporating other relevant information. The summary rating for each stretch ranges from 0 to 3 and is determined using a documented rule (with a preference for simple or weighted averaging) applied to a discrete transformation of the individual indicators in that stretch. Each indicator is assigned a rating from 0 to 3 based on the threshold it breaches (0 being no threshold breached, 3 being the highest threshold breached and indicating high risk). In addition, the overall risk rating is

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[14] The DSTI is computed based on the methodology of Drehmann, Illes, Juselius and Santos (2015), Box 2, p. 98. The DSR at time t is equal to the fixed debt service costs of an instalment loan, divided by income. Fixed debt service costs assumes identical repayment of the principal during the average maturity of the debt and an average interest rate, and is a factor of outstanding debt.The current computation of DSTI suffers from several drawbacks. For example, the measure is suited to analyse developments within one country over time and not for cross-country comparisons, as the level of the indicator depends on the structure of loans. Further, the total debt should be related to the income of indebted households only. Alternative indicators addressing these issues can make use of Household Finance and Consumption Survey (HFCS) data (e.g. adjustment taking into account median household income with debt and share of indebted households) and can be used by countries to validate the original indicator. However, HFCS data are available only with substantial lag. It should also be noted that most of the dynamics in household debt service are from the "interest payment component", which is naturally more volatile in countries with a prevalence of variable rate loans. Additionally, the BIS calculation approach is subject to a level bias in the DSTI ratios. This is primarily because the calculation of the repayment component is derived implicitly from (often incomplete) data on mortgage maturities, without considering that the repayment modalities actually agreed in the loan contracts are often quite different.

[15] Different transformations of the following variables were considered: debt-service-to-income ratio for households, a measure of overvaluation with respect to the fair value estimated through an econometric model, loans to households for house purchases, house-price-to-income ratio, residential real estate price index, household-debt-to-GDP ratio and household-debt-to-income ratio. The variables were lagged by one quarter to account for publication lags.

[16] Several alternatives were considered, including (i) setting thresholds on the basis of progressively increasing levels of the conditional probabilities of a crisis, and (ii) on the basis of different preferences between type 1 and type 2 errors. The final choice selected the method that delivered a set of thresholds that appeared plausible from an economic perspective.

obtained from the summary ratings across the three stretches by using the same rule followed within any stretch. The first threshold (yellow) of the average rating indicators is set at 1 (i.e. individual indicators breaching the first risk threshold on average). The second (orange) and third (red) thresholds are set on the basis of the 80th and 90th percentiles of the pooled distribution of average ratings.

Generally, ratings are designed to have the following economic interpretation:

- **Collateral stretch:** "No risk" means markets are undervalued and/or price dynamics are negative or stagnating. "Low risk" indicates that prices are fairly valued and/or price dynamics are growing moderately, potentially indicating a situation of balanced cyclical expansion which requires monitoring of some indicators. "Medium risk" indicates that there are tentative signs of price overvaluation and/or prices are growing more than justified by the macro environment. "Pronounced risk" indicates clear price overvaluation and/or exuberant pricing dynamics.

- **Funding stretch:** "No risk" means that financing conditions are tight as indicated by large spreads and/or negative/stagnating lending dynamics. "Low risk" indicates that financing conditions are appropriate against the backdrop of moderate lending and spreads, potentially indicating a situation of balanced cyclical expansion which requires monitoring of some indicators. "Medium risk" indicates that lending dynamics are relatively robust and/or spreads relatively compressed. "Pronounced risk" indicates excessive lending dynamics and clearly compressed spreads.

- **Household stretch:** "No risk" means that household balance sheets appear clearly sound. "Low risk" indicates that household balance sheets can be considered sound according to some metrics. "Medium risk" indicates some concerns about household balance sheets. "Pronounced risk" indicates clears weaknesses in household balance sheets.

Table 1

Residential real estate scoreboard

	Indicators										Summary measures			
	Collateral stretch				Funding stretch			Household (HH) strech						
Country	Residential real estate price index, 3y 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 (HP), 3y 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 Collateral Indicators	Average rating across Funding Indicators	Average rating across HH Indicators
AT	4.0	1.05	27.0	26.0	2.5	0.97	1.6	84.8	356.7	9.9	1.0	2.25	0.3	0.3
BE	0.6	0.93	15.0	-3.0	6.5	1.13	2.0	105.9	509.9	10.8	1.2	0.5	1.7	1.3
BG	7.0	1.22	-13.0	-18.0	3.3	0.88	3.5	33.3	577.6	7.5	0.5	1.3	0.3	0.0
CY	-0.5	0.85	-9.0	-5.0	-1.8	0.83	1.4	180.6	218.5	24.2	1.2	0.0	0.7	3.0
CZ	6.8	1.13	12.0	4.0	10.8	1.00	2.1	60.5	379.7	7.6	1.0	2.0	1.0	0.0
DE	4.8	1.15	6.0	10.0	2.9	1.01	1.8	84.4	349.7	9.1	0.8	1.8	0.3	0.3
DK	4.2	0.99	12.0	-1.0	1.1	0.94	2.5	230.9	271.4	19.1	1.0	0.8	0.0	2.3
EE	5.1	1.18	5.0	-9.0	3.7	1.11	1.8	71.9	302.9	7.6	0.9	1.5	1.3	0.0
ES	4.7	0.93	7.0	1.0	-3.8	0.75	1.8	99.8	301.3	11.6	0.8	0.8	0.3	1.3
FI	0.5	0.94	6.0	2.0	1.7	0.94	0.6	115.7	220.4	11.7	1.3	0.5	1.0	2.3
FR	0.7	0.91	16.0	12.0	3.9	0.99	1.4	92.0	401.1	9.8	1.1	1.5	1.0	0.7
GB	4.3	1.00	16.0	-2.0	-3.7	0.95		133.7	377.7	17.2	1.1	1.3	0.0	2.0
GR	-2.7	0.83	-17.0	-8.0	-5.8	0.73	2.2	88.1	264.9	20.2	0.7	0.0	0.0	2.0
HR	1.5	1.14	-12.0	-18.0	-4.8	1.02	3.3	54.3	353.2	8.1	0.3	0.8	0.0	0.0
HU	10.5	1.24	-3.0	-9.0	-3.4	0.84	4.0	39.6	687.0	5.5	0.5	1.5	0.0	0.0
IE	10.7	1.05	-4.0	-8.0	-1.2	0.77	3.0	140.5	268.7	16.9	1.2	1.3	0.0	2.3
IT	-1.4	0.88	-3.0	-2.0	0.9	0.90	1.3	61.3	605.5	11.2	0.3	0.0	0.7	0.3
LT	5.8	0.94	-5.0	-12.0	4.9	0.93	1.8	35.8	420.6	4.7	0.4	0.5	0.7	0.0

	Indicators										Summary measures			
	Collateral stretch				Funding stretch			Household (HH) stretch						
Country	Residential real estate price index, 3y 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 (HP), 3y 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 Collateral Indicators	Average rating across Funding Indicators	Average rating across HH Indicators
LU	5.0	1.05	42.0	3.0	6.6	1.07	1.9	172.4	256.4	11.8	1.7	1.8	1.3	2.0
LV	6.2	1.30	-5.0	-19.0	-3.6	1.10	2.0	38.6	476.0	4.8	0.5	1.3	0.3	0.0
MT	4.7	1.04	-11.0	-22.0	7.3	1.03	1.9	91.1	444.1	11.7	0.9	0.8	1.0	1.0
NL	5.3	0.98	8.0	-4.0	5.5	0.99	2.0	221.6	303.0	19.9	1.0	0.8	0.3	2.0
PL	2.3	1.07	-15.0	-17.0	1.1	0.88	3.0	59.9	291.8	12.2	0.4	0.5	0.0	0.7
PT	7.0	1.16	3.0	1.0	-3.3	0.78	1.3	101.1	296.4	13.8	1.3	1.5	0.7	1.7
RO	4.9	1.21	-23.0	-31.0	12.7	1.02	3.7	21.2	433.2	5.7	0.7	1.0	1.0	0.0
SE	6.5	1.07	60.0	39.0	3.2	0.94	1.6	174.7	338.5	16.6	1.7	2.5	0.7	2.0
SI	5.1	1.19	-1.0	-3.0	2.6	0.88	2.3	45.1	368.6	5.7	0.4	1.3	0.0	0.0
SK	3.2	1.03	-5.0	-15.0	13.8	1.08	1.2	63.9	204.2	9.9	1.2	0.5	2.0	1.0
EU average	4.18	1.05	3.89	-3.86	2.27	0.94	2.11	96.52	367.11	11.60	0.9	1.1	0.6	1.0
EU median	4.8	1.05	1.00	-3.50	2.52	0.95	1.91	86.43	351.48	11.0	1.0	1.1	0.5	0.8
Low	2.5	1.00	4.0	0.0	3.0	1.05	1.0	75.0	240.0	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	2.0	95.0	280.0	14.0	1.7	1.7	1.7	1.7

Notes: data as of Q1 2018. 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 (T1, T2 and T3), 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, Financial Stability Review, ECB, June 2011 and Box 3, Financial Stability Review, ECB, November 2015. The latest observation is Q1 2018. HH stands for household.

3.3 Step 2 – Integration of additional information and adjusted risk ratings by stretches

The goal of this step is to integrate additional relevant information in the assessment to transparently arrive at a final risk rating. The outcome of this step, which is summarised in a template (Table 2), is a risk assessment in the form of risk ratings for each stretch and an overall risk rating that encompasses evidence from the scoreboard and other relevant information. Other relevant information includes country-specific information, model-based evidence and expert judgement.

3.3.1 Integration of additional information and adjusted risk ratings

A template for Step 2 (Table 2) transparently reports all the information that enters into the assessment, the weight that this information receives, and how the information is used to adjust the outcome of Step 1 and reach a final rating. The template is organised along the three stretches in the scoreboard. This approach allows for contrasting the assessment based on the scoreboard of each category in Step 1 with additional complementary information for the same stretch. Further, this approach ensures that all relevant country-specific knowledge enters into the assessment of risks.

Guidelines for the additional information that can be used in the template to adjust the scoreboard ratings of individual stretches are provided in Box 2. The complementary information may cover specific time series (also non-harmonised time series), indicators and output from models. The complementary information may be provided by ECB/ESRB country experts and by national authorities. More specifically, models/indicators relating to RRE price valuations and dynamics are used to adjust the scoreboard rating for the collateral stretch, models/indicators relating to lending dynamics and credit standards are used to adjust the scoreboard rating for the funding stretch, and models/indicators relating to household balance sheets and household credit risk are used to adjust the scoreboard rating of the household stretch.[17] For each stretch a minimum set of expected information is specified. If these variables are not provided in the template, it should be clearly stated whether they confirm the risk rating or are not available.

[17] Example for the collateral stretch: the mechanical scoreboard of Step 1 indicates clear price overvaluation (“pronounced” risk) on the basis of common cross-country indicators (i.e. the ECB price overvaluation measures are above 7.5%). However, in Step 2, country-specific information including country-specific time series and models indicate only tentative signs of overvaluation. On the basis of this information, a downward adjustment is made in Step 2 to the result of Step 1. Accordingly, the risk category of the collateral stretch would be lowered to “medium” on the basis of relevant country-specific information.

Box 2

Inclusion of complementary information by category in Step 2

This box lists the potential information that can be used in Step 2 to complement and adjust the mechanical scoreboard ratings for each individual category.

Collateral stretch: (i) alternative measures of price dynamics and/or models assessing risks in relation to price dynamics, including early warning models, RRE price forecasts (under baseline and stress scenarios to assess the stability of current price trends) and models to predict RRE price turning points; (ii) model-based information on the drivers of price dynamics (stable vs. temporary factors) to assess the persistence of price trends and risks to the outlook; (iii) alternative measures of RRE price valuation on the basis of models or indicators; (iv) alternative specific indicators (expectations for house prices, transaction volumes, etc.) and considerations of other country specificities, including experts' views. **Minimum information required: alternative valuation measures.**

Funding stretch: (i) alternative measures of lending dynamics and/or models assessing risks in relation to lending dynamics, including early warning models; (ii) model-based information on the drivers of lending dynamics (stable vs. temporary factors/demand vs. supply) to assess the persistence of price trends and risks to the outlook, and to inform the policy discussion (curb demand vs. curb bank risk-taking); (iii) information on lending standards, including LTVs, LTIs, maturities, etc. (averages and distributions for new loans and outstanding stock); (iv) information on credit quality (banks' risk weights on mortgages, average by approach (internal ratings-based (IRB)/standardised approach (SA), mortality curves for loans by sector and by year of disbursement); (v) alternative specific indicators and considerations of other country specificities, including experts' views on funding conditions. Minimum information required: information on lending standards (average and tails of the distribution in new lending).

Household stretch: (i) any input (indicator or model-based) providing information on the soundness and resilience of household balance sheets, including estimations of deleveraging needs and/or projected debt paths, stress test household risk-bearing capacities, scenario analyses, calculations of the share of vulnerable households and PD calculations;
(ii) considerations of other indicators, including the share of households with mortgages, the share of mortgages with floating rate contracts (for new loans and outstanding stock), amortisation profile (for new loans and outstanding stock), etc.; (iii) consideration of other country specificities, including other potentially useful indicators on household balance sheet conditions and experts' views. Minimum information required: the share of floating rate loans in new lending and outstanding lending.

Systemic importance of RRE and potential for spillovers: In analysing the potential for spillovers from negative developments in RRE to the broader economy and the financial system, consideration should be given to specific features of the market that could lead to shock amplification. Evidence on the potential for shock amplification could emerge from models (e.g. estimated sensitivity of consumption to interest rate shocks) or indicators (e.g. the share of floating rate mortgages). Potential elements entering into the assessment in this step are: (i) any

input (indicator or model-based) providing information on whether the banking system (or other financial intermediaries) could amplify negative shocks in RRE markets, including input from scenario analyses, bank stress tests, DSGE models, etc.; (ii) consideration of any other structural features of the economy that could lead to the amplification of negative RRE shocks (e.g. the percentage of home ownership); (iii) potential for inward spillovers due to exposure to foreign RRE markets.

Discrete changes to the scoreboard ratings are envisaged when additional information provides a different picture than the scoreboard. Depending on the evidence provided in Step 2, the summary scoreboard rating of each category is adjusted on the basis of the following coefficients:

- No adjustment to the scoreboard (adjustment coefficient = 0): the evidence provided in Step 2 broadly confirms the rating assessment from the scoreboard.
- Moderate adjustment to the scoreboard (adjustment coefficient = +/- 0.5): the evidence provided in Step 2 suggests that the scoreboard somewhat understates (overstates) the risk.
- Sizeable adjustment to the scoreboard (adjustment coefficient = +/- 1): the evidence provided in Step 2 suggests that the scoreboard largely understates (overstates) the risk.

The ESRB evaluates potential new evidence found in Step 2, and following intense consultation with national authorities, decides on the magnitude of the adjustment to the rating. In principle, the magnitude of the adjustment should be limited, in line with the metrics shown above. However, due to the current lack of data and methods required for accurately controlling the impact of the many country-specific factors on the intensity of vulnerabilities, in practice the room for adjustment may be temporarily extended in order to avoid the risk of under- or overrating the actual vulnerabilities. In addition, in the event that the adjusted ratings across categories are not consistent with the original overall rating, the ESRB should carefully review the statistical and analytical foundations that justify the adjusted rating. The final overall rating for a country is calculated as the summary of the adjusted ratings across categories obtained by the same rule adopted in Step 1.

Table 2

Example of the template for including additional information

	Step 1 – Scoreboards					Step 2 – Additional Information and Adjustment		
	Benchmark indicators				Average scoreboard rating	Additional country specific information	Adjustment coefficient	Adjusted rating
Collateral	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)	**1.0**	Please include info that could potentially affect the assessment of the "collateral" stretch, these include: (i) alternative measures of price dynamics and/or models assessing risks in relation to price dynamics. These include early warning models, RRE price forecasts (under baseline and stress scenarios to assess the stability of current price trends) and models to predict RRE price turning points; (ii) information on the drivers of price dynamics (stable vs temporary factors) to assess the persistence of price trends and risks to the outlook. (iii) alternative measures of RRE price valuation on the basis of models or indicators; (iv) alternative specific indicators (expectations for house prices, transaction volumes, etc.) and considerations of other country specificities, including experts' views.	**0.3**	**1.3**
	5.31	0.98	5.00	1.00				
Funding	Loans to HH for house purchases (36m real growth, av. %)	Loans to HH for HP relative to trend	HH loan spread	-	**0.67**	Please include info that could potentially affect the assessment of the "funding" stretch, these include: (i) alternative measures of lending dynamics and/or models assessing risks in relation to lending dynamics, including early warning models; (ii) information on the drivers of lending dynamics (stable vs temporary factors / demand vs supply) to assess the persistence of price trends and risks to the outlook, to inform the policy discussion (curb demand vs curb bank risk taking); (iii) information on lending standards, including LTVs, LTIs, maturities etc. (averages and distributions; (iv) information on credit quality (mortality curves for loans by sector and by year of disbursement); (v) alternative specific indicators and considerations of other country specificities, including experts' views on funding conditions.	**0**	**0.7**
	3.15	0.96	1.60	-				
Household	HH debt (% of income)	HH financial assets to debt, %	Debt service to income ratio for HH (%)	-	**2.3**	Please include info that could potentially affect the assessment of the "household" stretch, such as (i) any input (indicator- or model-based) providing information on the soundness and resilience of household balance sheets, including estimations of deleveraging needs and/or projected debt paths; stress test household risk bearing capacity; scenario analyses; calculation of share of vulnerable households and PD calculations; (ii) consideration of other indicators: share of households with mortgages, share of mortgages with floating rate contracts, etc.; (iii) considerations of other country specificities, including other potential useful indicators on household balance sheet conditions and experts' views.	**-0.2**	**2.1**
	115.0	220.4	11.6	-				

3.3.2 Other information to assess risks and contribute to the policy discussion

3.3.2.1 Structural features of housing markets

Structural and institutional features of RRE need to be taken into account when assessing RRE risks and policies.[18] There is considerable heterogeneity in structural and institutional features across EU countries that might affect the assessment of vulnerabilities and the selection of optimal policies. Structural features and their expected developments tend to be incorporated in housing market expectations, and any structural changes may have large implications for RRE vulnerabilities. The most important structural and institutional features include market characteristics (home ownership rate, typical maturity and fixation), rental market restrictions, tax policy and transaction costs. Further, supply-side characteristics (price elasticity of new housing, regulation and spatial planning) as well as demand-side factors (demographic developments and changes in household structures) are important drivers of housing markets.

The impact of structural features on the risk assessment of RRE markets might not be clear ex ante. A number of structural features have a clear mitigating impact on RRE risks. For example, in mortgage markets where fixed interest rate contracts prevail, the interest rate risk of borrowers is reduced.[19] Other structural features, such as a structural gap between demand and supply for housing, do not have a clear impact on risks ex ante. While the structural gap might lower the risk of turning points in the short term, it could lead to more severe vulnerabilities in the medium term. This is the case when lending standards are relaxed and speculative demand for housing emerges in anticipation of continued price increases.

Therefore, while structural features of housing markets should be duly documented and taken into account in the risk assessment, their impact on risks should be qualitatively assessed on a case-by-case basis.

3.3.2.2 Systemic importance of RRE and potential spillovers to the rest of the economy

In order to frame the risk and policy discussions, the systemic importance of RRE in a country should also be assessed. This can be done on the basis of a set of reference indicators to capture the systemic relevance of RRE and to assess the potential for spillovers of shocks from RRE to the rest of the economy and to the financial sector. To this end, a table with reference indicators is proposed. The indicators contained in the table complement the predominantly cyclical

[18] For a comprehensive discussion of structural features of RRE markets, see ESRB report on ”Vulnerabilities in the EU residential real estate sector”, ESRB, November 2016.

[19] Although, in this case, interest rate risk is transferred from the borrower to the lender which might lead to vulnerabilities within the banking system.

indicator analysis in Steps 1 and 2 with a structural perspective.[20] The key indicators in the table provide a common basis for the assessment, which can be complemented by other relevant indicators.

The proposed table on the systemic importance of RRE consists of six key indicators capturing the role of construction in the economy as well as the extent of bank and non-bank exposures to RRE. In particular, the first indicator of gross fixed capital formation for dwellings in relation to GDP is included to provide a measure of the importance of expenditure on residential construction in a given country, and to assess the potential broader implications of a correction to the housing market.[21] The second indicator measures the exposure of domestic monetary financial institutions (MFIs) to domestic RRE markets in relation to GDP. It captures risks stemming from the size of the RRE market in a country, risks to banks stemming from the exposure to RRE, and risks connected to potential supply shocks (e.g. deleveraging) and the role of the collateral channel. The third indicator captures lending to households from non-bank financial intermediaries and the total assets of real estate investment funds. It captures risks to non-banks stemming from the exposure to RRE. It can also relate to the potential impact of supply shocks (e.g. deleveraging) on RRE markets. The fourth indicator captures the exposure of banks in relation to capital, and measures risks related to the concentration of exposures and to solvency in the event of adverse developments in RRE markets. The fifth indicator looks at the exposure of banks to the construction sector in terms of capital, and relates to the concentration of exposures and to potential solvency risks, as developments and risks in the construction sector may be closely linked to RRE during downturns. The sixth indicator captures household housing wealth in relation to GDP and provides information on the intensity of a negative fallout in consumer spending following a sudden house price reversal. The values of indicators for EU countries are presented in Table 3, while Table A.3 in the technical annex provides a more detailed description of the indicators and data sources.

The complex nature of spillovers as well as data limitations suggests a qualitative use of the indicators in the table in order to frame the risk assessment and provide input for the policy discussion. In contrast with the scoreboard, no mechanical thresholds are therefore used to benchmark key indicators, and composite summary indicators are provided in the table. The fact that a high degree of systemic relevance of RRE is not a source of vulnerability in itself but could render risks originating from the combination of three stretches considered more severe and urgent supports less mechanical use of the table. The information from the table can be used to adjust the overall rating, although the adjustment is less mechanical than the adjustment coming from the scoreboard stretches. Further, the table can guide the urgency of potential policy actions.

[20] While the scoreboard tends to focus more on cyclical aspects and the spillover table more on structural aspects, the separation is not clear cut. For example, it was considered appropriate to include one indicator of cyclical developments in the construction sector in the spillover table in order to understand cyclical links and the potential for spillovers.

[21] Prominent examples of building booms include Eastern Germany following reunification, Ireland and Spain up to 2007. See also the following studies for a general discussion of the importance of building sector developments from a financial stability perspective: Barras (2009), DeCoster and Strange (2012), Haughwout et al. (2012) and Sun et al. (2013).

Table 3

Systemic importance of RRE and potential for spillovers

Country	Indicators				
	GFCF dwellings to GDP (%)	Bank RRE exposures to GDP (%)	Non-Bank intermediary exposures to RE markets to GDP (%)	Bank exposures to RRE in relation to capital (%)	Bank exposures to construction in relation to capital (%)
AT	4.1	28.4	2.4	166.4	134.0
BE	5.6	33.3	2.6	399.8	83.1
BG	2.4	9.7	0.3	NA	62.2
CY	4.6	63.4	0.9	22.6	152.4
CZ	3.5	23.9	0.0	230.5	NA
DE	5.8	36.3	10.6	92.0	67.2
DK	4.3	104.6	0.4	658.0	263.5
EE	4.5	32.4	1.8	183.4	77.5
ES	4.5	47.3	0.2	426.7	89.4
FI	5.9	44.0	4.2	424.0	173.8
FR	5.9	42.7	4.5	176.9	92.8
GB	3.8	55.9	NA	NA	NA
GR	0.6	34.1	1.6	202.0	74.8
HR	NA	15.2	0.2	89.8	36.3
HU	2.2	8.5	2.8	NA	64.7
IE	1.9	27.7	8.2	250.8	54.9
IT	4.2	22.2	4.0	281.1	174.4
LT	2.9	17.6	1.5	383.6	108.9
LU	3.0	50.8	152.4	63.1	43.9
LV	1.8	17.5	0.2	194.6	112.9
MT	3.8	44.0	0.5	164.3	91.7
NL	3.9	61.8	29.4	622.0	122.7
PL	2.7	21.9	0.0	227.4	42.6
PT	2.5	50.6	7.4	446.6	105.7
RO	2.1	8.0	0.0	202.9	56.5
SE	5.0	66.8	0.1	641.6	308.1
SI	2.0	14.5	0.1	123.4	31.4
SK	2.4	29.6	1.4	332.4	60.9
EU average	3.6	36.2	8.8	288.4	103.3
EU Mediam	3.8	32.8	1.5	227.4	86.2

Note: Data as of Q1 2018.

3.4 Communicating the risk assessment

In order for the ESRB to communicate clearly the risk assessment and its building blocks, two summary tables are proposed. These tables complement the template for Step 2, which is more technical in nature.

The first table (Annex A.4, Table A.5) provides a horizontal overview of key elements of the risk assessment across countries. For each country, it indicates the cyclical position, the final "adjusted" overall risk rating, and the key vulnerabilities that are relevant from a macroprudential perspective and motivate the risk rating.

The second table (Annex A.4, Table A.6) provides a template covering the final risk rating of a country and an in-depth view of the key underlying determinants. The goal of the table is to communicate effectively the overall risk assessment of a country and the key elements motivating it. The table reports the final rating, the key vulnerabilities underpinning the rating, and the key vulnerabilities and risk ratings by stretch. It covers the cyclical position and the elements motivating the assessment on the cyclical phase. Finally, it covers other more qualitative elements that enter into the risk assessment, including structural features and the systemic importance of RRE markets in a country.

It is worth mentioning that once the final rating of vulnerabilities has been finalised across the three stretches, for the purposes of the policy assessment it may also be useful to group the identified vulnerabilities in terms of stock (namely high levels) and flow (rapid build-up). As discussed more extensively in the following section, the two may entail different policy reactions.

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Technical Annex A

A.1 Stylised facts of RRE cycles on the basis of the proposed characterisation

A full assessment of the cyclical phase would ideally take into account developments in the variables presented in Chart 2 combined with the information from models (forecasts, probabilities of turning points, etc.). Nonetheless, as a starting point, the summary statistics based on a simple rule where phases are delineated using the annual real growth rate of RRE prices and the average valuation measure (average of price-to-income and inverted demand model) are presented.[22] The resulting classification into phases in various countries based on this simple rule is shown in Chart A.1.

[22] Phases with a positive real growth rate of RRE prices and a negative average valuation measure are denoted as recoveries, phases with a positive real growth rate of RRE prices and a positive average valuation measure are denoted as expansions, phases with a negative real growth rate of RRE prices and a positive average valuation measure are denoted as downturns, and phases with a negative real growth rate of RRE prices and a negative average valuation measure are denoted as recessions.

Chart A.1

Cycles based on the proposed characterisation

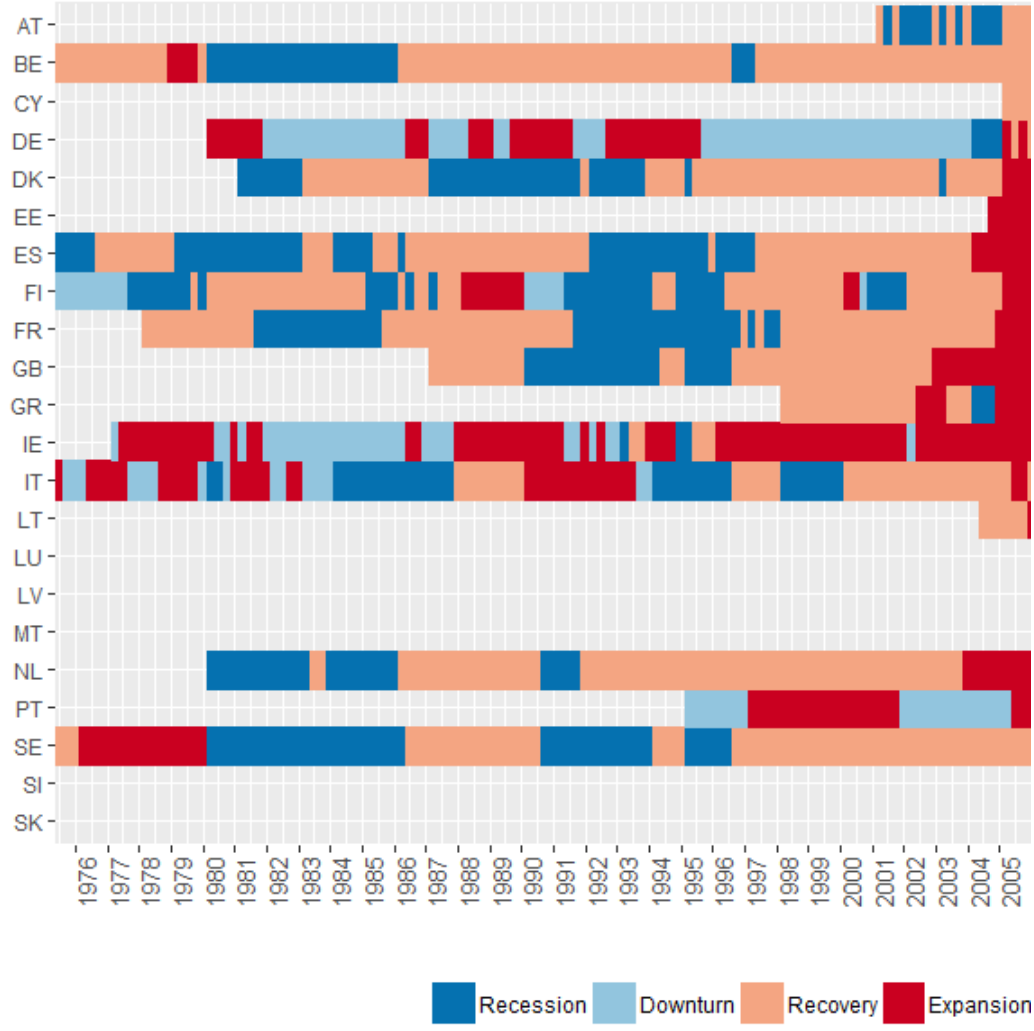


Table A.1 summarises the information on the development of various indicators in different phases of the RRE cycle. Unsurprisingly, expansion phases are associated with the highest average growth in prices, mortgages and construction activity, although the difference between average growth in expansion and recovery phases is not large for price growth and construction investment growth. Moreover, recovery phases last longer than expansion, downturn and recession phases.

Table A.1

Average developments in the various phases of RRE cycles

	Average annual real growth of RRE prices (%)	Average annual real growth of mortgage loans (%)	Average annual change of HH debt-to-GDP ratio (p.p.)	Average annual growth of construction investment (%)	Average duration (quarters)	Number of episodes
Expansion	7.6	11.4	-0.3	4.3	8.2	72
Downturn	-5.1	4.1	5.4	-6.1	8.3	50
Recession	-6.1	3.1	5.1	-2.7	8.1	63
Recovery	6.5	8.4	-1.3	3.9	12.0	66

Further, the correlation between price and mortgage loan growth rates and the correlation between price growth and construction investment growth seem to depend on the phase of the cycle (Table A.2). In particular, the correlation between price and mortgage loan growth rates is higher in a recovery, while price growth and construction investment growth seem to be more tightly linked in downturn and recession phases. The remaining correlations do not seem to systematically vary with the cyclical phases.

Table A.2

Correlations among variables across different phases of RRE cycles

	Prices and loans growth	Prices and debt	Prices and construction	Mortgage loans and debt	Loans and construction	Debt and construction
Expansion	0.6	-0.3	0.4	-0.2	0.4	-0.3
Downturn	0.2	-0.4	0.7	-0.2	0.1	-0.5
Recession	0.3	-0.4	0.6	-0.3	0.1	-0.3
Recovery	0.5	-0.2	0.2	0.0	0.1	-0.3

A.2 Information and data sources for the indicators included in the RRE scoreboard

Table A.3

[Table title]

Indicator	Description	Source (ECB Statistical Data Warehouse codes or other codes where available)	Threshold	Comments
(1) RRE prices, three-year average annual real growth (collateral stretch)	The indicator measures the dynamics of real estate prices with the goal of detecting unwarranted price developments. RRE price dynamics display early warning properties for predicting financial crises. Three-year average annual growth has been chosen on the basis of its early warning properties. Unit of measurement: three-year average annual growth in %.	AT, IE, ES: RPP.Q.cc.N.TD.00.3.00. BE, SK: RPP.Q.cc.N.ED.00.2.00. CY, IT, LT: RPP.Q.cc.N.TD.00.2.00. DE: RPP.Q.cc.N.TD.00.5.00. DK: RPP.Q.cc.N.TH.00.1.00. EE: RPP.Q.cc.N.TF.00.1.00. NL: RPP.Q.cc.N.ED.00.3.00. FR, FI, SE: RPP.Q.cc.N.ED.00.1.00. GR: RPP.Q.cc.N.TF.00.3.00. BG, CZ, HR, HU, PL, PT, RO: RPP.Q.cc.N.TD.00.4.00. GB, MT, LU, LV, SI: RPP.Q.cc.N.TD.00.1.00, where cc is the country code. CPI: ICP.M.cc.Y.000000.3.INX. CPI for DE, PL and SK: ICP.M.cc.Y.000000.2.INX, where cc is the country code.	The medium threshold for the indicator is set close to an early warning model threshold, with balanced preferences between type I and type II errors adjusted to the 75th percentile of distribution across time and countries. The high and low thresholds are set as the medium threshold +/- 2 standard deviation of the change in the indicator.	No specific comments on this indicator from WG-REM members.
(2) Residential price index relative to house purchase trend (collateral stretch)	RRE price index (constant series) relative to house purchase trend, estimated with a one-sided Hodrick-Prescott (HP) filter with Lambda equal to 400,000. The indicator is a coarse measure of RRE price overvaluation (i.e. price index above previous peak indicates potential overvaluation). Unit of measurement: ratio.	See previous indicator.	The medium threshold for the indicator is set close to an early warning model threshold, with balanced preferences between type I and type II errors adjusted to the 75th percentile of distribution across time and countries. The high and low thresholds are set as the medium threshold +/- 2 standard deviation of the change in the indicator.	New indicator included reflecting WG-REM comments. We acknowledge the possible drawbacks of the HP filter. Results from alternative approaches (e.g. Hamilton, 2018 or Estrella, 2007) can be used in Step 2.
(3) RRE overvaluation, house-price-to-income ratio (collateral stretch)	A measure of house affordability, this indicator displays early warning properties for predicting financial crises and RE market downturns. Unit of measurement: deviation from historical average in %.	Computed as the deviation of the ratio of nominal house prices to nominal disposable income from its average since January 1996. For information on valuation metrics and underlying series, see Box 3, Financial Stability Review, ECB, June 2011 and Box 3, Financial Stability Review, ECB, November 2015.	The medium threshold for the indicator is set as the 75th percentile of cross-country distribution. The high and low thresholds are set as the medium threshold +/- 2 standard deviation of the change in the indicator.	Country specificities for Finland to be addressed in Step 2. No other specific comments on this indicator.

Indicator	Description	Source (ECB Statistical Data Warehouse codes or other codes where available)	Threshold	Comments
(4) RRE overvaluation, econometric model (collateral stretch)	This is a model-based indicator that takes into account a number of macro-financial factors affecting RRE prices. It displays early warning properties for predicting financial crises and RE market downturns. Unit of measurement: % deviation from estimated fair values.	For information on valuation metrics and underlying series, please contact the ESRB Secretariat.	The medium threshold for the indicator is set close to an early warning model threshold, with balanced preferences between type I and type II errors adjusted to the 75th percentile of distribution across time and countries. The high and low thresholds are set as the medium threshold +/- 2 standard deviation of the change in the indicator.	No specific comments on this indicator.
(5) Loans to households for house purchases, three-year average annual real growth (funding stretch)	Three-year average annual real growth of bank lending for house purchases vis-à-vis euro area households. In combination with measures of real estate price growth and price valuations, this provides early indications of the formation of a debt-fuelled housing price bubble. Three-year average annual growth has been chosen on the basis of its early warning properties. Unit of measurement: three-year average annual growth in %.	Euro area countries: BSI.M.cc.N.A.A22.A.1.U2.2250.Z01.A. Non-euro area countries: BSI.M.cc.N.A.A22.A.1.U6.2250.Z01.A, where cc is the country code.	The medium threshold for the indicator is set close to an early warning model threshold, with balanced preferences between type I and type II errors. The high and low thresholds are set as the medium threshold +/- 2 standard deviation of the change in the indicator.	No specific comments on this indicator.
(6) Loans to households for house purchases relative to trend (funding stretch)	Bank lending for house purchases vis-à-vis euro area households relative to the trend, estimated with a one-sided HP filter with Lambda equal to 400,000. Coarse measure of cyclical expansion for mortgage lending. Unit of measurement: %.	See previous indicator.	The lower threshold for the indicator is set close to an early warning model threshold, with balanced preferences between type I and type II errors. The high and low thresholds are set as the medium threshold +/- 2 standard deviation of the change in the indicator.	New indicator included reflecting WG-REM comments. We acknowledge the possible drawbacks of the HP filter. Results from alternative approaches (e.g., 2018) or Estrella, 2007) can be used in Step 2.

Indicator	Description	Source (ECB Statistical Data Warehouse codes or other codes where available)	Threshold	Comments
(7) Spread on household loans (funding stretch)	Household loan spread. The indicator captures the compression of lending spreads that might relate to the under-pricing of risks and lax lending policies. Unit of measurement: %.	MFI lending margins on loans for house purchases. RAI.M.cc.LMGLHH.EUR.MIR.Z for euro area countries, RAI.M.cc.LMGLHH.U1.MIR.Z for non-euro area countries, where cc is the country code.	The medium threshold is set close to the 50th percentile of cross-country distribution. The high and low thresholds are set as the medium threshold +/- 2 standard deviation of the change in the indicator.	No specific comments on this indicator.
(8) Household debt to income (household stretch)	Ratio of household loans to gross disposable income. The indicator captures leverage for households and relates to the ability of households to withstand shocks. Unit of measurement: ratio in p.p.	QSA.Q.N.cc.W0.S1M.S1.N.L.LE.F4.T._Z.XDC._T.S.V.N._T. For gross disposable income: QSA.Q.N.cc.W0.S1M.S1._Z.B.B6G._Z._Z._Z.XDC._T.S.V.N._T. For CY, EE, LV, LT, MT and SK: ASA.A.N.cc.W0.S1M.S1._Z.B.B6G._Z._Z._Z.XDC._Z.S.V.N._T, where cc is the country code.	The first threshold is set close to the pre-crisis average across countries.	No specific comments on this indicator.
(9) Household financial assets to debt (household stretch)	Ratio of household financial assets to debt. The indicator captures the ability of households to withstand shocks by comparing their financial wealth to debt. Unit of measurement: %.	Household financial assets: QSA.Q.N.cc.W0.S1M.S1.N.A.LE.F._Z._Z.XDC._T.S.V.N._T. Household debt: QSA.Q.N.cc.W0.S1M.S1.N.L.LE.F4.T._Z.XDC._T.S.V.N._T, where cc is the country code.	The thresholds are set using expert judgement.	Netting out pension fund assets would be preferable, although homogenous data across countries are not available. Caveat on cross-country comparability to be added. Country specificities for Finland to be addressed in Step 2.
(10) Debt-service-to-income ratio (household stretch)	Debt-service-to-income ratio for households. It captures debt servicing costs in relation to income. This indicator displays early warning properties for predicting financial crises and RE market downturns. Unit of measurement: %.	The debt-service-to-income ratio is computed according to the methodology proposed by the BIS. Please find more comprehensive information **here**. Data availability on DSTI/LTI based on microdata is currently limited and will be addressed by the ESRB as part of its work on closing data gaps.	The medium threshold for the indicator is set close to an early warning model threshold, with balanced preferences between type I and type II errors. The high and low thresholds are set as the medium threshold +/- 2 standard deviation of the change in the indicator.	Some issues with current computations of DSTI were identified. An adjusted indicator taking into account HFCS data (median of income of households with debt and share of indebted households) can be used by countries to validate the original indicator.

A.3 Information and data sources for the indicators on the systemic importance of RRE and potential for spillovers

Table A.4

[Table title]

Indicator	Description	Source	Comments
(1) Gross fixed capital formation (GFCF) of dwellings to GDP	This indicator provides a measure of the importance of residential construction in a country. The size of the sector relates to the expected impact of adverse shocks on the overall economy and on the financial system. Unit of measurement: % of GDP.	GFCF of dwellings: MNA.Q.N.cc.W0.S1.S1.D.P51G.N111G._T._Z.EUR.V.N, where cc is the country code. GDP: MNA.Q.N.cc.W2.S1.S1.B.B1GQ._Z._Z._Z.EUR.V.N, where cc is the country code.	Annual frequency used for some countries (e.g. BE, HU, RO) when annual is not available.
(2) Bank exposures to RRE markets in relation to GDP	Total mortgage lending as a percentage of GDP. This indicator looks at the exposure of domestic MFIs to domestic RRE markets. It captures risks stemming from the size of the RRE market in a country, risks to banks stemming from the exposure to RRE and risks connected to potential supply shocks (e.g. deleveraging). Unit of measurement: % of GDP.	Amount outstanding of mortgage loans: BSI.M.cc.N.A.A22.A.1.U6.2250.Z01.E, where cc is the country code.	
(3) Non-bank intermediary exposures to RRE markets in relation to GDP	Total exposure of insurance companies, pension funds and investment funds to RRE as a percentage of GDP. It is the sum of lending to households from non-bank financial intermediaries and of the total assets of real estate investment funds. It captures risks to non-banks stemming from the exposure to RRE. It can also relate to the potential impact of supply shocks (e.g. deleveraging) on RRE markets. Unit of measurement: % of GDP.	Quarterly national accounts (lending to households) and ECB investment fund statistics. Insurance companies: QSA.Q.N.cc.W2.S128.S1M.N.A.LE.F4.L._Z.XDC._T.S.V.N._T. Pension funds: QSA.Q.N.cc.W2.S129.S1M.N.A.LE.F4.L._Z.XDC._T.S.V.N._T. Investment funds: QSA.Q.N.cc.W2.S124.S1M.N.A.LE.F4.L._Z.XDC._T.S.V.N._T. Total assets of real estate investment funds: IVF.Q.cc.N.40.T00.A.1.Z5.0000.Z01.E.	Caveat: figures represent lending to households which is not limited to house purchases, although other types of lending should be small. Figures for real estate investment funds include domestic and foreign exposures, as well as CRE exposures.
(4) Bank exposures to RRE in relation to capital	Total mortgage lending in relation to CET1 bank capital. This indicator looks at the exposure of banks in relation to capital. It captures risks related to the concentration of exposures and to solvency in the event of adverse developments in RRE markets. Unit of measurement: % of CET1 capital.	ECB consolidated banking data. Total mortgage lending: CBD2.Q.cc.W0.67.S1M._Z.A.F.A1131._X.ALL.CA._Z.LE._T.EUR. CET1 capital: CBD2.Q.cc.W0.67._Z._Z.A.A.O1100._X.ALL.CM._Z.LE._T.EUR.	Caveat: Consolidated banking data also capture foreign exposures due to the consolidation of controlled entities located abroad. In a few countries, foreign exposures are sizeable.

Indicator	Description	Source	Comments
(5) Bank exposures to construction and real estate activities in relation to capital	This indicator looks at the exposure of banks to the construction sector and real estate activities in relation to capital. It relates to the concentration of exposures and to potential solvency risks, as developments and risks in the construction sector may be closely linked with RRE during downturns. Unit of measurement: % of CET1 capital.	ECB consolidated banking data on sum of loans to the construction sector and loans for real estate activities. Construction (F): CBD2.A.cc.W0.67.S11.F.A.F.A1100._X.ALL.GC._Z.LE._T.EUR. Real estate activities (F): CBD2.A.cc.W0.67.S11.L.A.F.A1100._X.ALL.GC._Z.LE._T.EUR. CET1 capital: CBD2.Q.cc.W0.67._Z._Z.A.A.O1100._X.ALL.CM._Z.LE._T.EUR.	Caveat: Consolidated banking data also capture foreign exposures due to the consolidation of controlled entities located abroad. In a few countries, foreign exposures are sizeable.
(6) Housing wealth in relation to GDP	This indicator looks at household housing wealth in relation to GDP. It provides information on the intensity of negative fallout in consumer spending following a sudden house price reversal. Unit of measurement: % of GDP.	ECB, quarterly sectoral accounts. Household housing wealth: QSA.Q.N.Ecc.W0.S1M.S1._Z.D.LE.NUN._Z._Z.EUR._Z.S.V.N._T. GDP: MNA.Q.N.cc.W2.S1.S1.B.B1GQ._Z._Z._Z.EUR.V.N, where cc is the country code.	

A.4 Summary tables for the communication of risk assessment

Table A.5

Horizontal overview of key elements of the risk assessment across countries

Country	Cyclical position	Final risk rating	Key vulnerability	Policy priorities
...	...	...	...	...
Y	**Expansion** (firmly expanding)	Medium	Continued strong price increases, signs of overvaluation, moderate lending growth and potential exposure of household to interst rate risk due to the high share of floating-rate mortgages in new lending	TBD
...	...	...	...	...
X	**Expansion** (mature phase with accumulated vulnerabilities)	Medium	Materialisation of credit risk in housing markets due to high household indebtedness and price overvaluation which might amplify housing market downturns. Potential exposure of household to interest rate risk due to the high share of floating-rate mortgages in new lending	TBD
...	...	...	...	...

Table A.6

RRE risks – assessment template

General guidance for completing this template: ***[to be added depending on the use of the template that will be discussed by the RE group of the AWG]***

Section A: Risk assessment	
Final risk rating	**Medium Exposure**
A1. Cyclical phase Brief description of the indicators supporting the classification of the cyclical phase	**Firmly expanding** Robust price and mortgage credit dynamics, signs of overvaluations, model evidence points to permanent drivers of price growth relating mostly to structural factors.
A2. Key vulnerabilities [Please distinguish between "stock" (e.g. high indebtedness; overvaluation) and "flow" (e.g. increasing prices, growing lending, rising indebtedness, etc.) risks]	Sustained increases in residential real estate prices, signs of price overvaluation, high and rising household indebtedness, and strong and above trend lending growth and compressed lending margins.
A3. Summary adjusted rating for each stretch and key vulnerabilities in the stretch	
Collateral stretch	**Medium:** continued strong price increases and signs of overvaluation.
Funding stretch	**Pronounced:** robust mortgage lending and compressed lending margins, signs of deterioration of credit standards.
Houshold stretch	**Medium:** high and increasing HH indebtedness.
A4. Systemic importance of the RRE markets and potential for spillovers to the financial system and the rest of the economy [Please refer to the indicators in the spillover table in the risk id chapter of the report and other relevant indicators at your discretion]	Exposures of banks to RRE are significant both in relation to the GDP and total assets. Housing wealth (as % of GDP) is large, increasing the potential for a fall in consumer spending in case of price reversal.
A5. Potential transmission channels to financial stability	The high household indebtedness might amplify adverse shocks (e.g. house price reversal due to macroeconomic shocks). Relatively large exposure of banks to residential real estate might lead to credit losses with potential for limited supply of credit to finance the economy.
A6. Potential triggers and timing for the risk materialisation [Please discuss potential triggers that would lead to materialisation of the identified risks]	Macroeconomic shock resulting in reversals of house price dynamics.

General guidance for completing this template: ***[to be added depending on the use of the template that will be discussed by the RE group of the AWG]***

Section A: Risk assessment	
Final risk rating	**Medium Exposure**
A7. Expected evolution of risk over time (including projection in the absence of policy changes)	Vulnerabilities (household indebtedness) are expected to continue to build up.
A8. Strucutral features (inc. other relevant policies e.g. taxation, rental market regulation, employment policy, etc.) [Please discuss structural features important for the risk assessment and specify how they might mitigate or amplify RRE vulnerabilities]	• Debt largely concentrated among the households with the highest incomes and large financial assets, which might mitigate potential wealth effects from price reversals. • Tax deductibility of mortgage interest payments provides incentives for high household mortgage indebtedness, thus amplifying the RRE cycle.
A9. National authorities views on vulnerabilities [Please note key elements of disagreement and the key vulnerabilities according to national authorities]	National authorities do not observe overvaluations in the RRE prices.

4 Assessing policy appropriateness

This section provides a framework for assessing the appropriateness of RRE macroprudential policies, linking the outcomes of the assessment of risks and vulnerabilities to the choice of policy instruments (Figure 4). After considering the available macroprudential policy instruments to target real estate vulnerabilities (Step 3), the framework provides guidance on the choice of policy instruments, their interactions and possible combined use (Step 4). Step 5 takes into account additional relevant country-specific considerations that may affect the choice of macroprudential instruments. This section specifically focuses on macroprudential instruments targeting the RRE sector, both borrower-based (LTV, DSTI and D/LTI ratios, maturity and amortisation requirements) and capital-based (risk weights for RRE exposures, LGD floors).

Figure 4
Overview of steps in the RRE policy appropriateness framework

4.1 Step 3 – Macroprudential instruments to address RRE-related risks

The ultimate objective of macroprudential policy is to contribute to safeguarding the stability of the financial system as a whole, by strengthening its resilience and by containing the build-up of systemic risks, thereby ensuring a sustainable contribution of the financial system to economic growth. A set of macroprudential instruments to address risks related to RRE has been introduced in recognition of the potentially large negative consequences of the materialisation of these risks for the financial sector and the real economy. The macroprudential toolkit available to national macroprudential authorities in European countries encompasses two main categories of instruments to address real estate risks: capital-based measures and borrower-based measures.

Capital-based measures determine regulatory capital requirements for the exposures of lenders to real estate. They do so either directly, by imposing higher capital requirements, or

indirectly, by affecting variables such as PDs and LGDs that enter into the calculation of capital requirements. The legal framework for the implementation of these instruments is harmonised in the EU, and is provided by the EU Capital Requirements Directive (CRD IV) and the Capital Requirements Regulation (CRR).[23] Specific capital requirements can be introduced via risk weights (Article 124 of the CRR) or LGD floors (Article 164 of the CRR). Targeted capital requirements for real estate may also be introduced via Article 458 of the CRR, in view of country-specific circumstances. Measures under Article 458 are flexible, as they can be addressed to all or a subset of domestic financial institutions.

Borrower-based instruments directly affect the terms and conditions of lending by imposing limits on the volume of credit granted in relation to the collateral value (LTV), on the debt service payments of borrowers in relation to their income (DSTI), on the borrower's total indebtedness or the volume of credit granted in relation to income (D/LTI), on the loan repayment schedule (amortisation requirements) or on the maximum loan maturity (maturity limits). They are not included in the EU harmonised legal framework, and their use is governed by national law, with different institutional set-ups prevailing across Member States.

Instruments designed to counter borrower-based vulnerabilities can also mitigate spillover risks from real estate to the wider economy. Buffer requirements such as the systemic risk buffer (Article 133 of the CRD), the countercyclical capital buffer (Article 136 of the CRD) or capital requirements for systemic banks (G-SII and O-SII buffers) can also have repercussions on the real estate sector, by raising loss absorption and potentially limiting the extent and propagation of shocks. However, since these instruments do not specifically target RRE risks, they are not the primary focus of this section. Due to the potential overlaps of transmission channels with RRE instruments, the need to take into account potential interactions with instruments addressing broader vulnerabilities in the assessment of policy appropriateness is acknowledged in Section 4.3.1. In addition, institution-specific capital requirements under pillar 2 can be used to target real estate exposures to address systemic risks in a specific bank (or group of banks exposed to similar risks). Pillar 2 measures enjoy the highest level of discretion, but are the least transparent as they are often not disclosed.

4.2 Step 4 – Assessment of selected macroprudential instruments given the identified risks

4.2.1 Transmission channels of real estate macroprudential instruments

In order to assess the appropriateness of a policy, it is important to first explore the strength and timing of the different transmission channels of macroprudential instruments targeting real estate risks. These channels are summarised in Figure 5. The figure highlights

[23] Several macroprudential instruments explicitly target systemic risks stemming from real estate exposures, posing issues with consistency and coordination. Following the European Commission's proposal to remove the macroprudential use of Pillar 2, discussions are ongoing to streamline and improve the various instruments in the EU toolkit.

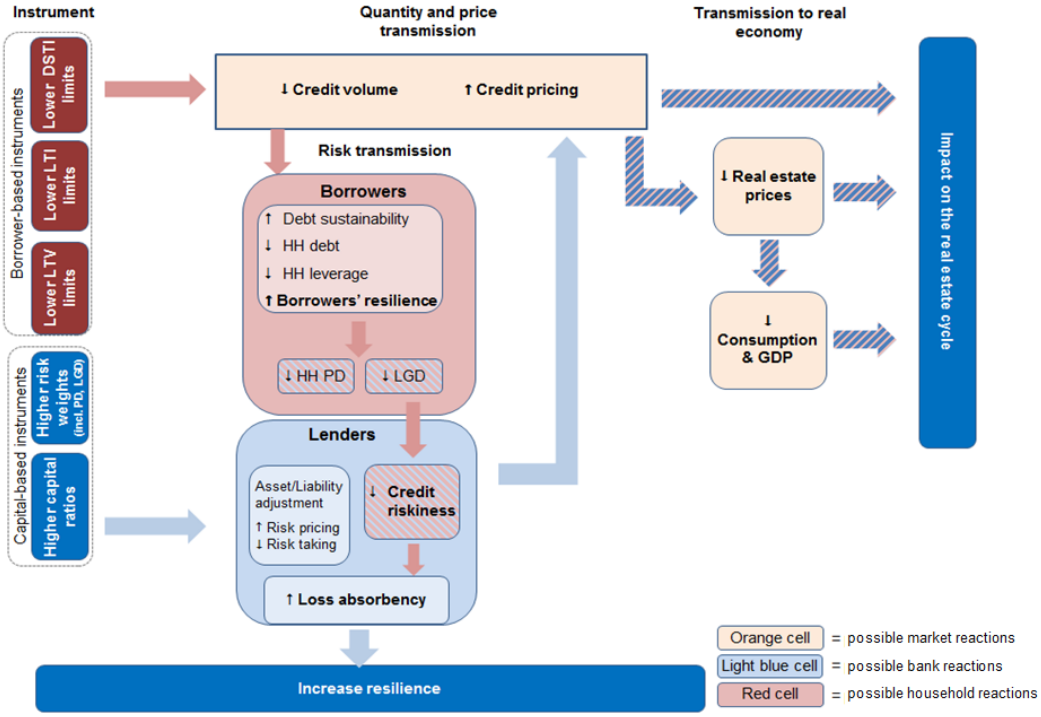
how borrower- and capital-based measures have an impact on the resilience of banks and households and/or the real estate cycle through bank, household or market reactions. The figure shows that although instruments may be targeted to achieve a specific policy objective, either increasing the resilience of the financial system or addressing risks stemming from exuberant real estate market developments, they may also impact other key variables through the interaction of their effects with banks' and borrowers' balance sheets.

Borrower-based instruments have a direct impact on the conditions at which mortgage loans are granted, affecting the maximum amount of a new mortgage loan and hence the flow of credit. A tightening of borrower-based instruments may therefore dampen the real estate cycle. By constraining the volume of new lending, either in relation to the value of the underlying collateral (LTV limits) or to borrowers' income (D/LTI limits), or by limiting debt service payments in relation to income (DSTI limits), borrower-based instruments restrict households' access to credit, thus mostly affecting lending flows in the short run. Depending on the instrument design and calibration, households for which the limits are binding will borrow less. In the aggregate, this will slow down the dynamics of new lending, resulting in turn in lower demand for real estate property and dampened real estate price growth.

Borrower-based instruments also increase the resilience of borrowers, by insulating them from the materialisation of risks related to house price reversals or to household income. Notably, by requiring a down payment in relation to the value of the collateral, LTV limits reduce the influence of real estate prices on the borrowing capacity of households in the long term. While the evolution of the DSTI ratio during the term of the loan depends on many factors that are not predictable at origination (evolution of the monthly repayment and of household income, unemployment, divorce, etc.), a limit on the DSTI or D/LTI ratios at origination supports a lower DSTI level throughout the term of the loan and thus the ability of households to absorb losses of disposable income or increases in debt repayment (e.g. due to an interest rate increase). Similarly, a limit on loan maturity or amortisation at origination reduces the term of the loan and therefore the probability of occurrence of a negative event before the full repayment. Amortisation floors would have similar effects.

Figure 5

Transmission of RRE related macroprudential instruments



Borrower-based instruments also have positive repercussions for banks, increasing their resilience. By restricting the amount of lending relative to borrowers' income or collateral value, they reduce the PD or LGD for the specific exposure. The ensuing lower credit risk improves the soundness of banks' mortgage loan portfolios. Moreover, through their dampening effect on house prices, borrower-based measures may reduce the negative effects on private consumption and aggregate demand ensuing from a reversal in house prices.

Capital-based instruments improve the resilience of banks by increasing their ability to absorb losses. Instruments that target regulatory capital requirements work either directly, by imposing higher capital requirements for (large) exposures to real estate, or indirectly, through variables that have an impact on risk exposures, such as risk weight add-ons and LGD floors. Capital requirements are primarily intended to strengthen banks' resilience, and as they apply to the stock of loans, they can be especially effective if risks have already accumulated. To the extent that capital-based instruments lead to additional capital accumulation, they have a direct impact on bank resilience. In downward phases of the real estate cycle, capital buffers help ensure the smooth provision of lending as they can be used to absorb losses in banks' real estate portfolios. Furthermore, capital-based instruments can be designed to target specific pockets of risk within banks' mortgage loan portfolios, by making them a function of specific borrowers' characteristics.

Through their effect on credit conditions, capital-based measures can affect borrower resilience as well as the business cycle. While tighter lending standards can induce borrowers to

engage in less risky borrowing behaviour, they may also dampen the business cycle. The actual impact of capital requirements on credit conditions depends on how capital adequacy is ensured and on the relative strength of the related transmission channels. If banks raise new equity, their cost of financing may increase, in turn leading to increased mortgage lending spreads ("bank funding cost channel"). At the same time, investors could perceive banks as more resilient ("bank investor channel") and therefore be willing to provide banks with additional equity at a lower cost. The net impact on credit conditions will depend on which of these two effects dominates. Although a dampening of the business cycle may be a positive side effect in an upturn, it could be detrimental in a downturn, especially if banks choose to meet the new capital requirement by reducing assets ("bank deleveraging channel").

Expectations play an important role in the transmission of both borrower-based and capital-based instruments, either weakening or strengthening the effectiveness of measures. For example, the announcement of tighter borrower-based measures might induce borrowers and banks to frontload new loans, which may exacerbate lending growth and boost real estate prices between the moment of announcement and implementation. On the other hand, the expectation of higher capital requirements might induce banks to implement more prudent lending practices before the requirements become effective. This suggests that signalling measures could be effective, even though their direct impact on lending conditions is limited.

4.2.2 Cyclical position

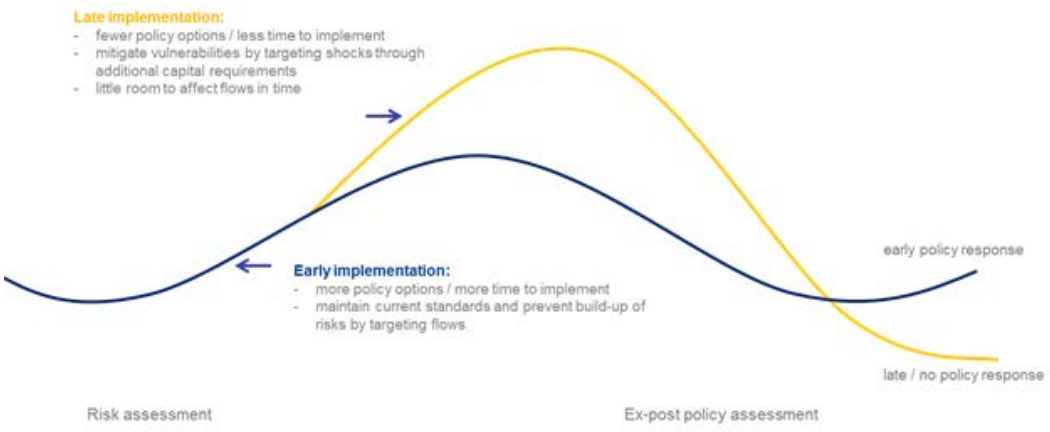
The timing of policy intervention influences the choice of instruments to be activated, and should take into account the phase in the real estate cycle as well as lags in implementation. By acting early on in the real estate cycle, vulnerabilities can be addressed when they are still building up, effectively smoothing cyclical swings compared with the counterfactual of late policy response (see Figure 6 for a stylised representation). The effect of a measure may also depend on potential delays in the policy process. Lags between the moment vulnerabilities are identified and the moment policies are enforced may be due to institutional features (e.g. legislative processes needed to implement a given instrument), or simply due to the time needed for a measure to have the desired effects through the different transmission channels.

In the early stages of the real estate cycle, when the real estate market is expanding and vulnerabilities are building up, measures acting on the flow of new lending are likely to be more effective. Borrower-based measures should therefore be considered the preferred policy option in this phase. The measures can also be activated in a non-binding way, in order to prevent the further deterioration of lending standards. In order words, if lending standards are considered sufficiently conservative, they can be "frozen" at the current level by activating borrower-based instruments to prevent their deterioration in future stages of the real estate cycle. Such a pre-emptive activation can be beneficial on two grounds. First, limiting the build-up of vulnerabilities early on may reduce the need for additional measures in the future. Second, such an approach might also limit the need to impose tighter, binding policies (imposing stricter constraints on a larger proportion of borrowers) later in the cycle, with stronger repercussions for borrowers' access to the real estate market.

If the real estate cycle is more mature, risks have already accumulated on the balance sheets of banks and/or borrowers, calling for measures targeting the stock of existing loans. In such a situation, strengthening resilience becomes a key priority, as vulnerabilities might materialise over a short time horizon. As most borrower-based instruments act on the flow of new lending, they have a limited impact on the resilience of existing borrowers. Hence, capital-based instruments are the preferred option (see the stylised representation in Figure 6). Nevertheless, should accumulated vulnerabilities coexist with strong credit/price dynamics, a more encompassing approach is justified, whereby capital-based measures are complemented with borrower-based instruments aimed at limiting risks related to credit/house price spirals. However, particular caution is warranted if the prolonged cyclical expansion is accompanied by clear signs of real estate overvaluation. In this case, a sharp tightening of lending standards could trigger an early price reversal and thus precipitate the materialisation of the very vulnerabilities the policymaker aims at shielding the economy from. In such conditions, a gradual introduction of borrower-based instruments (e.g. phasing-in period, allowance of exceptions, gradual tightening) is recommended. In addition, they call for careful monitoring in the RRE and credit conditions.

Figure 6

Cyclical position and timing of implementation of policy instruments



The timing and choice of policy intervention also needs to take into account lags in the policy process, from the moment vulnerabilities are identified to the moment policies are enforced. These lags may be related to the institutional policy framework (e.g. formal notification requirements, the need to enforce specific legislation to implement a given instrument[24], lengthy approval processes delaying policy implementation), to the required time to consult the relevant stakeholders prior to implementation or to the time needed for a policy to have the desired effects. The implications for the choice and timing of instruments relate to two main considerations, namely the phase in the cycle and the intensity of the identified vulnerabilities. Policy lags are a less immediate concern in the early stages of the cycle, when vulnerabilities are still building up and the likelihood that risks materialise is low. However, when vulnerabilities are more pronounced and/or

[24] This is particularly relevant for borrower-based measures.

the cycle is maturing, policy lags are crucial in determining the appropriateness and effectiveness of the enacted policies. Policymakers should take these considerations into account and favour an early tackling of vulnerabilities to avoid reaching the point where policy lags make it more difficult to address them in time.

4.2.3 Linking risks and vulnerabilities to instruments

In the context of the RRE market, the key risk consists of financial instability stemming from the direct and indirect effects of a housing market downturn on lenders. Macroprudential policy actions may be aimed at addressing this risk directly (i.e. lowering the probability that the risk materialises) or at strengthening the resilience of the financial system against the consequences of this risk materialising. Reducing the probability of a risk occurring entails curbing excessive developments in the phase where vulnerabilities are building up. This implies addressing risks stemming from exuberant credit and real estate price developments, ensuring the appropriateness of credit standards, the sustainability of household debt and limiting excessive risk-taking by banks. Alternatively, macroprudential policy may be directed at bolstering the resilience of borrowers and/or lenders, by ensuring their balance sheets are able to withstand potential adverse shocks.

In general, the appropriateness of a policy response depends on the nature of the identified risk or vulnerability as well as on the policy objective(s). The choice will depend, among other factors, on the specific risks identified, the position in the real estate cycle and the policy tools available. Table 4 summarises a framework for assessing the appropriateness of a policy, building on the risk assessment framework presented in Section 3. For each of the three stretches, the table describes the main considerations that determine the appropriateness of a certain instrument, depending on the risks and identified vulnerabilities, the policymaker's priorities and the ultimate objectives.

Risks related to the collateral stretch, such as excessive price increases or overvalued real estate prices, imply an elevated probability of a sudden reversal in house prices, more so in the case of a mature cyclical expansion. In addition, unwarranted price increases might feed into expectations, leading to speculative demand and to deterioration in credit standards. In the case of exuberant RRE price dynamics, policymakers may aim to contain the risk of excessive and self-reinforcing credit and price spirals by ensuring that credit standards remain appropriate. While close monitoring of lending standards is warranted, instruments such as D/LTI, DSTI and LTV limits are appropriate to address risks related to excessive credit growth. However, in the face of strong house price growth, LTV limits may be less effective than D/LTI and DSTI limits in dampening credit growth.

Table 4

Framework for policy appropriateness: the relationship between residential real estate risks, policy objectives and instruments

Dimension	Phase of the cycle	Identified risks and vulnerabilities	Policy objective	Policy instruments
Collateral stretch	Expanding RRE and/or credit market	Exuberant RRE price dynamics (flow vulnerabilities)	Ensure that current and expected future real estate price growth do not lead to a deterioration of credit standards. Target: flows of credit	Close monitoring of credit standards D/LTI, DSTI and LTV limits
	Mature/expanding RRE and/or credit market	RRE price overvaluation (stock vulnerabilities)	Strengthen the resilience of lenders and borrowers to a house price correction. Target: outstanding stock of credit	Primary: capital requirements, LGD floors, risk weights Secondary: D/LTI, DSTI and LTV limits, amortisation requirements
Funding stretch	Expanding RRE and/or credit market	Exuberant mortgage credit growth (potential risk-taking); (flow vulnerabilities)	Limit the risk of a credit and house price spiral by containing excessive credit growth. Target: flows of credit	Primary: D/LTI, DSTI and LTV limits, maturity limits Secondary: capital requirements, risk weights and LGD parameters
	Expanding/mature RRE and/or credit market	Deteriorating or loose lending standards – LTV, LTI, DSTI, maturities, higher interest rate sensitivity of borrowers (excessive risk-taking); (flow vulnerabilities)	Ensure that lending standards remain appropriate. Target: flows of credit	D/LTI, DSTI and LTV limits, amortisation requirements, interest rate sensitivity tests
	Expanding/mature RRE and/or credit market	Under-pricing of risk (compressed lending margins, low risk weights) (flow/stock vulnerabilities)	Ensure prudent risk pricing, limit the incentives for risk-taking by banks. Target: outstanding stock of credit	Primary: capital requirements, risk weights and LGD parameters Secondary: D/LTI, DSTI and LTV limits
	Mature RRE and/or credit market	Insufficient capital buffers to withstand potential losses in the RRE portfolio (stock vulnerabilities)	Strengthen banks' resilience to the materialisation of credit risk. Target: stock of credit	Capital requirements, risk weights and LGD parameters
Household stretch	Expanding RRE and/or credit market	Increasing household indebtedness/debt service ratios (flow/stock vulnerabilities)	Contain credit growth and ensure sustainability of household debt. Target: flows of credit/debt	D/LTI, DSTI and LTV limits, affordability tests, amortisation requirements, maturity limits
	Mature RRE and/or credit market	High household indebtedness/debt service ratios, vulnerable household balance sheets (stock vulnerabilities)	Strengthen banks' resilience to the materialisation of risks stemming from household indebtedness. Target: outstanding stock of credit/debt	Capital requirements, risk weights and LGD parameters
	Expanding/mature RRE and/or credit market	High/rising share of floating rate mortgages (interest rate risk) (flow vulnerabilities)	Strengthen borrowers' resilience to adverse income and interest rate shocks. Target: flows of credit/debt	Affordability (stress) tests, amortisation requirements, DSTI limits

Notes: In this table only capital-based instruments specifically targeting RRE exposures are considered. In addition, national authorities may opt to implement capital-based measures targeting specific risks pursuant to Article 458 of the CRR, which may be considered most appropriate to address risks related to specific segments of lenders' mortgage loan portfolios. Owing to difficulties related to foreseeing all possible cases, these measures have not been included in the table. The appropriateness of the other instruments mentioned in the table should be assessed taking into account the identified vulnerabilities and the policymakers' objectives.

Price reversals could expose borrowers and lenders to losses due to decreases in the value of collateral. On the borrowers' side, this can imply important wealth effects, with consequences for private consumption. Furthermore, the resulting increase in LGD will expose banks to considerable credit risk. If vulnerabilities are rooted in overvalued real estate prices, policymakers may therefore aim at insulating both households and lenders from the materialisation of house price reversals. To increase lender resilience, capital-based measures targeting the stock of credit are appropriate. The case for these measures is strengthened in the event of low capital buffers and large and/or concentrated exposures. Borrower-based measures can strengthen household resilience, but only gradually to the extent that they affect the flow of new lending. Changes to amortisation requirements (or fiscal measures) could also be used to affect the stock of existing lending.

Risks related to the funding stretch may lead to the build-up of credit risk on the balance sheets of lenders. This can arise from the combination of several vulnerabilities. By reducing credit demand, instruments targeting borrowers (D/LTI, DSTI, LTV and maturity limits) can be used to address risks related to excessive mortgage credit growth and related house price spirals. Such instruments are also appropriate to target risks stemming from deteriorating or loose lending standards: as they directly affect the terms and conditions of lending, they ensure prudent lending standards on the flow of new loans. Risks related to banks' under-pricing of risk (reflected in compressed lending margins or low risk weights), or to insufficient capital buffers to withstand potential losses from the RRE portfolio, call for measures aimed at reducing banks' incentives for risk-taking and at insulating banks from the materialisation of risks stemming from the unravelling of credit-fuelled RRE imbalances. To strengthen the resilience of lenders to credit risk, capital requirements and higher (sector-specific) risk weights can be imposed, tailored to the specific risks in the mortgage loan portfolio. By acting on the stock of existing loans, such measures cushion banks against negative shocks and externalities. In a more indirect manner, liquidity and funding ratio requirements could also help limit vulnerabilities.

Risks related to the household stretch stem from high or rising household indebtedness and/or debt service ratios, affecting households' resilience to adverse shocks. The actual sensitivity to a shock depends, among other things, on the refinancing profile, the timing of interest rate adjustments, and the conditions of the labour market and the general economy. In a phase where vulnerabilities are still building up (e.g. increasing household indebtedness and debt service ratios), policymakers may wish to ensure the sustainability of household debt by containing excessive credit growth and limiting increases in debt and debt service ratios. Instruments such as D/LTI, DSTI and LTV limits, accompanied by amortisation requirements and maturity limits, are the most appropriate for these objectives. However, as they affect only new lending flows, they bolster the resilience to adverse income and interest rate shocks of new borrowers only. For maximum impact, these instruments should be activated early on in the cycle when household balance sheet conditions start deteriorating. To increase lenders' resilience to a materialisation of credit risk, borrower-based instruments such as D/LTI, DSTI and LTV limits aimed at enhancing borrowers' resilience can be complemented with capital-based measures. However, measures should be targeted to avoid precipitating an unintended recessionary impact through a bold tightening of credit conditions, especially when household balance sheets are already weak due to high debt servicing ratios or high indebtedness.

The assessment of policy appropriateness is also affected by the size of the spillover effects due to large or concentrated exposures of the banking sector to real estate. These could act as amplifiers of a shock in the RRE market and lead to important negative externalities in the broader economy. Risks are likely to be higher in a mature cyclical expansion. Accordingly, strong spillover effects call for prompt policy action. They reinforce the rationale for increasing the resilience of the financial system. In such circumstances, policymakers may wish to activate tools with a short time lag. An appropriate option would be imposing higher capital requirements, including through higher risk weights and changes to LGD parameters, and large exposure limits, possibly in combination with other measures.

4.2.4 Choice and combination of instruments and overlaps

Due to the interaction of their effects on banks' and borrowers' balance sheets, different macroprudential instruments targeting real estate should be seen as complements rather than substitutes, especially when several risks coexist. The degree of complementarity or substitutability between different instruments may not only allow the policymaker to better target the existing vulnerabilities, but also to address shortcomings related to individual instruments as well as to prevent their potential circumvention. In practice, the choice of the mix of actual instruments is highly contingent on pragmatic considerations and country-specific circumstances.

As they work through complementary transmission channels, a combination of macroprudential instruments is likely to be most effective in addressing real estate-related risks and in achieving the stated policy objectives. For example, LTV and DSTI caps can be implemented jointly to influence the two key parameters determining banks' expected loss: the borrower's probability of default (addressed by the DSTI limit) and the loan's loss given default (addressed by the LTV limit). LTV caps can also be combined with LTI limits as the two instruments tend to reinforce each other: while LTV caps provide new borrowers with a buffer in the event of a house price decline, LTI caps provide a buffer against income and employment shocks, thereby increasing borrowers' resilience. In addition, as LTV limits may become less binding on credit demand as real estate prices increase – especially for home movers – policymakers may wish to complement them with D/LTI and/or DSTI limits.

Depending on the relative trade-off of policy goals, "hybrid" instruments such as targeted capital-based measures could be implemented. These include, for example, the use of higher risk weights for loans (or part of loans) that exceed certain LTV, LTI or DSTI ratios, and have been implemented by several countries, including Ireland and Luxembourg.

In addition, the implementation of multiple instruments might be desirable in order to prevent the circumvention of individual instruments. For example, while borrower-based instruments have a positive impact on banks' resilience through their effect on LGD and PD, this effect may be partly offset when this leads to lower risk weights and, hence, to lower capital requirements for real estate exposures. DSTI limits might induce borrowers to demand longer loan maturities in order to reduce the monthly loan repayments, thereby calling for complementary maturity limits. Also, borrower-based measures not accompanied by instruments limiting total

borrower indebtedness might result in borrowers taking up unsecured loans to increase their borrowing capacity.

4.2.4.1 Combinations of borrower-based measures

In some cases, borrower-based instruments should be considered as complements in achieving policy objectives. Combinations of collateral- and income-based measures can simultaneously improve the resilience of both lenders and borrowers against real estate market downturns. In addition, due to their different focus, they enhance resilience to different types of shocks. While collateral-based measures protect banks against losses stemming from real estate price corrections, income-based measures may improve borrowers' resilience to income and interest rate shocks. Complementarities also arise between DSTI limits on one side and maturity and amortisation requirements on the other. While borrowers may circumvent each of these instruments when applied in isolation by loosening the other (unconstrained) lending standards, joint instrument implementation prevents this issue.

In some cases, important synergies among borrower-based instruments arise, resulting in a stronger effect of combinations of instruments compared with their isolated implementation. This is particularly evident in the case of collateral/income-based instruments on one side and maturity/amortisation constraints on the other. The joint implementation of collateral- or income-based instruments with maturity and/or amortisation requirements accelerates the pass-through of the former instruments to the outstanding stock of mortgage loans, thereby strengthening their effect.

Finally, a certain degree of substitutability may be observed between LTI/DTI and LSTI/DSTI instruments due to their shared similar transmission channels and objective of increasing borrowers' resilience. Notwithstanding the similarity of their objectives and their mechanism of transmission to both micro and macro variables, the two instruments focus on different aspects of borrower resilience. LTI/DTI instruments focus on borrower solvency, by linking the amount of new loans to income, while LTI/DSTI instruments take a liquidity perspective, promoting borrowers' ability to service the flow of loan repayments. However, there may be cases warranting the use of combinations of DTI and DSTI limits. For example, DSTI limits used in isolation may not be sufficient in an environment of low interest rates if the underlying DTI ratios are rising.

The appropriateness of combinations of borrower-based instruments should be assessed against the objectives the instruments aim to achieve. While individual instruments may be particularly suited to achieve specific objectives, existing complementarities and synergies among instruments may be exploited to reinforce individual instruments or to limit unintended consequences.

The objective of increasing borrowers' resilience may be achieved with combinations of income-based measures and maturity and amortisation requirements. Combinations of DTI and DSTI instruments are particularly suited when the policymaker aims at limiting the amount of borrowers' debt in relation to their income, while at the same time ensuring the affordability of borrowers' periodical loan repayments: by combining DTI and DSTI limits, policymakers tackle both the solvency and liquidity of mortgage borrowers. DSTI limits should be preferred if new loans predominantly have variable rates and there are concerns related to future interest rate increases.

In these cases, DSTI limits should be computed accounting for stressed interest rates at loan origination. DSTI limits should be complemented with DTI limits in cases where the prevailing low interest rate environment lowers debt repayments, but underlying debt levels are rising. To avoid circumvention, DSTI limits should always be accompanied by maturity and amortisation requirements. Combining income-based instruments with maturity and amortisation requirements also reinforces the effect of the instruments by accelerating their pass-through to the stock of loans. Finally, income-based limits may also be accompanied by LTV limits in countries where borrowers have high incentives to default (e.g. in the case of lengthy foreclosure procedures and/or non-recourse mortgage loans).

Combinations of income- and collateral-based instruments are complements in fostering the quality of banks' mortgage loan portfolios. Combinations of LTV and DTI/DSTI limits concur in simultaneously limiting banks' LGD while simultaneously decreasing the PD of borrowers, leading to a reduction in banks' expected losses on their mortgage loan portfolios. However, in countries where loan refinancing is possible, LTV limits are less effective in reducing lenders' LGD, warranting the joint implementation of full amortisation requirements. In addition, maturity and amortisation requirements also contribute to improving the quality of banks' mortgage loan portfolios by reducing the probability of borrower default due to negative shocks. In general, combining income- and collateral-based instruments with amortisation requirements reinforces the effect of the individual instrument on the quality of the outstanding mortgage loans (stock).

Income-based instruments are also desirable when policymakers aim at containing credit and house price spirals, in combination with LTV limits. Both DTI/DSTI and LTV limits contribute to reducing credit demand, but whereas income-based instruments constrain debt (or debt repayments) in relation to income, LTV limits link the demand for credit to the value of collateral. However, LTV limits used in isolation may not be sufficient to achieve this objective because of the procyclicality of LTVs over the real estate cycle. In addition, a tighter calibration of income-based instruments is warranted in countries where fiscal incentives to purchase a house are in place (e.g. fiscal deduction of mortgage interest expenses).

Finally, income-based instruments combined with maturity and amortisation requirements are best suited to curtail the rise in household indebtedness. While DTI and DSTI limits limit new credit demand, maturity and amortisation requirements ensure a faster pass-through of the income-based measures to the outstanding loan stock, thereby accelerating their effect on aggregate household indebtedness. In addition, maturity and amortisation requirements also concur in lowering credit demand by prompting borrowers to reduce loan amounts, thereby reinforcing the effect of income-based instruments.

Combinations of borrower-based instruments are particularly desirable when targeting several objectives at the same time.

4.2.4.2 Combinations of borrower-based and capital-based measures

While borrower-based and capital-based measures operate differently, there is some substitutability between them. The primary goal of capital-based measures (e.g. risk weight policies) is to increase bank resilience to the materialisation of risks in the RRE lending portfolio.

Capital-based measures also affect bank incentives and influence the pricing, risk features and quantity of new lending, thereby having the potential to affect cyclical developments. The primary impact of borrower-based measures is on flow variables, thereby affecting cyclical developments. As borrower-based measures improve the risk profile of new lending, over time they contribute to safer bank lending portfolios and ultimately greater bank resilience to the materialisation of risks. Both capital- and borrower-based measures affect cyclical developments and the resilience of banks, and can be used to achieve the same policy goals.

On the one hand, the early implementation of borrower-based measures in the RRE cycle could result in safer lending portfolios as the cycle matures and alleviate the need for capital-based measures in the medium term. Beyond making bank mortgage lending portfolios safer, particular combinations of borrower-based measures may also help limit the negative response of household expenditure to income shocks, thereby reducing the risk of negative spillovers to the rest of the economy. Ultimately, borrower-based measures may reduce bank losses in adverse scenarios. The early implementation of borrower-based measures in the cycle may therefore substitute for higher capital requirements later in the cycle.

On the other hand, certain capital-based measures may alleviate the need for borrower-based measures. For example, beyond increasing resilience, risk weight policies that penalise riskier loans or that are linked to certain loan characteristics (e.g. risk weight surcharges linked to LTV) could, in some situations, achieve the same goals of borrower-based measures. Ultimately, as is the case with the adoption of borrower-based measures, capital-based measures could lead to safer lending portfolios over time and may reduce the flow of (riskier) loans.

Finally, borrower-based measures could complement capital measures and reinforce the overall policy action to address RRE risks. The activation of a broad capital buffer covering all risk-weighted exposures, such as the CCyB or SyRB, may lead to portfolio rebalancing towards mortgage loans, which normally have lower risk weights than other exposures. This rebalancing could ultimately have implications for existing RRE vulnerabilities due to an acceleration of mortgage lending and an increase in the riskiness of average loans. In this context, borrower-based measures could complement capital-based measures by containing the portfolio rebalancing towards mortgage lending or by keeping risk-taking in the mortgage portfolio under control.

4.2.5 Temporary vs. permanent use of instruments

Macroprudential instruments can be used either in a time-varying way in response to cyclical developments or as a permanent feature of the prudential regulatory framework, ensuring that minimum prudent lending standards and the financial sector's resilience are maintained at all times. However, these two approaches are not mutually exclusive since, even if instruments are introduced in a permanent way, their calibration can be adjusted in response to cyclical developments posing risks to financial stability. The advantages of a permanent approach to the use of macroprudential instruments are a more predictable environment for both lenders and borrowers, and a lower risk of procyclical policies resulting from information and implementation

lags[25]. That said, a fixed level for a certain instrument might not be appropriate in all phases of the cycle. Conversely, a purely time-varying use of macroprudential instruments, i.e. activating and deactivating instruments when the need arises, is not subject to implementation lags but might create uncertainty and even amplify volatility if lenders and borrowers adapt their behaviour according to their expectations of policy tightening or loosening, by frontloading or postponing lending and borrowing decisions. In addition, the institutional features of the legislative framework and policy lags might lead to action/inaction bias.

An intermediate approach combining a permanent, minimum level of macroprudential instruments with a time-varying component reacting to cyclical market developments could ensure the appropriateness of macroprudential policy over the cycle. Once an instrument is in place, it may be relatively easy to loosen or tighten, thereby mitigating inaction bias. For instance, in expansionary phases, a tightening of lending standards may be justified to contain the risk of excessive and self-reinforcing credit and house price spirals, to ensure that lending standards remain appropriate, and to contain the increase in borrowers' indebtedness and debt service ratios. In more mature phases of the cycle, a tightening of capital requirements may be warranted to ensure that lenders have sufficient capital buffers to withstand the potential materialisation of the identified (level of) vulnerabilities. Finally, in downward phases of the cycle, instruments may be loosened to mitigate the impact of the downturn by ensuring a smooth provision of credit and households' access to the real estate market. The more specifically measures address risk in RRE, the better they can be adapted to cyclical conditions. This differs from the less targeted framework for the CCyB, which progressively builds up resilience as the cycle matures.

Finally, the duration of some instruments is determined by law. For example, macroprudential measures implemented under Article 458 of the CRR have a maximum duration of two years, and their renewal depends on whether the vulnerabilities justifying their introduction still exist.

4.3 Step 5 – Consideration of additional country-specific factors

4.3.1 Institutional framework and additional policy considerations

The discussion has so far examined the appropriateness of different macroprudential instruments regardless of the feasibility of their implementation in a given jurisdiction. In practice, the institutional framework for macroprudential policy will play a key role in the conduct of macroprudential policy to address RRE risks. From an EU perspective, the selection of instruments should reflect the various legal conditions set out in the CRD IV and CRR. For example, certain instruments (the SyRB and the instruments under Article 458 of the CRR) require authorities to consider, before making use of them, the sufficiency of other instruments according to a predefined process.

[25] A permanent approach to the use of macroprudential instruments crucially involves determining the level of instrument calibration consistent with the real estate market evolving in line with fundamentals.

Moreover, the possibility to implement the most appropriate instrument to address the identified risk(s) may be constrained by the national institutional framework and legislation. This is particularly the case for borrower-based instruments, for which the existence of a national legal basis is a precondition for implementation. In addition, even when a legal framework for their implementation exists, political considerations (especially relevant for instruments entailing distributional effects) may limit policymakers' ability to activate the most appropriate instrument to address the risk(s) at hand. Such limitations may therefore induce policymakers to opt for a "second-best" policy (if one addressing the identified risks exists) or alternative forms of policy intervention. For example, capital-based measures may be enacted when borrower-based measures are not available to the policymaker. Conversely, borrower-based measures implemented by means of public recommendation, even though not legally binding, can still be considered a "first-best" policy, especially when they are accompanied by strict reporting requirements and authorities are able to make the measure enforceable if recommended limits are not observed. Further, public recommendations are useful signalling tools, in particular when they involve quantitative "recommended" targets for lending standards.[26]

Macroprudential policy decisions are also influenced by other policies and other structural features of the real estate market. The use of macroprudential tools cannot be seen in isolation, and country-specific factors play a large role. In addition, macroprudential instruments designed to counter broader-based vulnerabilities can also have repercussions for the real estate sector. For example, the CCyB may influence the provision of credit throughout the cycle, thereby influencing mortgage lending and the real estate market. Instruments such as capital requirements for systemic banks (G-SII and O-SII buffers), by raising loss absorption and potentially limiting the extent and propagation of shocks, also contribute to increasing banks' resilience, albeit not specifically against potential losses stemming from RRE exposures. Moreover, the development of and the response to imbalances in the RRE sector will also depend on other policies which are not under the control of macroprudential authorities. For example, monetary and fiscal policies, urban planning influencing the supply of housing and the depth of the rental market can influence macroprudential policy decisions. Furthermore, the monetary or fiscal policy stance might either accommodate or interfere with the macroprudential policymaker's objectives, thereby influencing the choice and calibration of instruments. Any assessment of the effectiveness and/or efficiency of macroprudential measures should thus take into account the broad range of policies.

Finally, interplays between macro- and microprudential policy mandates and objectives might also influence macroprudential policymaking. A key issue concerns the interplay between macro and microprudential mandates of authorities and the ownership or degree of control they have over the tools. Certain instruments have a hybrid nature. When the competent and designated authorities differ, this may lead to a lack of consideration of macroprudential objectives and a lack of involvement of macroprudential authorities by other policymakers. Again, any overall

[26] Often, a first implementation of new measures is aimed at ensuring that lending standards (LTV/DSTI/DTI/maturity distributions) do not deteriorate. Prior to the activation of legally binding measures, a detailed communication strategy or non-binding recommendations (qualitative or quantitative) can prove powerful tools in assuring sustainable lending standards and containing the increase in borrowers' indebtedness and debt service ratios. Another advantage of this course of action is that it provides forward guidance to market participants and potentially minimises the market impact of measures once they are activated.

judgement on the appropriateness of policies requires such a broad perspective across institutional competences and policy fields.

Table 5

Additional consideration for macroprudential policy appropriateness and related indicators[27]

Institutional framework: EU and national legal basis, mandates of micro- and macroprudential authorities, political considerations	If the most appropriate policy is not available or feasible, authorities may have good reason to choose second-best policies.
Structural real estate market characteristics: elasticity of housing supply, functioning of the rental market	The appropriate policy response may lie outside the scope of macroprudential policy, or the macroprudential policy measure may be part of a broader policy mix. In the latter case, it should be assessed as part of this mix.
Fiscal, tax and monetary policies: fiscal incentives for mortgage lending, real estate taxation, interest rates	The appropriate policy response may lie outside the scope of macroprudential policy, or the macroprudential policy measure may be part of a broader policy mix. In the latter case, it should be assessed as part of this mix.
Cross-border and cross-sectional spillovers: role of foreign FIs in domestic market, role of domestic FIs in foreign markets	Spillovers may affect the instrument choice: is the policy tool still effective, can it be easily reciprocated, does it have a substantial impact on foreign markets?
Arbitrage/leakage: role of non-bank financial institutions	Leakage may affect the instrument choice: is the policy tool still effective, can leakage be addressed by a combination of (macro)prudential measures?

4.3.2 Cross-border and cross-sectional considerations

Both outward and inward cross-border spillovers should be considered when assessing the international repercussions of macroprudential instruments. Cross-border spillover effects can occur through an "inward" transmission channel and an "outward" transmission channel. "Inward" transmission occurs when foreign financial institutions can circumvent macroprudential policies in the host country. For example, branches of foreign banks could increase lending as a result of tighter credit standards or capital requirements imposed on domestic banks. "Outward" transmission, on the other hand, refers to the effects of domestic policies on other economies. A policy's unintended outward effects may be channelled via subsidiaries and branches of domestic banking groups operating in the foreign country, or indirectly, e.g. via the impact on real activity involving international trade channels. It could also be the case that international banks redirect their lending and investment activities in response to macroprudential measures taken in the home country, which could affect the access to finance for borrowers in the host country. Securitisation of mortgage portfolios is another possible transmission mechanism. A careful coordination of measures across the EU is important to avoid fragmentation of the common market and ring-fencing, which is the rationale for the coordination measures embedded in the EU regulatory

[27] For an in-depth discussion of structural real estate market characteristics, see ESRB (2015), *Report on residential real estate and financial stability in the EU*.

framework.[28] They aim at ensuring appropriate reciprocation, with materiality thresholds to avoid an undue administrative burden for limited exposures with no systemic importance and no distortion of the level playing field.

In the case of real estate policies, cross-border spillovers are likely to work mainly through their effects on branches and subsidiaries of foreign credit institutions affected by domestic macroprudential policy measures. RRE markets are predominantly domestic, i.e. populated by domestic borrowers purchasing domestic properties. However, countries with a high degree of foreign ownership or foreign presence in the banking sector might feel the effects of capital-based real estate measures taken abroad. In such cases, coordination across borders may be needed to ensure that macroprudential measures apply to both domestic and foreign banks, to hinder leakages and to promote a level playing field. This implies that an appropriate choice of measures involves foreign authorities reciprocating macroprudential measures imposed by the domestic macroprudential authority. While positive spillovers in terms of increased resilience are beneficial, unintended (and undesired) effects can arise if countries are in different phases of the financial cycle.

Both the magnitude and direction of spillovers may vary across different policy measures. Different macroprudential instruments are likely to entail different types of responses from financial institutions and other agents, resulting in various forms of cross-border spillovers and possibly a broader segmentation of financial markets. More specifically, cross-border spillovers are likely to differ between instruments for which reciprocity is mandatory and instruments for which countries can decide whether or not to reciprocate. Thus, a separate analysis of the effects of individual instruments should first and foremost be performed before any consideration of the total cross-border spillover effects of joint measures.

4.3.3 Room for arbitrage and leakage

The effectiveness of instruments could be undermined by arbitrage and substitution opportunities, potentially rendering an alternative policy measure more appropriate. This is the case for both capital requirements and borrower-based measures. For example, an increase in capital requirements for real estate exposures may induce banks to increase their exposure to other sectors characterised by a higher margin, and potentially more credit risk. As a result, the impact on bank resilience will be smaller. In the case of borrower-based measures, stricter limits may lead to substitution with lenders or types of lending that are not subject to these measures. For example, if borrower-based measures apply to bank lending only, borrowers may turn to non-bank lenders, thereby reducing the effectiveness of the measure in addressing borrowers' resilience (see Cizel et al., 2016)[29]. Moreover, if measures apply to mortgage lending only, continued strong demand for credit may lead to an increase in other types of lending (such as consumer loans). Both types of leakage may undermine the impact of the policy measure on credit growth.

[28] See also the ESRB Recommendation on the assessment of cross-border effects of and voluntary reciprocity for macroprudential policy measures (ESRB/2015/2).

[29] Cizel, J, Frost, J., Houben, A., Wierts, P. (2016), "Effective Macroprudential Policy: Cross-Sector Substitution from Price and Quantity Measures", *IMF Working Paper Series*, No 16/94, International Monetary Fund.

The potential for arbitrage and leakage may have important implications for instrument selection and the design of a policy measure. In general, as borrower-based measures have the most direct effect on lending, they also come with stronger incentives to find substitutes. If the objective of a macroprudential measure is to address risks related to excessive credit growth, it should ideally apply to all sources of credit and cover securitisation via off-balance vehicles. This is especially important in countries where arbitrage opportunities are readily available, for instance because non-bank lenders play a substantial role or because households have access to different types of lending. In the first case, it is important to make sure that borrower-based measures apply to both banks and non-banks. In the second case, limits could apply to all lending instead of just mortgage lending (e.g. using a DTI limit instead of an LTI limit), or the regulatory frameworks for different types of credit can be aligned to prevent leakage.

4.4 Final rating and communication of the assessment of policy appropriateness

As a final outcome of the integrated horizontal and country-specific information, the policy appropriateness is assessed using a three-level rating, with the following interpretation:

- **Fully appropriate,** when the following four conditions are jointly met: (a) the policy objectives are consistent with the identified vulnerabilities according to the proposed framework (see Table 4 in Section 4); (b) the policy mix meets the policy objectives according to the proposed framework; (c) leakages and circumvention are duly considered and, to the extent possible, addressed; and (d) interactions with other policy areas are taken into account;
- **Partially appropriate,** when conditions (a) and (b) are met; either (c) or (d) or both are not, or (a) is met but (b) is not because country-specific conditioning factors constrain the feasibility of policy instruments;
- **Not appropriate,** when the conditions for partial appropriateness are not met, or no policy is in place to address the identified vulnerabilities.

In line with the proposals regarding the communication of the risk assessment, a template is provided by the ESRB as guidance for clear and effective communication, including of the final grading of the appropriateness of the enacted policies as well as of the reasons behind the overall assessment (Table 6).

Importantly, the sequence of the templates (risk and policy assessment) is only provided to enhance the communication strategy by the ESRB and does not necessarily entail any implication for the current communication rules followed by the national authorities within their own countries and with respect to the ESRB and ECB.

Table 6

Residential real estate policy – Policy appropriateness of macroprudential measures – Assessment update

General guidance for completing this template

The assessment of appropriateness of the policy measures enacted by the national authorities (NA) under review is based on the framework outlined in Section 4 of the WG-REM RRE report.

- Please, keep answers to the point, while providing all the necessary details to support your assessment
- Please, do not insert any charts or tables
- Where indicated, please use the assessment scale (choose one of the options in the drop-down list).

Key concepts and definitions valid throughout the template

The first step of the assessment judges whether policies are conceptually suitable given the nature and timing of the identified vulnerabilities, i.e. they can be expected to address the risk at hand based on their transmission channels. In the second step, additional considerations that can condition the policymaker's choice of instruments are taken into account.

As a result of the assessment, the overall rating of the policy appropriateness follows a three-level rank:

1. **Fully appropriate**, when all the following four conditions are jointly met:
   a) the policy objectives of the national authority are consistent with the identified vulnerabilities according the framework proposed by the WG-REM (see Table 4 in Section 4 of the WG-REM RRE Report);
   b) the policy mix meets the policy objectives according the framework proposed by the WG-REM;
   c) leakages and circumvention are duly considered and, to the extent possible, addressed;
   d) interactions with other policy areas are duly taken into account;
2. **Partially appropriate** when:
   - a) and b) are met; either c) or d) or both are not met;
   - a) is met, but b) is not satisfied, because country-specific conditioning factors constrain the feasibility of policy instruments.
3. **Not appropriate** when:
   - the conditions for partial appropriateness are not met, or no policy is in place to address the identified vulnerabilities.

Section B: Policy appropriateness	
FINAL ASSESSMENT OF POLICY APPROPRIATENESS	
Brief motivation for the final assessment [e.g. the selection of instruments is in line with the WG-REM framework. There is no mismatch between policy objectives as suggested by the framework and the objectives of national authorities. Borrower based measures are enacted to address flow issues, specifically strong lending growth and rising indebtedness. The combination of existing borrower based measures limits the possibility of circumvention.]	
B1. What are the policy objectives as stated by the NAs? [e.g. to mitigate and prevent excessive credit growth and leverage.]	
B2. Are these policy objectives consistent with the identified vulnerabilities, making reference to the WG-REM framework (see WG-REM RRE Report, Section 4, Table 4)?	
B3. What are the appropriate policy instruments on the basis of the identified vulnerabilities (see WG-REM RRE Report, Section 4, Table 4)?	
B4. Activated macroprudential policy instruments. [Please use one line per instrument] **1.** **2.** **…**	[With reference to each instrument in place, please expand on the following: • the calibration of the instrument (amplitude/phasing in); • dates of the introduction and recalibration of the measure (if applicable) • information on the temporary/cyclically adjustable/permanent nature of the instrument]
B5. If multiple instruments are in place, please discuss the considerations that led to the choice of a specific combination of instruments according to the national authorities.	
B6. Please describe the transmission mechanism through which the policy package is envisaged to contribute to the ultimate policy objective(s) (stated in question B1) according to the national authorities.	
B7. Which considerations related to other policy areas (e.g. monetary, fiscal, microprudential) were taken into account when choosing the policy mix? How does the policy mix address them?	

Section B: Policy appropriateness	
B8. Were considerations related to potential policy circumvention (e.g. arbitrage, leakage) taken into account when introducing the policy mix? If so, please explain if they were addressed and how.	
B9. Were considerations related to cross-sectional/cross-border effects and related to the policy's impact on the internal market taken into account when choosing the policy mix?	
B10. Alternative policy options. [Please give any alternative macroprudential instruments considered by the national authorities as equally or better suited than the enacted policies to achieve the stated policy objective(s) given the identified vulnerabilities. Which considerations led to their dismissal? Did the legal framework and institutional competences affect the choice of instruments?]	

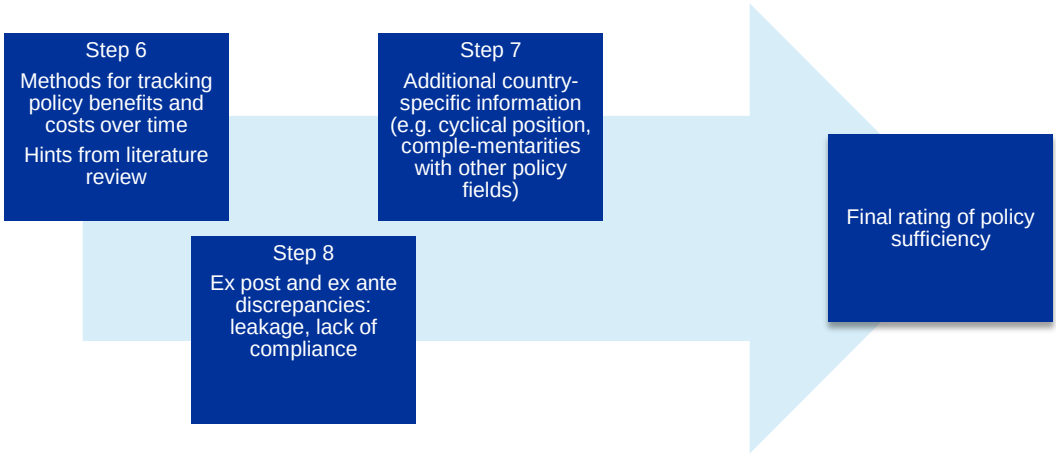
5 Assessing policy sufficiency

This section designs a framework for assessing the sufficiency of RRE related macroprudential policies. **The aim is to turn in operative guidelines a conceptual definition of sufficiency closely linked to the overall objectives of macroprudential policies and their effects on key target variables**. In the ESRB framework, macroprudential policies aim at two main intermediate objectives, namely increasing the resilience of the financial system and decreasing the build-up of systemic risks[30].

In this context, the assessment of policy sufficiency is conditional on: (i) the identification of the target variables that are expected to affect the conditions for the achievement of the intermediate objectives; (ii) the ability to assess the balance between the expected gains and costs of a given policy. The expected benefits and costs may occur over time depending on the calibration of the policy and on the country's economic environment and/or action in other policy fields.

An activated macroprudential instrument, conditional on proving appropriate, is assessed to be sufficient based on a twofold criterion: (i) it delivers a substantial contribution to mitigating the identified vulnerabilities (effectiveness); (ii) it delivers over time reasonably higher benefits than costs in pursuing the stated policy objectives (efficiency) against the identified vulnerabilities (Table 4 in Section 4)[31]. In other words, an appropriate policy can be also considered sufficient when it affects the target variables in such a way to maximise the benefits over time while minimising the possible costs – known or unintended.

Figure 7
Overview of the steps in the RRE policy sufficiency framework



[30] More broadly, the literature of effectiveness of macroprudential policies points to a reduction in systemic risk, with positive implications for the real economy and the financial sector (Wong et al. (2011), Lim et al. (2011), Claessens et al (2013), Kuttner and Shim (2013), Claessens et al (2014), Cerutti et al (2017) etc.).

[31] The definition also relates to the broader framework that relates policy instruments, intermediate targets/objectives and ultimate goals which builds on the monetary policy literature. For an application to macroprudential policies see IMF (2013, 2014), ESRB (2014), Galatti and Moessner (2017).

Alike the risk and policy appropriateness modules, the assessment of policy sufficiency is structured in three steps (Figure 7).

In the first place, it is part of the sufficiency assessment to review any quantitative and qualitative methods that could help in the calibration of policy against the intensity of the identified risks, as well as in the monitoring of the net benefits projected both in the short, medium and long term. Measuring the costs and benefits of macroprudential tools is not an easy task in practice, as it is extensively discussed in Section 5.1. Useful hints could be gained by reviewing the available literature along the lines sketched in Section 5.2, especially as the number of available empirical studies could keep increasing in the near future. The literature review could thus provide a soft guidance on the range of reasonable values for the size of the policy impact on specific variables, especially in countries where the lack of experience and data is more severe.

More generally, the development of a suitable kit of analytical methods and statistical inputs is a key aspect for the sufficiency assessment, and enhancing efforts to achieve substantial progress in this direction should be a priority for most European countries. Section 5.3 provides guidance to make operative the net benefit approach to policy sufficiency based on methods suitable for ex ante calibrating macroprudential measures (the ex post perspective is reviewed, mostly in the same lines, in Section 5.5). Key ingredients are: (i) listing a set of principles for a sound selection of methods; (ii) discussing appropriate methods for calibrating capital-based and borrower-based measures.

In the second place, in addition to the general findings of methods and literature, for macroprudential policies targeting RRE risks to be deemed sufficient a number of additional considerations need to be taken into account. As discussed in Section 5.4, whenever the impact of measures is relaxed via exemptions, speed limits or loss compliance requirements, due consideration should be paid to the impact on risk for banks and borrowers[32]. Moreover, there is a minimum data requirement for a sound policy calibration, which often is not currently met.

The calibration of individual instruments should also consider the impact of other macroprudential measures activated over time, as well as the interactions with other economic policies (monetary, fiscal, and structural), as these could substantially amplify or mitigate the effect of macroprudential policy depending on the transmission channels prevailing in a country. The sufficiency of measures therefore depends not only on the choice of macroprudential instrument itself, but on the mix of other policies which affect the balance of costs and benefits.

In the third place, the assessment of policy sufficiency needs to consider the uncertain effect of macroprudential instruments, time lags in implementation as well as the possibility of leakages and legal and political constraints. These aspects identify a block of factors that affect the size of the possible discrepancies between the ex-ante and the ex-post assessment,

[32] Speed limits/exemptions refer to the ability of lenders to issue a limited proportion of new loans above the regulatory limit on that specific lending standard. It is important to assess to what extent these exceptions (for instance, higher LTV limits targeted to first-time buyers), while addressing affordability issues; do not compromise the goal of mitigating risks in the flow of new mortgages. Some of the countries which have introduced exceptions of this kind are Finland, Iceland, Ireland, Czech Republic and Hong Kong.

which unveils a valuable information content regarding either the ways the measures in place are actually working or the need for further action in terms of recalibration of the activated policies.

The remainder of this section gives various perspectives to help a comprehensive assessment of policy sufficiency that, in practice, needs to be tailored to the specific circumstances country by country. The ideal approach is mostly based on quantitative methods, which could be hopefully available in an increasing number of European countries in a proximate future as the statistical progress gain substantial momentum.

However, in current times the important constraints coming from the limited experience in the activation and in understanding the operation of macroprudential tools is to be acknowledged. Importantly, the contingent lack of suitable methods and data for the policy calibration is not to cause inaction bias against the identified vulnerabilities: alternative approaches (such as peer review and experts' judgments, experimental and qualitative data) should be pursued with any urgent effort, with the only requirement that modalities and possible limitations in the policy process are clearly documented.

5.1 A conceptual definition of policy sufficiency within a cost-benefit framework

The assessment of policy sufficiency should consider qualitative and quantitative criteria to estimate the sign and the magnitude of the impact on target variables over time. Policies can be considered sufficient when the expected effects prove to be overall beneficial to offset the identified vulnerabilities, i.e. the benefits in terms of achieving the policy targets largely exceed the costs in terms of negative consequences in other dimensions related to the housing and financial markets as well to the conditions of the general economy. The cost benefit framework below is equally applicable to both capital- and borrower-based instruments once they prove appropriately matched with the relevant risks and policy objectives. Ideally, the assessment needs to be pursued in the whole time horizon by which the full impact of the policy action may materialize.

Table 7 is structured along the key elements of such a framework[33]. Interestingly, some of these elements can also be considered for assessing appropriateness and, more generally, the sufficiency assessment consistently builds upon the several blocks that in sequence drive the risk detection and the policy appropriateness assessment.

A critical aspect for operationalizing the assessment of policy sufficiency is that in the class of methods generally available costs are easier to quantify than benefits.

Costs are most commonly measured as the dampening effect that a macroprudential policy instrument has during expansions (i.e. the foregone boom otherwise expected under a no policy scenario). Often, costs are reported in terms of GDP-, credit-, and/or consumption-level losses (or lower growth rates) compared to a scenario where the measure is absent. For instance,

[33] It is important to note that the framework presented in Table 7 indicates a minimal guidance on key elements that should be considered when designing a full matrix of costs and benefits in practical policy implementation. In that sense, it should not be construed as exhaustive.

whereas models assuming life-cycle consumers are available, costs can be calculated as the reduction in life-time consumption. Accordingly, borrowing consumers are most affected by a policy since they will be supplied less credit (credit supply channel), their borrowing capacity will be diminished (net worth channel) and they will consume less over time (dynamic consumption channel). The three channels can manifest also jointly. Related to the first channel, banks could charge a higher lending premium, increasing the borrowing cost of firms, households, and possibly even other banks. Thus, another common cost measure is the increase in external finance premium as a result of a policy measure. Fiscal costs may also be non-negligible, although they are less modelled. The decrease in income-and consumption levels as a result of imposing a measure affects the tax base for both the income and value-added budget revenues.

Costs depend also on the degree of gradualism in implementing a measure and the length of the adjustment period. Many models show that an abrupt change in policy, in particular during recessionary times, will significantly increase the costs thus often warranting a gradual implementation and preferably while risks are built. At the same time, a long adjustment period may also increase costs due to higher uncertainty and may create frontloading/back loading incentives which may not be consistent with the cyclical position.

Table 7

Benefits and costs in assessing the policy sufficiency of macroprudential measures

Intended benefits (maximise)	Target variables	Time horizon	Expected costs (1) (minimise)	Time horizon	Unintended consequences
Increase bank resilience	Bank portfolio risk parameters (PD, LGD), risk-weighted assets, capital ratio shortfall; interaction with bank liquidity	Short to medium term	GDP and consumption loss, decrease in construction investment, adjustment cost of financial service provision (e.g. loan pricing), efficiency loss [credit?]	Short term (1)	Increase in riskiness of some portfolios
					Cross-border/regional/sectoral costs – GDP, credit, house prices, sectoral portfolio composition of banks
Increase borrower resilience	PD, LGD, debt service under interest rate and income shocks	Medium term			Distributional costs (e.g. house affordability, credit rationing, wealth inequality)
Tame the financial cycle (mutually reinforcing credit-house price spirals)	Distribution of the flow of new loans for credit standard indicators (DSTI/LTI/DTI and LTV)[34], predicted recession probability, indebtedness	Medium term			Circumvention costs

(1) Note that some short-term costs can also be interpreted as long-term benefits (e.g. reduction in excessive GDP growth).

[34] What we observe in practice (Table 8), however, is that empirical analyses on the impact of macroprudential instruments are based on the perspective of aggregate level of credit or real estate prices, which are not the target variables proposed by this methodology.

Benefits are generally measured in terms of either a smoothing of the cycle (short to medium term) or a reduction in crisis probability. The first category is more intuitive and easier to quantify and key targets are the reduction in volatility of output, credit, or interest rates, allowing for smoother cycles (in particular recessions) and improved resource allocations. The reduced volatility is associated with a smaller number of crises (and smaller losses in each) which leads to a decrease in funding costs for banks (either a smaller deposit premium charged by depositors or cheaper equity since investors will perceive banks to be safer). The second category, however, is harder to quantify and relies on a longer time-horizon. A typical example is the reduction in expected future probability of default of a bank or financial system. It is a very relevant measure, but it entails a demanding requirement in terms of data and analytical skills in order to be quantified. It also depends on the definition of past crisis episodes used to inform the historical crisis probability. Because of the reduction in expected probability of default, the bank bailout costs are reduced significantly (with possible impact on the future sustainability of the government fiscal position).

5.2 Step 6 – Informing the sufficiency assessment on the basis of existing empirical evidence and analytical methods

5.2.1 Using existing empirical evidence to inform the sufficiency assessment

The growing literature on the effects of macroprudential policy can provide valuable information in performing the sufficiency assessment within the proposed methodological framework. This section reviews selected available empirical evidence in order to pave the way along which its information content can be exploited. **A review of the models, data and results of empirical studies, although still limited in number, can offer guidance with respect to the range of possible quantitative effects of the policy measures.** The ranges in the size of the expected effects might be particularly useful in situations where no country-specific studies are available, thus contributing to inform the sufficiency assessment of the domestic macroprudential policies.

Where allowed by the available evidence, which is admittedly scarce for the time being but is progressively expanding, the expected magnitude of the policy effects can also be decomposed into the short-term impact (i.e. one to two years after the implementation of the policy measure) and the total impact over the overall time horizon in which the policy is expected to exert its action. Ideally, the literature review should further reveal the calibration of the policy measures (given a specific shock magnitude) and the relevant target variables, such as capital levels or the share of risky mortgage loans (see Table 8). The clear identification of the target variables enables a concrete assessment of the effects in terms of bank and household resilience. This task could be performed on an increasingly robust foundation as the empirical literature on macroprudential policy effectiveness continues to expand.

Notwithstanding the potentially high added value of conducting a comprehensive review of the empirical evidence, the relatively little amount of experience with macroprudential policies, especially in advanced economies, implies that the available literature is currently quite limited.

The considerable heterogeneity of the specific measures considered in the available empirical studies, as well as the tool calibration, phasing-in periods and possible exemptions, hamper a more general interpretation of the reviewed evidence. In general, the quantitative ranges found on average in the literature should *not* be considered as a benchmark to assess policy effectiveness, owing to the abundance of country-specific factors and possible differences in the intensity of underlying vulnerabilities, policy transmission channels and overall stances. It is worth noting that this holds especially true given the currently limited number of available studies, which in addition hardly report quantitative effects on the target variables, as the impact of policies is broadly measured in terms of changes to housing price growth, overall credit or lending standards. Looking ahead, however, compiling a summary table of policy effects based reasonably on extensive empirical literature can provide useful input for both national macroprudential authorities, which can gain from the peer experience in calibrating and monitoring the effects of the policy tools they activate, and supranational authorities tasked with policy assessment in member countries (e.g. the ESRB, ECB and European Commission).

With these caveats in mind and for the empirical guidance to be as informative as possible, the literature review distinguishes between (i) capital and borrower-based measures, and (ii) simulation studies of potential policies (ex ante assessment) and those that assess measures already implemented (ex post assessment). Importantly, some discrepancies may arise between the ex ante and the ex post assessment. As discussed extensively in Section 5.4.1, these discrepancies can be informative for assessing policy sufficiency, since they shed light on actual calibration, the functioning of the transmission mechanisms and the potential country-specific factors causing clear deviations between observed and expected outcomes.

In addition, the literature review distinguishes between cross-country and individual country studies. While the former are more common in the current literature and typically provide specific quantitative ranges for the effects of macroprudential policies on house prices and credit growth, their findings are difficult to interpret for the purpose of extracting reasonable ranges in the sensitivity of target variables to the implemented tools. For instance, multi-country analyses often consider policy measures in a binary form (implemented/not implemented), without accounting for the level of risks, the policy variables and the tool calibration. Furthermore, the identification problem should be taken seriously due to the high relevance of structural features in the domestic housing markets. By contrast, individual country studies should ideally allow for a better understanding of the policy design, the economic/institutional environment and the transmission channels. Although they may provide evidence on which domestic factors can facilitate/hamper policy effectiveness, they are currently less numerous and typically less detailed in terms of the estimated quantitative effects, and present limitations on the extensibility of the results to other countries.

Tables B.1 and B.2 in technical annex B present a selection of relevant papers: Table B.1 focuses on capital-based measures, while Table B.2 focuses on borrower-based measures. The selection is not exhaustive and aims at providing an overview of recent studies and

illustrating how to make the above methodological considerations operative. Taking into account all the available information, loose quantitative ranges can be extracted for the different measures (Table 8). For instance, the effect on housing prices is estimated on average to be -0.8% to -5.7% for risk weights in the first year; for LTV ratios the estimated impact is around -1% in the first year and -8.3% over ten years, for DTI ratios -0.3% in the first year and -0.8% in the first two years. Looking at the impact on mortgage credit, the quantitative effects estimated on average are -0.7% in the first year and -3.5% in the first two years for risk weights, -3.7% in the first year and -22.6% over ten years for LTV ratios, and -2.8% in the first year and -17.2% over ten years for DTI ratios. Finally, the effects of borrower-based measures (LTV and LTI limits) on lending standards are currently highly varied and of little value in informing the policy assessment[35].

A closer look at the available evidence to date warrants some additional remarks. For instance, **regarding capital-based measures, the ranges are only based on cross-country results**; indeed, in the individual country studies considered (Belgium, Switzerland), the effects are either not statistically significant or the focus is on qualitative issues. **The selection of papers on borrower-based measures is more diverse but reflects similar considerations.** For Romania, Florian et al. (2015) estimate the effects of a borrower-based policy package consisting of five changes in prudential regulation between 2003 and 2011, including a DSTI cap of 35% for mortgage loans and 30% for consumer loans, an LTV limit of 75% and a total indebtedness limit of 40% of household net income. The authors found that this regulation package led to a reduction of 5 and around 8 percentage points respectively for mortgage and consumer loan growth in the first quarter after the measures were introduced, but the impact of the measures was significantly reduced after one year, turning close to zero after two years.

Table 8
Preliminary summary of estimated effects

	Type of measure	Estimated effects, of which:			Target variables
		Total	% in the first year	% in the first two years	
Impact on housing prices	Risk weights[36]		-0.8% to -5.7%		Missing
	LTV[37]	-8.3%*	-1%		Missing
	DTI[38]		-0.30%	-0.80%	Missing
Impact on mortgage credit	Risk weights		-0.70%	-3.50%	Missing
	LTV	-22.6%*	-2.80%		Missing
	DTI	-17.2%*	-2.80%		Missing

On the one hand, this raises the question of what the calibration of macroprudential measures should be if they are intended to have a material impact on credit supply in the

35 See Kinghan et al. (2016a and 2016b), Karam (2018).

36 See Nymoen et al. (2018), Vandenbussche et al. (2015).

37 See Ahuja and Nabar (2011).

38 See Nymoen et al. (2018).

medium run; on the other hand, even a non-binding measure may be effective as an insurance policy against a worst-case scenario. This was the motivation in the United Kingdom in 2014 behind the Financial Policy Committee's decision to recommend a non-binding LTI flow limit[39], calibrated to not have a material impact on mortgage lending and housing transactions in the central scenario but at the same time to provide insurance against a significant increase in lending at very high LTI multiples. Similarly, Łaszek et al. (2015) find limited direct effects of macroprudential measures on the volume of new mortgages in Poland but a significant long-run effect concerning the quality of the loan portfolio.

Nevertheless, even in cases where the macroprudential policies enacted do not seem to be effective overall, heterogeneous effects can be uncovered within the sample over sub-periods and across different units of observation (banks, borrowers or countries). In Ferrari et al. (2017), no effect on mortgage interest rates and loan growth is found on average after the introduction of the risk weight add-on on mortgage loans for IRB banks. However, in the 2013-14 sub-samples, IRB banks with a larger ratio of mortgage loans to total assets curb mortgage loan growth relatively more, while for those with a larger capital buffer above minimum regulatory requirements, mortgage loan portfolios tend to grow relatively faster after the introduction of the macroprudential measure. Similarly, outside Europe Tzur-Ilan (2017) observed a differentiated impact in Israel for the segment of the population investing in housing (not buying primary residence), with a sharp reduction in the value of houses bought after the imposition of an LTV limit[40]. In a study on the introduction of borrower-based measures in Ireland (Kinghan et al., 2016a and 2016b)[41], evidence of heterogeneous effects based on borrower income is documented: for high-leverage, first-time buyers the average LTV ratio is 0.5% lower following the implementation of the measures, while for those in the top 20% of income distribution the predicted LTV ratio is about 2% lower after the regulation.

Moreover, **single-country studies provide an interesting and more focused analysis**, while several papers investigating the effects of LTV or DSTI caps opt for a multi-country analysis and the usage of policy dummies or macroprudential indices to identify quantitative ranges for the macroprudential effects on macro variables (Cerutti et al., 2017 and Ahuja and Nabar, 2011). In this respect, Tzur-Ilan (2017) for **Israel** and Andersson et al. (2018) for **Sweden** found that an LTV limit did not crowd out borrowers, but encouraged them to borrow less and to buy cheaper and lower-quality houses (further from the economic centre).

In **Denmark**, a regional macroprudential measure was implemented in 2016 in those areas that experienced strong growth (notably Copenhagen and Aarhus) through guidelines on prudent credit

[39] These heterogeneous effects are attributable to the introduction of differentiated LTV limits: 75% for first-time buyers, 70% for upgraders (who need to sell their first home within 18 months) and 50% for investors (who own two homes or more).

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[41] In February 2015, the following measures were introduced in Ireland: a sliding LTV limit of 90% for first-time buyers, a cap of 80% for non-first-time buyers, a cap of 70% for investors and an LTI limit of 3.5. The measures were implemented with certain allowances and exemptions.

assessment[42]. Based on a difference-in-difference regression model, the Danish central bank estimates that (i) the guidelines have made borrowers in growth areas (i.e. those subject to the guidelines) borrow less than borrowers outside growth areas (i.e. not subject to the guidelines), albeit with a modest impact, and (ii) the DTI ratio has increased by 4.8 percentage points less than in non-growth areas which are not subject to the recommendation. Moreover, no effect was seen on house prices. The modest impact on mortgage lending may be due to slow implementation[43], scope for deviation from the guidelines and the fact that the guidelines were in line with best practice in the institutions.

Price (2014) highlights for the case of **New Zealand** that a counterfactual analysis of the ex post assessment could be an appropriate method for policy effects in the short run. According to this analysis, the LTV limit lowered house price inflation by 3.3 percentage points and household credit growth by 0.9 percentage points in the first six months after policy implementation. However, other estimation methods should be considered for longer-term effects, as a counterfactual scenario is exposed to a higher degree of uncertainty.

A recent study for **Spain** (Montalvo and Raya, 2018) provides no specific quantitative effects but offers useful insights on the potential circumvention of LTV limits: appraisers were induced to overvalue houses to be financed, since they were not fully independent from banks and appraisal values (instead of the minimum of appraisal and transaction values) were considered for the measure of the LTV ratio[44].

Similarly for **Ireland**, Acharya et al. (2018) find that in response to the introduction of LTV and LTI limits in February 2015, banks increased their risk-taking in both credit to firms and holdings of securities, the two largest asset classes not targeted by the regulation. Moreover, low-income households borrowed less while high-income households kept borrowing, increasing their leverage. Interestingly, low-leverage, high-income households increased their leverage post regulation: more exposed banks offered lower interest rates to attract high-income households to take out larger loans and thus (partially) make up for the lost business due to the introduction of the macroprudential policy. Finally, the authors find that the increase in mortgage credit to high-income households is mostly driven by areas outside Dublin, while the contraction in mortgage credit to low-income households is driven by the Dublin area. House price appreciation in areas where its pace was elevated (Dublin) slowed down relative to the pre-implementation period.

In the case of borrower-based measures, four papers of the selected literature concern ex ante simulations: Bloor and McDonald (2013) for New Zealand, Avouyi-Dovi et al. (2014) for France, Cussen et al. (2015) for Ireland and Finansinspektionen (2017) for Sweden. As in other

[42] The key element of the guidelines is specific limits on a household's total debt relative to its gross income. For households with a DTI ratio of 4-5, aggregate wealth should generally remain positive if the value of the home declines by 10%. For households with a DTI ratio above 5, wealth should generally remain positive if the value of the home declines by 25%. Loans breaching these limits are subsequently referred to as loans to households with high DTI ratios and insufficient wealth.

[43] Indeed, thematic inspections by the Danish Financial Supervisory Authority have found evidence of considerable lag in implementation among credit institutions.

[44] Similarly, Tzur-Ilan (2017) uncovers somewhat counterintuitive effects of the introduction of LTV limits in Israel, showing that affected borrowers paid a higher interest rate and increased their term to maturity (despite decreasing their loan amounts) due to riskier assets and an increase in unsecured credit; while the objective of hard LTV limits was to reduce borrower risk, the paper finds that in certain aspects it actually increased.

related papers, the ex ante assessment of borrower-based measures is often performed in two steps, where micro data on loans or households are first used to estimate the impact on aggregate credit and this is then fed as a shock into a macro model. This approach is used for New Zealand, Ireland and Sweden, while the study for France relies on a multi-equation model estimated by 3SLS. Ex ante simulation results are in similar ranges, e.g. the introduction of LTV limits should lead to a decrease in housing prices of around 1.5% after two years in New Zealand and about 1.3% after three years in Ireland. In Sweden, the introduction of a stricter amortisation requirement for households with high loan-to-income ratios is expected to slow the growth of debt by almost 4% and house prices by approximately 1.5%. However, there is uncertainty surrounding these estimates, which is amplified by the ex ante nature of the exercise and underlying assumptions. Ideally, individual country studies focusing on ex post assessments should be less exposed to such concerns. In addition, the control for the cyclical positions of the housing and credit markets is hardly performed.

It is not uncommon to find empirical results that point to the absence of overall effects of enacted policies on lending growth, house prices or household indebtedness. It may be the consequence of e.g. restrictions that are not binding at the time of implementation, but are, anyway, intended to insure market players and targeted agents against future developments towards lending to riskier borrowers (in case of borrower-based instruments) or provide a cushion against a potential slump in mortgage markets (in case of capital-based instruments). Moreover, **cases in which no overall effect is detected often show evidence of heterogeneous significant impacts in specific cohorts of the population under study,** be it banks, borrowers or countries. **The literature also provides evidence of unintended consequences,** such as spillovers to other banks' business areas (risk shifting) and circumvention which can be tackled with more risk sensitive calibration of policies (e.g. risk weights dependent on LTVs).

In conclusion, the empirical literature review carried out is not meant to serve as a direct benchmarking of country cases making use of the quantitative information gathered. In fact, as the available empirical evidence remains scant, the ranges of impacts of policies on specific target variables remain indicative and ancillary to the policy assessment. **Further, it is not uncommon to find empirical results that point to the absence of overall effects of enacted policies on lending growth, house prices or household indebtedness.** This may, for example, be the consequence of restrictions that are not binding at the time of implementation, but are nonetheless intended to insure market players and targeted agents against future developments towards lending to riskier borrowers (in the case of borrower-based instruments), or provide a cushion against a potential slump in mortgage markets (in the case of capital-based instruments).

Moreover, cases in which no overall effect is detected often show evidence of significant heterogeneous impacts in specific cohorts of the population studied, be it banks, borrowers or countries.

The literature also provides evidence of unintended consequences, such as spillovers to other banks' business areas (risk shifting) and circumvention, which can be tackled with a more risk-sensitive calibration of policies (e.g. risk weights dependent on LTVs).

Finally, more research is needed to better inform the policy debate on (i) the redistributional effects of macroprudential policies and bank credit reallocation, (ii) the comparison between

capital-based and borrower-based policies, (ii) spillovers to asset classes not targeted by the regulation, and (iii) cross-border spillovers or spillovers to the unregulated financial sector.

5.2.2 Some general principles to assess the soundness of methods

The purpose of this subsection is to outline the key principles that could guide the assessment of policy sufficiency in terms of the soundness of the methods adopted to calibrate tools and to analyse their expected effects. It follows the process of matching identified risk(s) to an appropriate set of macroprudential instruments and takes both as given (Section 4). Specifically, the subsection aims to provide a number of key criteria for choosing models to support the calibration and the analysis of the effects of macroprudential instruments.

A number of key conceptual and operational criteria could be used to guide the choice of methods for the optimal calibration of instruments. They apply equally to capital-based (RW add-ons and floors, PD/LGD floors) and borrower-based (LTV, D/LTI, DSTI, amortisation/maturity limits) instruments for real estate risks.

1. **Breadth:** does the method capture the macro-financial transmission mechanism(s) relevant for the chosen instrument(s)?

2. **Balance:** given a predefined net benefit of activating/recalibrating the instrument, is the method sufficiently flexible to encompass both benefits and costs (including cross-border spillovers where relevant)?

3. **Robustness/flexibility:** are the method's results sufficiently robust to account for data updates and the inclusion of other variables? Can the method be easily adapted to structural changes in the economy and financial sector? Can it evaluate the effectiveness of a mix, rather than single, macroprudential instruments?

4. **Limitations:** what are the method's technical (see 1-3) and usefulness (4-5) limitations? In practice, any approach, when considered across the dimensions above, will have some non-negligible limitations. Expert judgement and a transparent presentation of results, especially when implementing multiple approaches, should therefore be standard complements to a quantitative framework.

In addition, when selecting the methods for a calibration framework, the following characteristics should also be considered:

5. **Parsimony:** is the method the simplest way to track the relevant transmission mechanisms and to assess the achievement of the predefined net benefits of policies? Experience within policy institutions shows that model development is a resource- and time-intensive process. In addition, model implementation needs to consider issues like the frequency of updates, operational documentation and staff turnover.

6. **Communication to policymakers:** are the results of the adopted method easy to interpret and communicate to policymakers? This consideration is key because the final policy decision

inevitably looks at a complex set of factors (see also Section 3.3). The output of a method that cannot be reasonably summarised in a limited number of structured messages is therefore likely to be dismissed as uninformative for practical policymaking.

In general, it is very difficult to provide guidance on an optimal mix and/or hierarchy of methods, considering that all of them have both strengths and weaknesses. Accordingly, a comprehensive toolkit should include a number of approaches (a fact confirmed by the approaches taken by national authorities).

The following subsections provide more detailed guidance on the assessment of methods based on the suggested set of technical criteria. The analysis focuses on quantitative models even if available evidence, including a dedicated questionnaire that the WG-REM circulated among the European national authorities, shows that they are not the most common methods currently adopted to calibrate the policy tools; in perspective, however, model-based calibration can become the standard approach as new expertise is gained over time across domestic and international institutions.

The discussion distinguishes between capital-based and borrower-based instruments. It (i) provides some concrete suggestions regarding potential variables that can be used to model the transmission channels highlighted in Figure 2 of Section 4, (ii) considers various model classes that best capture the transmission channels (including some of their technical limitations), and (iii) frames the possible model selection within the guidelines 1-6 presented above.

5.2.2.1 Guidance on assessing quantitative approaches to calibrating capital-based instruments

Policy models that analyse capital-based instruments usually start with a focus on bank balance sheets and should also include a feedback loop with the broader economy. In line with the transmission channels extensively discussed in Section 4, these instruments work either directly, by imposing higher capital requirements for (large) exposures to the real estate sector, or indirectly, through variables that have an impact on risk exposures, such as RW add-ons and LGD floors. The instruments primarily affect bank resilience but could also have a secondary effect on credit supply (taming excessive credit growth and leverage). Because the secondary effect in particular is conditioned by the size of voluntary capital buffers that a bank may decide to hold, specific modelling assumptions need to be considered when calibrating the capital-based measures.

General capital requirements affect all banks, and modelling their impact needs to account for whether capital adequacy is ensured via new equity issuance or asset deleveraging. In the first case, the net impact of a positive shock to bank equity depends on which effect dominates: (a) increased funding costs (and possibly spreads) or (b) lower costs because of the perceived

increased resilience. Alternatively, the negative shock to bank assets may result in a decrease in lending.[45]

RW add-ons or LGD floors contain risks by increasing the weight of real estate exposures against which capital must be held. They have the added flexibility to distinguish specific risks or losses originating from the RRE sector.

In order to quantitatively assess the ex ante sufficiency of capital-based measures, the transmission channels need to be mapped together with costs and benefits in a model framework. The framework should, inter alia, be able to assess (i) bank resilience, (ii) the impact of loan pricing and credit supply, and (iii) the riskiness of bank portfolios. While the input normally consists of selected bank balance sheet and macroeconomic variables, key output variables underpinning resilience will be the portfolio's PD, LGD, average risk weights and capital shortfalls (ideally including second-round macroeconomic effects). Importantly, interaction with other risk parameters (e.g. the liquidity position of banks) needs to be considered in a comprehensive assessment. Also, whether or not a capital-based measure is intended to affect loan pricing overall or for certain portfolios, i.e. the impact on loan spreads, should be quantified. Finally, the calibration should also consider the impact on the cross-bank distribution of risk (for example, when implementing a risk weight floor, banks showing a high share of loans with model-based risk weights well below the floor might be incentivised to become less conservative, as risk weights for conservatively granted loans will be floored anyway).

In general, a sound assessment framework combines models that can address granular microtransmission within banks as well as general macro-financial linkages. *Structural macroeconomic models*, such as a representative agent dynamic stochastic general equilibrium (DSGE) model, agent-based model (ABM) or structural vector autoregression (VAR) model may be better suited to identify the transmission channels related to general capital requirements (or to the CCyB). *Macro- (time series) or microeconometric models* could better identify the channels related to RW add-ons/LGD floors because they can model institutions and exposures (or other dimensions) more granularly. *Bank stress tests* complement the suite of models because they evaluate the impact of an adverse scenario on banks' resilience, but are not so well suited to channel identification and quantification. The set of models discussed in this subsection is not exhaustive; it simply includes commonly used methods by national authorities or academia. For example, there may well be cases where a DSGE model is robustly adapted to model banks more granularly and therefore allows an in-depth examination of an externalities channel.

Structural models are best suited to analyse instrument transmission in a well-defined specification that accounts for the impact on the aggregate economy. Their micro-foundation implies that aggregate dynamics are based on microeconomic decision-making and resource allocation, which can either be optimised for a representative agent (standard DSGE models) or agent-specific (ABMs). Instrument transmission channels are clearly defined, and the models permit a systematic, robust and simultaneous analysis of the impact of changing an instrument. They can be used to guide the calibration of instruments which results in the desired macro-

[45] A countercyclical capital buffer instrument will also account for the position in the cycle and, while general in nature, could also be designed for specific sectors (e.g. real estate).

financial impact. A *key advantage* of structural models is the time- and cross-section-consistent analysis of channels and instrument impact in a general equilibrium system. Moreover, they incorporate the role of expectations in policy design and assessment, and can therefore be used for both ex ante and ex post policy analysis. An important *limitation* is complexity, as solving the model becomes increasingly difficult when the number of agents (or interactions) grows. In addition, advanced technical knowledge is required to develop and operationalise the models. Finally, they also require a careful interpretation of results for operational policymaking.

Time series models estimate the historical statistical relationship between capital requirements and other macro variables. They include numerous VAR-based methodologies[46], as well as vector error correction, panel and quantile regression models. A key advantage is that they do not impose excessive structure on the data and can model the transmission of shocks over time (e.g. VAR) or across distributions (e.g. quantile regressions). Key challenges include (i) translating capital requirements to shocks (e.g. deleveraging vs. endogenous accumulation), (ii) identifying shocks to isolate the impact of policy changes, and (iii) the strong assumption of a stable and linear relationship over time.

Cross-sectional models, especially when based on supervisory data, can be used for ex ante instrument calibration to assess the impact on individual bank capital ratios. When combined with time series methods in a panel/accounting set-up, they can estimate capital and asset adjustments in response to instrument activation, together with the impact on lending spreads and volumes. The results can then be used as inputs into macroeconomic forecasting and policy analysis. The key advantage of these models is their cross-sectional (distributional) focus. They can also be used for an ex post assessment of macroprudential instruments (e.g. difference-in-difference techniques on bank- or loan-level data). The main drawback of microeconometric models lies in their extensive data requirements.

Stress-testing tools directly assess the loss absorption capacity of banks (resilience) under predefined stress scenarios. They can be used to guide the calibration of capital-based measures to ensure banks' solvency under adverse conditions and should also be integrated in a dynamic macroeconomic set-up. The main strength is the possibility to derive implications for individual bank balance sheets and quantify losses in specific portfolios. Their key drawbacks include (i) the need for granular data; (ii) their reliance on some strong behavioural assumptions, for instance regarding balance sheet adjustment under stressed conditions; (iii) a lack of structural identification; and (iv) the partial equilibrium view. As the behavioural assumptions deeply affect the transmission of stress, it is very important (but not straightforward) to integrate feedback loops. Related to this, scenario design should be severe but plausible and take into account the relevant risks. In addition, some consistency issues may arise as stress test tools are complex and rely on a number of satellite models.

An operational approach to modelling the ex ante impact of capital-based instruments would integrate the bank cross-section within a macroeconomic feedback loop. Linking to the criteria listed in Section 5.2, a panel VAR including a bank-level cross-section could be an example of a first step towards breadth. Resources permitting, this data-grounded approach could be

[46] E.g. B-VAR, S-VAR, TVP-VAR, Markov/regime-switching VAR, FAVAR, GVAR, panel-VAR, quantile-VAR.

usefully complemented with a DSGE for channel identification and/or the very granular bank stress tests for a full bank resilience test. To achieve balance, which in turn is linked to the model definition of net policy benefits, further extensions may be needed (e.g. a logit module to incorporate the benefit in terms of reducing crisis probability, a time-varying parameter (TVP) VAR to capture time variation in parameters and changes to the underlying economic/financial structure, or a global VAR to capture cross-country policy spillovers). Robustness (for example to the inclusion of a large number of bank variables or to capturing macro-financial linkages) could be achieved through the use of a factor-augmented VAR (FAVAR), but also via the appropriate modification of a DSGE to improve the modelling of macro-financial linkages.

Achieving parsimony could be relatively straightforward; given the model's predefined net policy benefits, it could be as simple as removing variables that are uninformative for realising the net benefits. Conversely, an optimal communication of results is more delicate as it needs to strike a balance between brevity/clarity and the minimum set of results that are needed to inform the ultimate policy decision (the "guided" analysis preceding discretion). In practice, the approach will be model- (suite-) specific and needs to be determined on a case-by-case basis. Finally, it is extremely important to acknowledge the model limitations relevant for the policy decision. This will inform the degree of reliability ("the weight") of the quantitative analysis in the final policy decision.

5.2.2.2 Guidance on assessing quantitative approaches to calibrating borrower-based instruments

Policy models that analyse borrower-based instruments focus on household balance sheets and also need to include banking sector and macro feedback loops (in particular the impact on credit developments and house prices). The standard instruments include DSTI (including complementary amortisation requirements/maturity limits), D/LTI and LTV limits. We recall from Section 4 that they chiefly have an impact on the flow of new lending but also gradually act on the stock of exposures (household debt) and are likely to be more effective in the early stages of risk build-up.

Models incorporating income-based limits (DSTI, D/LTI) usually analyse household debt flow affordability and, closely related to this, debt stock sustainability.[47] They usually start with a cross-section distribution of lending standards, and incorporate household variables (employment, income, indebtedness) that are relevant for estimating borrowers' resilience (household PDs) to negative shocks to income or debt (servicing) capacity (e.g. via increased interest rates) through the life of the loan. PDs, in turn, inform credit riskiness and can be combined with bank and macroeconomic variables to estimate the impact on credit volumes (in particular new lending) and pricing as well as on house prices.

Models considering LTV limits analyse the negative impact of RRE price shocks on banks' resilience. Overvaluation is likely to increase banks' LGDs in the event of repricing, hence limiting

[47] Conceptually, the instruments can be best understood starting from an income assumption and adding in the elements of an amortisation formula (loan size, interest, maturity, amortisation schedule). Limits then act to restrain a combination of these variables.

banks' exposure in new mortgage loans has a direct effect on banks' resilience. Models should pay particular attention to assessing cyclical developments in house prices, as implementing such an instrument may be particularly detrimental in the late phase of risk build-up, potentially triggering price reversals and hence financial instability.

Compared with capital-based measures, assessing the ex ante sufficiency of borrower-based measures also needs to link costs and benefits with transmission channels. As borrower-based measures primarily focus on taming the build-up of risk associated with new lending, a quantitative framework needs to assess the dynamics of (i) bank riskiness, (ii) borrower resilience, and (iii) the impact of exemptions (speed limits) given the distributional consequences of borrower-based measures. Input variables will also include loan-level distributions of lending standards (preferably including borrower age and income characteristics), in addition to bank balance sheet and macroeconomic variables. Key output variables will include risk weights and their distribution across portfolios, stressed debt ratios by type of borrower[48] and joint distributions of lending standards (to see, for instance, if the speed limits applied to a measure result in a shift in the lending standard(s) that is/are effectively binding at the borrower level).

In order to assess the expected impact of borrower-based instruments, a sound approach would place a greater emphasis on granular micro models, especially those that incorporate household level data. Accounting for macro-financial feedback loops would be as necessary as in the case of capital-based measures; however, the calibration of borrower-based measures risks being imprecise in the absence of information about the distribution of income and indebtedness in the cross-section of households.

In general, stress tests and microeconometric models are very useful tools to assess the impact of borrower-based instruments on households and bank balance sheets. Their granular structure considers specific household groups or individual banks, and can be complemented by time series and structural models (e.g. VAR and DSGE models) to evaluate the dynamic propagation of the instruments with respect to credit, consumption, GDP and real estate prices.

The combination of cross-sectional and time series methods, ideally using data from credit registries, can estimate the historical relationship between the distributions of LTI/DSTI/LTV ratios and the PDs and LGDs of mortgage loans. In turn, these relationships can be used to study the instrument's impact on PDs and LGDs, in normal or stressed dynamic macroeconomic scenarios. These models can also link the actual distribution of LTI/DSTI/LTV to new lending (both volumes and spreads) and the credit cycle, and distinguish the effects, especially of LTV limits, on first-time buyers versus existing homeowners. Simulated DSTI, LTI and LTV can also be used as input for the computation of changes in PDs and LGDs. Furthermore, by assuming specific shock sizes to household income or to housing collateral, it is possible to derive the probability of household default and negative home equity. However, the impact on the resilience of banks crucially depends on the extent to which the changes in PDs and LGDs interact with the amount of bank capital.

[48] Stress test performed on interest rate and income shocks.

Specifically, time series and micro models can be used to quantify the impact of instruments targeting the level and dynamics of indebtedness. An instrument that aims to slow down *debt dynamics* will have an impact via the growth rate of lending and the ratio of credit to household income or GDP. Instrument calibration is often based on the distribution of a selected indicator (e.g. DSTI) across new loans, which allows an estimation of the proportion of households affected by a restriction on their borrowing capacity. A more precise estimate can be made accounting for the possibility of a household to modify its financing scheme (for example, by increasing DSTI and decreasing maturity) to comply with a limit on an indicator without actually lowering its borrowing capacity. If the instrument aims to reduce the level of household debt, the target variables are in levels instead of growth rates. Information on the maturity of existing stock is also needed to estimate a stock turnover rate. In the long run, accounting for macroeconomic feedback loops is of great importance and the target debt level should ensure sustainability. This long-run debt level can be estimated with household stress tests or structural models (e.g. DSGE).

Household stress tests and DSGE models can also be used to calibrate instruments that aim to strengthen households' resilience. Relevant target variables include aggregated leverage or aggregate DTI. A DSGE model can also be used to estimate the impact of a decline in households' income on their consumption, and to incorporate macroeconomic feedback.

Time series and microeconometric models can be used to assess the ex ante impact on real estate prices of a restriction to the borrowing capacity of households. For an instrument to mitigate price overvaluation (e.g. LTV), the target variable may be the growth in real estate prices or the gap between current levels and fundamentals. The latter can be estimated using either times series or structural models.

An operational approach to modelling the ex ante impact of borrower-based measures should place a particular emphasis on modelling risks at the household and bank level within an integrated micro-macro framework. Therefore, microeconometric household- and bank-level panel approaches with a focus on lending standard distributions could be a first step towards *a sufficiently broad* model suite. The framework could be enriched with a VAR-based extension to account for the macroeconomic feedback and, where possible, with DSGE/ABM models that would help to identify policy transmission channels while maintaining sufficiently flexible household assumptions. Because borrower-based measures could have welfare effects across the household distribution, models may need to incorporate such effects to be deemed *sufficiently balanced* in their analysis of net benefits, even if it is not necessarily the design of macroprudential initiatives that should counteract such effects. More generally, considerations related to robustness, parsimony, communication and limitations are very similar to those outlined for the modelling of capital-based instruments.

5.3 Step 7 – Additional considerations at the country level

This section gives guidance on how a broader set of country-specific considerations should be taken into account in the policy sufficiency assessment, as is also the case for risk identification and the policy appropriateness assessment. These considerations include the cyclical position of the country's RRE market, other data-based input (other than models),

complementarities with other policies (package of implemented macroprudential instruments as well as other economic policies) and structural features of the domestic economy. Specific data limitations affect the overall process of calibrating and monitoring the macroprudential tools. This is worth recalling in order to mitigate the inaction bias against the risk of inaccurate tool calibration and to emphasise the need for urgent progress on the statistical front.

5.3.1 The role of cyclical position

The cyclical stance of the RRE market affects both the timing and intensity of macroprudential action. The position in the cycle affects the reading of risk indicators and the choice of related policy instruments (see Sections 3.1 and 4.2.2); as a consequence, the timing of activation and the calibration of the appropriate tools are also impacted. For instance, particular caution is warranted if the prolonged cyclical expansion is accompanied by clear signs of real estate overvaluation. In this case, a sharp tightening of lending standards could trigger an early price reversal and thus precipitate the materialisation of the very vulnerabilities the policymaker aims at shielding the economy from (see Section 4.2.2). In such conditions, a gradual introduction of borrower-based instruments (e.g. phasing-in period, allowance of exceptions, gradual tightening) is recommended. In addition, they call for careful monitoring in the RRE and credit conditions.

If observed credit standards are sufficiently conservative, a (non-binding) calibration in line with prevailing market conditions is particularly appropriate in the early stages of the housing cycle. Later in the cycle, when risks are more pronounced, a tighter calibration – or a different choice of instrument – may be considered.

5.3.2 Other data-based inputs

As for the detection of systemic risks, a sound calibration of policy tools and the regular monitoring of their effects on the targeted variables are ultimately connected with the availability of relevant data. While official statistics are the basis due to their high level of legitimacy and consistency, these may prove to be incomplete and fragmented in some countries, thus failing to provide the required statistical inputs for the policy process. In this context, it is important to foster any initiative that helps fill the real estate data gaps in line with the ESRB recommendation[49] (see also Box 3). It should be acknowledged that the absence of such information is a serious drawback to the assessment of policy sufficiency. At the same time, it is important that the required policy action is activated based on the best use of available data, coming either from market participants, households or expert surveys. For instance, surveys among experts quantify the “expectation-driven” component of real estate cycles. Occasional data limitations should not justify a policy inaction bias until the data gaps are filled.

Effect uncertainty – which is likely be particularly pronounced in the absence of sufficiently informative data – can translate into potentially high costs ex ante. In turn, this may mean that the adoption of a cautious approach is fully sufficient ex ante. At the same time, a subsequent

[49] See the ESRB Recommendation on closing real estate data gaps (ESRB/2016/14).

reassessment ex post may reveal the policy was only partially sufficient. **When assessing borrower-based measures, micro-level data should be used if available.** Micro data (loan-level data) are needed for the analysis of risk distribution (e.g. LTV, LTI and/or DSTI, both at origination and for the stock of loans). The data should be available at the bank level and, in a first-best scenario, should include characteristics of individual households, such as age and income, as well as indicators of delinquency in loans. This information should allow an identification of vulnerable borrowers and an estimation of macroprudential policies' potential impact on default. In some cases, the observed ("reduced-form") changes in lending patterns attached to the policy measure may be what is available and should provide some evidence of whether a policy measure is effective.

When assessing capital-based measures, the time series for mortgage losses covering past severe downturns and data on risk weights are an important input. Such time series should include absolute losses and data allowing for the computation of LGD. This provides a necessary capital cushion to cope with these losses, which can be mapped to the calibration of a capital instrument. In this context, data constraints include but are not limited to collateral valuation/adjustment, as PDs and LGDs under stressed conditions are needed. Some data gaps have been bridged due to the fact that COREP/FINREP templates include a number of indicators reported based on common standards, such as (i) exposures to the real estate sector, (ii) PDs and LGDs for mortgage portfolios (by pool of borrowers), and (iii) regulatory capital covering real estate exposures.

Peer country comparisons can be undertaken for assessing ex ante the sufficiency of both borrower- and capital-based macroprudential instruments. However, one should particularly identify countries with a similar typology and intensity of risks, and be aware of the differences in real estate market structural characteristics and institutional frameworks, when undertaking such international benchmarking (see the ESRB's study of structural characteristics of RRE markets across EU Member States, 2015)[50].

For capital-based instruments, the history of real estate-related losses in countries that have experienced a financial crisis could inform the calibration of a measure in a country without such past episodes. Nonetheless, expert judgement should also play an important role in this case, as the usage of other countries' loss data (or even the usage of pooled data across countries) may lead to the overcalibration of policy instruments in jurisdictions with no crisis episodes. Additionally, other countries' experiences with macroprudential measures can provide relevant information on substitution effects (Cizel et al., 2016), the appropriate design of instruments, and the combination and substitutability of measures, among other factors, as discussed in Section 5.2.

The introduction of macroprudential measures may also be preceded by dialogue with the banking industry and consumer representatives. Such dialogue can provide useful information for the cost-benefit assessment, including on industry performance, market outcome and distributional effects. Additionally, such dialogue can give insights into how best to define the calculation method for the instruments (e.g. DSTI/DTI/LTI/LTV).

[50] ESRB (2016), *Report on residential estate and financial stability in the EU*.

5.3.3 Policy complementarities and other national factors

The entire package of instruments with macroprudential effects should be taken into account in the sufficiency assessment. Authorities may have implemented more than one measure, either as a package or sequentially. In any case, it is the combined effect of the instruments that should feed into the sufficiency assessment. The more the package of instruments tends to address the identified vulnerabilities in the risk assessment (see Section 3), the less tight the calibration of individual instruments may need to be.

In the same vein, the combined effect on systemic risks of macroprudential policies and other policies (fiscal, structural, etc.) should enter into the assessment. The greater the extent to which changes in other non-macroprudential policies (e.g. strengthened countercyclical housing taxation or limited interest deducibility) potentially dampen future risk build-up, the smaller the need for a tight calibration of macroprudential policies, and vice versa. Although other policies are outside the scope of the macroprudential toolkit, this complementarity implies that such policies should be taken into account in the sufficiency assessment. In this respect, tightening the macroprudential tools instead of reviewing other policies mostly supporting real estate financial vulnerabilities may entail an overreaction causing higher policy costs against smaller benefits, thus weighing on the sufficiency assessment.

Other country-specific characteristics to be considered in the sufficiency assessment include the institutional set-up, the economic structure and the financial structure, in particular the size of non-banking and cross-border intermediaries. In addition, a set of indicators for the structural characteristics of real estate market developments should inform policymakers on the sufficiency of macroprudential measures, such as fiscal treatment, demographics and supply elasticities. Most of these factors have already been considered as relevant inputs for both the risk identification and policy appropriateness assessment (e.g. scope for policy circumvention and arbitrage, legal enforceability, adjustments in lending and borrower patterns). They can also inform the sufficiency assessment as they reasonably affect the materialisation and extent of policy costs and benefits observed over time in a country, either at the aggregate level or across types of lenders and borrowers (with politically sensitive distributional effects). Ideally, a full consideration of these factors would draw on a model-based approach to policy calibration, based on both macro and micro data, in order to monitor the impact on the transmission channels of the macroprudential measures.

Box 3
Possible approaches to tackle data gaps

In the event of data shortcomings, the examples of other countries with more complete data collection initiatives could be a starting point for the set-up of new data gathering techniques. An interesting approach in this context is the data factory AuRep (Austrian Reporting Services), which was founded in 2013 by the majority of Austrian banks in order to fulfil regulatory data needs on a loan-by-loan level and thereby reduce the enduring reporting burden for participating banks.[51] An advantage of this approach from the banks' point of view is a minimisation of data reporting

[51] See: **www.aurep.at**.

redundancies, as all regulatory data needs can be compiled from single loan-level data reports to the common data factory.

In Romania, the Central Credit Register provides a large amount of information at the credit level and has been dynamically adapted to financial stability needs. As data requirements grew following the financial crisis and the increased importance of risk monitoring, major improvements to indicators were made in 2012 and 2015 in order to provide more information on collateral values, lending standards at loan origination and restructuring measures, etc.

5.4 Step 8 – Guidance on the ex post sufficiency assessment

In addition to the ex-ante sufficiency assessment, the enacted macroprudential policy measures should be evaluated from the perspective of ex post sufficiency. This provides an idea about the effectiveness of the measures in place, in particular how the targeted variables are affected and whether the measures are helpful in achieving the policy objectives. In addition, the ex post policy sufficiency assessment informs the need for further action in terms of recalibration or further fine-tuning of the policies in place. The ex post sufficiency assessment is closely linked to ex ante sufficiency (and the cost-benefit framework), but there are issues specific to ex post sufficiency which need to be taken into account, and these are in turn discussed below. A framework to evaluate the ex post sufficiency of enacted measures should enable timely recalibration or corrective action. Ideally, the ex post assessment includes appropriate model-based and qualitative methods to complement models that are not able to capture all the specificities and transmission channels of a certain measure. In practice, model-based methods are not always available or feasible, and more reliance will have to be placed on other inputs.

5.4.1 Specificities of the ex post assessment

The effective (ex post) impact of a (combination of measure(s) may differ from its ex ante calibration. In particular, while some of the intended and unintended consequences of a measure can reasonably be anticipated (and should hence be included in the ex ante assessment – see Table 9), the actual extent of both intended and unintended costs and benefits may differ from the ex ante calibration. In addition, some issues are specific to the ex post analysis and cannot be (easily) covered in an ex ante assessment. For instance, unanticipated changes in economic conditions and policy changes elsewhere in the policy mix may give rise to unanticipated costs and benefits. Measures may also be circumvented or subject to leakages in unforeseen ways or to an unexpected extent. In addition, the broad reach of the macroprudential instruments and their recent character mean there is still limited knowledge of their impact. Table 9 summarises the differences between the ex ante and the ex post assessment.

Table 9

Specificites of the ex post assessment

Ex ante assessment	Ex post assessment
Anticipated intended costs and benefits	Unanticipated difference between actual impact and ex ante calibration: - Calibration - Specificities of ex post assessment - Circumvention, leakages and arbitrage - Change in economic conditions - Change in policy mix
Anticipated unintended costs	

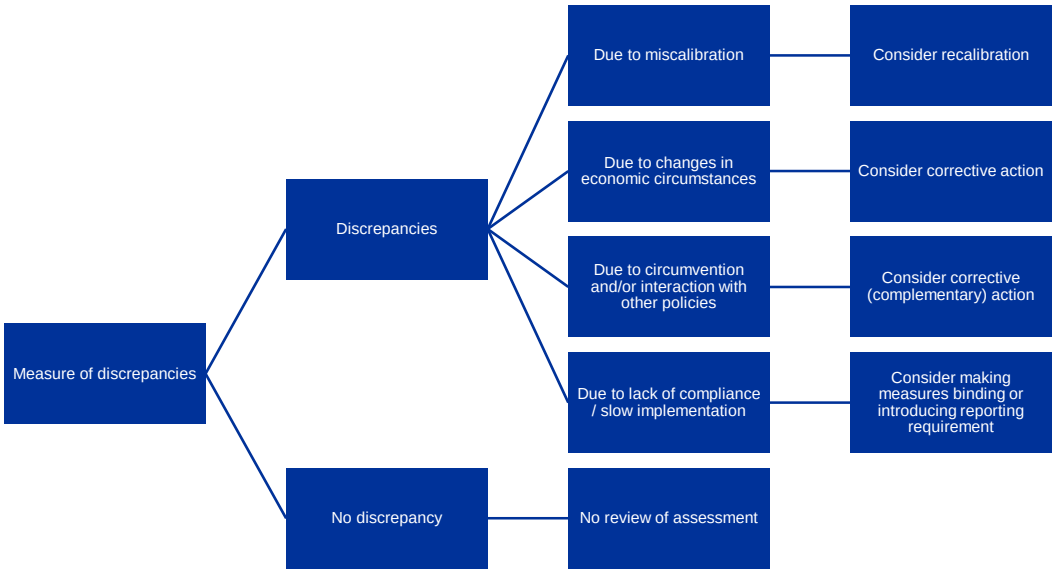
Section 5.2.1 provides an overview of empirical evidence in the existing literature that can also inform the ex post sufficiency assessment, with particular relevance for the situation among current ESRB member countries. For example, the expected effects of the policy can be compared with the range of effects found in the literature, paying particular attention to conditions indicating whether measures are sufficient or not.

5.4.2 Impact on the sufficiency assessment

The nature of discrepancies between the expected and observed effects of a macroprudential measure should guide potential amendments. Figure 8 outlines an approach for the stepwise identification of reasons behind discrepancies between the estimated ex ante impact of a measure and its ex post actual effect. It starts by identifying the precise extent of the difference between ex ante estimations and effective impact (see Section 5.5.2), followed by an identification of the sources of discrepancies found. If no discrepancy is observed between the ex ante calibration and the effective (ex post) measures, controlling for deviations in the parameters of conditional projections used for the estimation, it can be concluded that the ex ante assessment still holds (on the assumption that the overall absence of discrepancies is not the result of offsetting sub-discrepancies). If discrepancies are observed, their nature should be identified. In the case of miscalibration, a recalibration should be considered. On the basis of this new calibration, a new assessment of the existing measures' efficiency may be pursued. If discrepancies are due to circumvention and/or interaction with other policies, corrective complementary action should be considered to allow the intended transmission of the measure(s) taken. On the basis of this corrective action, a new assessment of the existing measures' efficiency may be pursued. The possibility of a change to the risk assessment following the ex post sufficiency assessment is not covered in this approach.

Figure 8

Ex post assessment and potential amendments to the sufficiency assessment



Circumvention, leakages and arbitrage play a specific role in assessing the impact of macroprudential measures and the extent to which their sufficiency should be reconsidered. Leakages can take various forms and can be triggered by different agents. Arbitrage can to a certain extent be assessed ex ante, but it remains an ex post specificity given the complexity of the various possibilities of arbitrage and circumvention by different agents.

- First, it should be monitored whether **banks** are circumventing the measure, especially in the context of financial conglomerates, which would make arbitrage easier and allow targeted entities to redirect portfolios towards related, non-targeted entities. Lower production volumes at bank level could, for instance, indicate that production has been redirected and originates from another entity within the group. Stable production volumes combined with decreasing outstanding amounts could indicate that production still originates from a targeted entity, but that stocks are transferred to non-targeted entities.

- It should also be monitored whether **households** themselves are circumventing the measure. Households could, for instance, use consumer credit to circumvent LTV-based measures if the specification of the measure is not sufficiently precise in this regard. Changes in the ratio of mortgage indebtedness to total household indebtedness should therefore be carefully monitored to determine whether targeted borrowers are circumventing the implemented measures.

- Finally, developments at **non-targeted institutions** should be monitored to see if the (intended) impact on targeted institutions is being offset by an opposite impact on non-targeted institutions, including branches of foreign banks in the event that domestic measures have not been reciprocated by the home supervisor. It should also be monitored whether non-banks (be it related – see above – or not) are taking over.

One particular feature influencing the effectiveness of the measure relates to the enforceability of borrower-based measures. If the policy instruments are not legally binding or not enforceable, this fact should be taken into account in the sufficiency assessment. While it may be challenging to model the level of compliance ex ante, an ex post assessment will evaluate whether instruments were sufficiently effective regardless of their legal basis. For example, if key target or risk indicators move in the right direction, this could be a sign of the instruments' effectiveness. However, if non-binding measures prove ineffective, a potential corrective action could be to make them binding. Similarly, there may be long implementation lags for borrower-based measures, as credit institutions may need to introduce or alter definitions of the specific measure (LTV, LTI, etc.), define exemption policies and change internal processes for granting loans, ensuring implementation by all account officers. Introducing reporting requirements or making the measure legally binding may speed up this process. At a later stage and in the event of removal, the countercyclical feature of a measure should also be assessed, in particular whether, in a downturn, the measure has been removed or softened in due time to avoid unintended procyclical developments.

5.4.3 Methods for capital- and borrower-based measures

Generally, models and techniques used for an ex ante assessment of sufficiency can also be used in an ex post evaluation (see Section 5.3). However, models and techniques developed more specifically for an ex post assessment should be considered as first-best options. Other models and techniques may be less suited for an ex post assessment given the limited impact which recalibrations are expected to have on the models' specifications (taking into account the most recent period, i.e. after the implementation of measures).

Econometric models designed to estimate (causal) effects of policy interventions should be considered first-best options. In particular, methods such as difference-in-difference estimation allow the impact on target variables to be measured while controlling for other shocks. Indeed, the review of existing empirical evidence (see Table 8 in Section 5.2) suggests that most of the country studies used panel regressions to estimate the effects of policy action. Such techniques, however, require an observed counterfactual. This can, for instance, take the form of a group of institutions not targeted by the measure but subject to the same economic environment. The main assumption typically is that the differences in outcomes stemming from differences in unobserved characteristics do not change over time.

Models that are designed in the first instance for ex ante aims should be considered as second-best options. These include DSGE models (theoretical; identifying micro transmission channels) or VAR models (empirical; historical statistical relationships). An ex post recalibration of these models is not expected to significantly alter the specification. The observed evolution of variables should then be compared with the (ex ante modelled) expected path, and the persistence of observed deviations assessed. This is complicated, however, by the fact that controlling for other sources of deviations (such as changes in other policies or in the economic baseline) is not straightforward.

5.4.4 Other data-based inputs specific to the ex post assessment and country-specific considerations

Targeted variables should be assessed to the extent possible for capital-based and borrower-based measures by including other country-specific information and considerations. Independent of the (current) level of sophistication of countries' assessment frameworks, key outputs described in Sections 5.3.1 (bank resilience, impact on loan pricing and supply, and portfolios' riskiness) and 5.3.2 (banks' riskiness, borrower resilience and impact of speed limits) should be assessed to the extent possible for capital-based and borrower-based measures.

Indicators of potential circumvention could include:

- prudential reporting data for individual institutions indicating shifts from targeted entities (e.g. banks) to related entities (e.g. insurance companies) not subject to the measure;
- central credit registers (loan-by-loan), especially if they cover all types of institutions (and not only banks) and allow developments in specific sub-segments to be identified that aggregated statistics might not be able to isolate.

Similarly to the ex ante sufficiency assessment (Section 5.4), additional country-specific information should be taken into consideration. This includes (i) the position in the cycle, (ii) whether the design of a measure ensured its enforceability, (iii) interaction with other policies (fiscal, structural), and (iv) additional country-specific features such as institutional factors, economic structure and financial structure.

5.5 Final rating and communication of the assessment of policy sufficiency

As a final outcome of the combined blocks on the soundness of the tool calibration methods and the magnitude of the expected net benefits of the enacted measures, the policy sufficiency can be assessed using a three-level rating, with the following interpretation:

- **Fully sufficient:** Conditional on policy objectives and related target variables, an appropriate policy has been calibrated that mitigates systemic risks stemming from the RRE sector to a large extent and for which the expected benefits largely exceed the expected costs over time (see Table 7), as informed by methods ideally meeting most of the listed principles (Section 5.3) and other considerations.
- **Partially sufficient:** Conditional on policy objectives and related target variables, an appropriate policy has been calibrated that mitigates systemic risks stemming from the RRE sector to some extent and for which the expected benefits somewhat exceed the expected costs over time (see Table 7), as informed by methods ideally meeting most of the listed principles (Section 5.3) and other considerations.
- **Not sufficient:** The conditions for full or partial sufficiency are not met.

Similarly to the risk and the policy appropriateness assessment, a template is provided as ESRB guidance for clear and effective communication of the final grading of the sufficiency of the enacted policies, as well as of the reasons behind the overall assessment (see Table 10). At the end of the overall process a collection of three templates makes fully accountable and consistent the final ratings in three dimensions: (i) intensity of RRE risks; (ii) RRE policy appropriateness; (iii) RRE policy sufficiency. Importantly, the full sequence of the three templates (risk assessment, policy appropriateness and policy sufficiency) should be considered as the final outcome of the overall assessment process, as elements in any one step may provide consistent inputs for the other steps.

It is worth restating that the templates are only provided to enhance the communication strategy of the ESRB and do not necessarily entail any implication for the current communication rules followed by national authorities within their own countries and with respect to the ESRB and to the ECB.

Finally, the sufficiency template may also be an important source of guidance for national authorities that are not currently equipped with a well-suited body of methods and practices in the calibration of policies and in monitoring their effects over time. In this respect, it is pivotal to recall that, whereas methods complying with the criteria set in Section 5.2 are not currently available, the required policy action should take place based on any alternative considerations, even qualitative in nature as based on peer reviews and expert judgements. The minimum requirement for the policy sufficiency assessment is that any input used in the tool calibration is documented as clearly as possible.

Accordingly, the contingent lack of a suitable kit of models and sound methods will not trigger policy inaction bias against the identified vulnerabilities. Generally speaking, the development of required methods and data remains crucial in order for a country to be equipped to timely and effectively offset systemic vulnerabilities stemming from RRE development.

Table 10

Residential Real Estate Policy – Policy sufficiency of macroprudential measures – Assessment template

Geneal guidance for filling in this template

The assessment of sufficiency of the policy measures enacted by the national authorities (NAs) under review is based on the framework outlined in **Section 5 of the WG-REM Report**.

- Please keep answers to the point, while providing all the necessary details to support your assessment;
- Please do not insert any charts or tables;

Where indicated please use the assessment scale (choose one of the options in the drop-down list).

Key concepts and definitions valid throughout the template

The concept of policy **sufficiency** is closely linked to reaching the overall objectives of macroprudential policies. Macroprudential policy mix refers to the combination of all macroprudential policy measures that are currently in place, as well as future measures that are decided and publicly communicated.

Regarding evaluation of policy sufficiency the following aspects should be kept jointly in mind:

- The assessment should refer to the overall sufficiency of policy measures, i.e. whether they are *achieving the policy objective (e.g. mitigating systemic risk)*.
- Costs of policies and the expected net benefits of the policies should be taken into consideration. We should get an understanding of the relative magnitude of the benefits and costs that the activated policy may entail in the medium run. Regarding the assessment of benefits and costs of policy measures, please take into account the general cost-benefit framework as presented in Table 7, Section 5 of the WG-REM Report.

When providing the replies, the evaluation may be made in qualitative terms, based on reasoning and international experience, but quantitative evidence should be provided to support the arguments where available.

As a result of the assessment, the overall rating of the policy sufficiency follows a three level rank:

1. **Sufficient:**

   Conditional on policy objectives and related target variables, an appropriate policy (enacted and adopted, or publicly announced) has been calibrated so that the following requirements are jointly met:

   - systemic risks stemming from the RRE sector, are achieved to a large extent;
   - the expected benefits largely exceed the expected costs in the medium term (see Table 7), on the basis of evidence that meets most of the criteria in Section 5.2.2, and other considerations (Section 5.3).

2. **Partially sufficient:**

   Conditional on policy objectives and related target variables, an appropriate policy (enacted and adopted, or publicly announced) has been calibrated so that the following requirements are jointly met:

   - systemic risks stemming from the residential real estate (RRE) sector, are achieved to some extent;
   - expected benefits exceed the expected costs in the medium term (see Table 7 in Section 5.4), as informed by evidence that meet most of the criteria in Section 5.2.2, and other considerations (Section 5.3);

3. **Not sufficient:** conditions for full or partial sufficiency are not met.

Section C: Policy sufficiency	
ASSESSMENT OF POLICY SUFFICIENCY	
Brief motivation for the final assessment	The calibration and the analysis of instruments are sound and well documented. Policy meets the desired benefits, with little costs. (e.g. The LTV thresholds minimizes the risks for future borrowers and the costs on excluding borrowers are judged to be low)
C1. What is the policy objective and what are the target variables related to the policy objectives according to the National Authorities?	
C2. Please list the macroprudential policy measures for which you evaluate policy sufficiency and whether these are already in place, to be recalibrated or to be adopted (for the latter, refer only to measures which have been publicly announced). **1.** **2.** **…**	[Choose the corresponding attribute from the drop-down list]
C3. Discuss the intended benefit of each macroprudential policy measure, according to the policy objective that is to be achieved (see WG-REM RRE Report, Section 5, Table 7), also taking the position in the real estate cycle into account. **1.** **2.** **…**	[Please refer to how policy measures are expected to influence the target variables indicators related to financial stability, such as lending standards (e.g. imposing a DSTI limit would diminish excessive credit supply), RRE overvaluation, bank credit risk indicators (NPLs, borrower PDs and LGDs), while taking into account the position in the cycle. Please use a medium time horizon (up to 3 years) for the assessment, and mention if another time horizon is applied (short/medium-to-long term)]
C4. Discuss the expected cost of each macroprudential policy measure and how it is reduced (see WG-REM RRE Report, Section 5, Table 7), also taking the position in the real estate cycle into account. **1.** **2.** **…**	[Please refer to how policy measures are expected to influence specific indicators such as access to finance (e.g. imposing a DSTI limit would limit the access to finance of certain individuals and potentially reduce their consumption), riskiness of non-RRE related portfolios, while taking into account the position in the cycle. Please use a medium time horizon (up to 3 years) for the assessment, and mention if another time horizon is applied (short/medium-to-long term)]
C5. Discuss the net benefit for each macroprudential measure (mentioning also how it was defined and assessed). **1.** **2.** **…**	[Please use a medium time horizon (up to 3 years) for the assessment, and mention if another time horizon is applied (short/medium-to-long term)]

Section C: Policy sufficiency	
C6. Please comment on the methods used to assess sufficiency of policy measures, including effectiveness and efficiency. Are they mostly based on a quantitative, model-based approach, or on qualitative, judgment-based considerations? If quantitative methods are used please comment on the following criteria: (i) breadth, (ii) balance, (iii) robustness/flexibility, and (iv) limitations (please see Section 5 of the WG REM RRE Report) **1.** **2.** **…**	
C7. If multiple instruments are in place, please make a qualitative assessment of the extent to which their combined implementation may significantly influence the total sufficiency of the policy mix?	
C8. Do other policies adopted in the country (e.g. monetary, fiscal, microprudential) and/or the legal environment affect the sufficiency of the macroprudential policy mix? If yes, which are the main channels?	
C9. Please mention if you plan future macroprudential measures that have not yet been publicly announced, and describe their expected impact on the risk assessment and the assessment of policy sufficiency on the medium term (up to 3 years). [Please refer to measures that are under discussion in the competent authorities in your country.]	
C10. Annex – additional information on data, models, and other more detailed information that supports the sufficiency analysis. You can refer to any documentation on methodology or policy discussions. [You may refer to more technical aspects of certain econometric models or other type of quantitative assessments, tables or charts, more detailed qualitative information.]	

Technical Annex B

Table B.1

Borrower-based instruments

Study		Acharya et al. (2018)
Measures		LTV and LTI
Country		Ireland
Main motivations for the policy activation and RRE cyclical position		The authors provide a comprehensive micro-level analysis of the transmission of macroprudential policies aimed at limiting bank risk-taking in the residential mortgage market. Combining loan-level data on residential mortgages with bank credit to firms, and security-level data on bank holdings of securities, they examine the February 2015 introduction of LTV and LTI limits on the issuance of residential mortgages in Ireland. They analyse how the policy affected banks and households.
Type of model; sample period and policy calibration (shock)		Diff-in-diff specification based on loan level data; 2014M02 – 2016M01; Calibration: Lending for primary dwelling housing (PDH) is limited to 80% LTV and to an LTI of 3.5. For First-Time-Buyers (FTB), a more generous LTV limit of 90% is imposed for houses up to €220,000. For any amount exceeding €220,000, the excess amount over €220,000 faces an LTV limit of 80%. The measures impose a lower threshold for buy-to-let (BTL) properties, requiring banks to apply an LTV limit of 70% for this type of loans.
Estimated effects	**Total**	The authors find that, in response to the introduction of the lending limits: 1. low income households borrowed less, 2. banks reallocated their mortgage portfolio reducing the rate charged to high income households who lever up by taking larger loans, 3. banks increased their credit supply to risky rms and their holdings of risky securities, 4. house price appreciation (especially in areas where its pace was elevated) slowed down relative to the pre-implementation period.
	of which % in the first year	No information available
	of which % in the first two years	No information available
Heteregeneous effects		No information available
Comments		Following the introduction of the lending limits, banks increased their risk-taking in both credit to firms and holdings of securities, the two largest asset classes not targeted by the regulation. Following the policy, low income households borrowed less while highly higher income households kept borrowing, increasing their leverage. Interestingly, low leverage high income households increased their leverage post regulation. Indeed, banks reduced the rate charged to high income household who levered up and obtained larger loans. Our effects are consistent with the time-series evolution of house prices. In particular, they find that the increase in mortgage credit to high income households is mostly driven by areas outside Dublin. On the other hand, the contraction in mortgage credit to low income household is driven by the Dublin area. House price appreciation continues in the entire country, with the exception of Dublin where borrowers tend to be highly levered and therefore more affected by the policy.

Study		Ahuja (2011)	
Measures		LTV, DTI	LTV
Country		Cross-country (49 emerging and advance economies)	Hong Kong
Main motivations for the policy activation and RRE cyclical position		In general, the caps are intended to limit the build-up of vulnerabilities during the upswing and the extent of fallout during the downswing of a property price cycle.	VAR; 2003Q1-2011Q2; calibration: LTV caps are dependent on the property price; caps were progressively reduced from 70% to a minimum of 50% (between 2009 and 2011).
Type of model; sample period and policy calibration (shock)		Panel regression; 2000Q1-2010Q4; Undetermined (the panel regression only considers dummy variables for the LTVs and DTIs).	
Estimated effects	**Total**	1. Cumulative effect of LTV caps on property price growth: -8.3% in the full sample of countries; -5.6% in the sample of countries with fixed FX regimes; 2. Cumulative effect of the DTI caps on property price growth is significant for fixed FX regimes but positive	Little effect on total mortgage lending. Transaction volumes are affected first and property prices later.
	of which % in the first year	The1Y effect of LTV caps on property price growth: -1.0% in the full sample; -0.9% in the sample of fixed FX regimes;	There is no significant effect on the rate of RRE price growth or mortgage growth. More binding LTVs reduce transaction volume growth starting around 1Y after policy tightening, for both high- and lower-end segments.
	of which % in the first two years		Property price growth decreases around 2Y after the policy change. The impact on mortgage growth is still uncertain after 1Y.
Heteregeneous effects		The use of LTV caps appears to strengthen bank capital buffers and bank performance relatively more in economies with fixed exchange rate regimes.	No heteregenous results: although LTV caps are more actively used in the high-end housing market segment, they affect transaction volumes and property price inflation both in the high- and lower-end segments.
Comments		The effect of DTI caps on property price growth and NPLs is estimated to be positive. The authors note that, since DTI caps are used less frequently than LTV caps, it may be the case that they are deployed in extreme times when a property price-run up is already underway.	Together with LTV caps, other measures were introduced, such as increases in public land supply and transaction taxes to discourage speculative behavior. Results suggeest that the tightening of LTV caps could affect property market activity through the expectation channel.

Study		Andersen (2018)
Measures		Specific DTI
Country		Denmark
Main motivations for the policy activation and RRE cyclical position		To ensure that underwriting standards in geographical areas with strong price increases are based on the robustness of borrowers financial conditions.
Type of model; sample period and policy calibration (shock)		Ex post difference-in-difference regresion model; 2009-2016; pecific limits on household total debt relative to its gross income
Estimated effects	Total	Modest effects of initiative: Households affected by regulation reduced borrowing by DKK 40.000 relative to similar households not affected (corresponding to a reduction in the debt-to-income ratio 5%); no significant effets on house prices
	of which % in the first year	
	of which % in the first two years	
Heteregeneous effects		
Comments		The relatively modest impact may reflect credit institutions' failure to fully implement the guidelines in their credit policies (as also indicated publicly by the Danish FSA). Therefore, the impact of the measure may increase as it becomes fully implemented in credit policies. In addition, some credit institutions may have chosen to roll out the rules for the whole countries which makes the econometric identificaiton difficult.

Study		Avouyi-Dovi et al. (2014)
Measures		DSTI and maturity limits
Country		France
Main motivations for the policy activation and RRE cyclical position		The paper simulates the effect of policy measures ex-ante. Measures could be enacted to counteract the rise in prices and the relaxation of lending conditions.
Type of model; sample period and policy calibration (shock)		Multi-equation model estimated by 3SLS; 1993Q1-2012Q2; calibration: Shocks are calibrated to have a similar impact on the demand for credit: DSTI is restricted from 33% to 30% and there is a 2-year reduction in loan maturity
Estimated effects	**Total**	Similar effects of DSTI and maturity shocks: - the impact on lending is progressive, as the initial effect is amplified by the persistent decline in loan maturities; - the fall in lending leads to a fall in housing stock and house prices.
	of which % in the first year	1. Impact of maturity limit: - on lending: decrease of 0.16% in the first quarter and around 0.75% after 1Y; - on house prices: decrease of around 0.1% in the first quarter and 0.2% after 1Y; 2. impact of DSTI limit: - on lending: decrease of 0.2% in the first quarter and around 1% after 1Y; - on house prices: decrease of around 0.1% in the first quarter and 0.25% after 1Y.
	of which % in the first two years	1. Impact of maturity limit: - lending decreases by around 1.75%; - house prices decrease by around 0.3%; 2. Impact of DSTI limit: - lending decreases by around 2.25%; - house prices decrease by around 0.5%;
Heteregeneous effects		No heterogeneous effects.
Comments		Additional qualifying information (2014): 1. More than half of housing loans granted in FR are secured with an institutional guarantee rather than a mortgage, leading to a selection of higher quality loans; 2. Various measures have been introduced to stimulate housing supply; 3. More than 90% of housing loans are fixed rate.

Study		Bloor and McDonald (2013)	Cussen (2015)
Measures		LTV	LTV
Country		New Zealand	Ireland
Main motivations for the policy activation and RRE cyclical position		The paper simulates the impact of the policy ex-ante. The measure was introduced in response to the combination of rapidly rising house prices and high and growing household indebtedness.	The paper simulates the effect of policy measures ex-ante. Measures had been proposed by the CBI to safeguard the economy from the negative consequences of unsustainable credit growth.
Type of model; sample period and policy calibration (shock)		Micro exercise to assess the impact on new mortgage lending and BVAR model to assess the impact on other macro variables; 1992M01-2016M06; Proportional LTV limit of 80% for 90% of new mortgage lending. This would require banks to reduce the proportion of high-LTV loans by about half.	Two-step approach: micro-simulation to assess the impact on new mortgage lending and BVAR model to assess the impact on other macro variables; 1992Q3-2014Q2; calibration: proportional LTV limit of 80% for 85% of the value of new mortgage lending. In the sample, 44% of new loans were issued above the cap, with a weighted LTV of 75%.
Estimated effects	**Total**	Taking into account uncertainty, housing credit growth is likely to be reduced by 1-3% and house prices by 1-4%.	The impacts are relatively moderate in terms of housing prices and mortgage interest rates, albeit slightly less so in terms of housing supply
	of which % in the first year	Housing credit growth is reduced by 1.7% in the first year. The net effect on house sales is a reduction of around 5%.	1. The value (number) of new mortgage lending is reduced by 9% (5%) in the first quarter; 2. After 1Y: house prices are reduced by 0.8%, mortgage interest rates are reduced by 0.38%, and housing completions are reduced by 2.1%.
	of which % in the first two years	House prices and household credit are about 1.5% lower after two years.	The shocks reduces house prices by 1.3% after three years.
Heteregeneous effects		Borrower heterogeneity is considered in the micro exercise.	Borrower heterogeneity is taken into account in the micro-simulation, via a stylized behavioral function.
Comments		Significant degree of uncertainty concerning the estimated effects.	The elasticity of housing supply to changes in house prices in the BVAR model is relatively high, at 1.6.

Study		FA (No. 10-12)	Gadatsch et al. (2017)
Measures		LTV and LTI	Borrower-based
Country		Sweden	Cross-country (European)
Main motivations for the policy activation and RRE cyclical position		Sweden saw a drastic increase of house prices (by 80% during 2007-2017) and an increase of housing debt by the same number. The main reason are increase in the ownership rate, reduced taxes and interest rates and migrations to metropolitan ares.	Not addressed.
Type of model; sample period and policy calibration (shock)		Analysis of factual data before and after the introduced; 2010-2017 (LTV) and 2016-2017 (LTI) restrictions; calibration: LTV caps on new mortages of 85% since 1 October 2010. New mortgages with LTI abover 450% must amortise 1 percentage point more than under the current requirement since June 2016. Beside that, the minimal annual amortisation for new mortgages with a LTV above 50% is 1% and for LTV above 70% it is 2%.	Instrumental variable (IV) approach; 2015; calibration: not addressed
Estimated effects	**Total**	The LTV cap made new borrowers to buy housing that is cheaper by 1.6% on average, as most of the buyers used lower LTV levels than the cap. But those who were affected by the cap borrowed 13% less and bought housing that was cheaper by 10%. The report states that this information should be taken with caution, as the data that was avaliable around the implementation of the cap was not very good. The increased amortisation requirement has a significant impact, households buy less expensive housing, take less mortgage, use more own savings. The effect should be the strongest in the metropolitan areas, where house prices are the highest in the country.	Results show that borrower-based measures have a strong and statistically significant dampening effect on credit growth in the European Union.
	of which % in the first year		Activation of an additional borrower-based measure leads to a statistically and economically significant decrease in bank loan growth by 3% to 4%.
	of which % in the first two years		
Heteregeneous effects		No information available	No information available
Comments			The approach does not allow to capture objectively the intensity of a measure, nor does it provide information on whethera measure is actually binding.

Study		IMF (2013)	Jácome and Mitra (2015)
Measures		LTV and amortization period	LTV
Country		Canada	Five countries: Hong Kong, Korea, Malaysia, Poland, Romania
Main motivations for the policy activation and RRE cyclical position		The measures were intended to support the long-term stability of the housing and mortgage markets and prevent excessive household leverage	Stem excessive credit growth and prevent house price booms.
Type of model; sample period and policy calibration (shock)		Single equation time series model (OLS estimation); 2018M08-2012M11; calibration: Four waves of tightening regulations: 2008 – maximum amortization period set at 35 years; maximum LTV reduced from 100 to 95 percent; 2010 – maximum LTV reduced from 95 to 90 percent; 2011 – maximum amortization period reduced from 35 to 30 years; maximum LTV lowered from 90 to 85 percent; 2012 – maximum amortization lowered from 30 to 25 years; maximum LTV lowered from 85 to 80 percent.	Panel regression; 2002M07-2012M12; calibration: variable
Estimated effects	**Total**	A 1% reduction in maximum LTV delivered a 0.4% reduction in credit growth. A 5 years reduction in amortization period is associated with 0.45% lower credit growth when interest rates are 4.5% and with 0.8% when interest rates are 8%. April 2010 and y/y house price growth would have been 1.2% higher.	A 10% reduction in the maximum LTV is associated with a 0.7% lower level of mortgage credit after 5 quarters
	of which % in the first year		65%
	of which % in the first two years		
Heteregeneous effects		No hetereogeneous results. Results for the specific measure of maximum LTV on first time buyers are of the same order of magnitude.	No heterogeneous results.
Comments		The results are dependent on the level of the interest rates, suggesting that there would have been a role for monetary policy in dampening the developments of credit growth.	The impact of LTV limits on the level of credit is significant but low. The impact on house prices is counterintuitive.

Study		Kinghan et al. (2016a and 2016b)
Measures		LTV, LTI
Country		Ireland
Main motivations for the policy activation and RRE cyclical position		The LTV/LTI limits were designed to enhance the resilience of banks and borrowers to future shocks and to reduce the potential for house price-credit spirals.
Type of model; sample period and policy calibration (shock)		Regression on loan-level data; 2006M01 – 2016M06; calibration: In February 2015, the following measures were introduced: a sliding LTV limit of 90% for first-time buyers (FTBs), a cap of 80% for non-FTBs, 70% for investors and a LTI limit of 3.5
Estimated effects	**Total**	
	of which % in the first year	Average LTV is marginally higher following the implementation of the measures: +1.3% for FTBs; +1.1% for non-FTBs. However, the effect is the opposite when restricting the sample to only high leverage borrowers
	of which % in the first two years	
Heteregeneous effects		There is some evidence of heterogenous effects based on borrower income. For high- leverage FTBs in the top 20% of the income distribution, the predicted LTV is about 2% lower after the regulation.
Comments		The regression analysis is limited to the effects on LTVs or LTIs, there is no information, for example, on the effects on mortgage lending.

Study		Łaszek et al. (2015)
Measures		LTI, risk weights, DSTI
Country		Poland
Main motivations for the policy activation and RRE cyclical position		Following accession to the EU, housing demand increased sharply in the largest Polish cities. This was to a large part related to the rapid development of loans denominated in foreign currencies, mainly in Swiss francs. Often, these loans were given to people with lower incomes. The rapid increase in demand caused a fast increase in prices, related speculative purchases and the beginning of price bubbles in several cities. The supervisor's intention was to reduce housing demand and put pressure on prices and to limit FX denominated loans to people with the lowest income. According to official declarations, the purpose of the regulation was the limitation of credit risk in connection with the possibility of exchange rate shocks and a potential risk of a drop in property prices caused by forced sale of apartments.
Type of model; sample period and policy calibration (shock)		A formal model was not used; 2006 – 2014; Since July 2006 Recommendation for FX denominated housing loans to calculate the mortgage affordability as if they took a PLN loan (higher interest rates) and to increase the mortgage value by 20% in the calculation. In 2007 the risk weight for the part of the FX denominated housing loan where the LTV was below 50% was increased from 35% to 75%. At the same time, the risk weight for this part of the PLN housing loan was lowered to 35%. In both cases the risk weight for the part of the housing loan that corresponds to 50-100% of the LTV remained the same and stayed at 100%. In July 2011 the FSA introduced a DTI cap of 42% for FX denominated housing loans and in June 2012 the risk weight for them was increased to 100%, irrespective of the LTV level.
Estimated effects	Total	Limited direct effect on the volume of new mortgages, but a good long-run effect concerning the quality of the loan portfolio (see Comments for more details).
	of which % in the first year	
	of which % in the first two years	
Heteregeneous effects		
Comments		A lack of longer time series and large structural changes caused that the tools used and their calibration were based on expert knowledge. The analysis of the introduction of individual instruments shows that they did not affect the credit activity both on the demand side for loans (households) and the supply of loans (universal banks). The lending activity collapsed due to problems on the international capital markets and not as a result of the introduced regulations. Subsequent experience related to the rapid appreciation of the Swiss franc, however, showed the high stability of the franc portfolios, whose loss ratio only slightly increased. This shows that the policy of limiting LTI and hence indirectly DSTI and thus strengthening the resilience of households to shocks turned out to be effective. Denominated loans were characterized by high margins in the initial period, which also allowed to strengthen the banks' capital base for later shocks and a drop in the margin. This case also confirms the prevailing opinion that in conditions of mass speculation, fast price growth and credit boom, traditional and moderately used macroprudential policy instruments may not affect the dynamics of loans and property prices.

Study		Montalvo and Raya (2018)	Neagu et al. (2015)
Measures		LTV	DSTI and LTV
Country		Spain	Romania
Main motivations for the policy activation and RRE cyclical position		Housing market boom counteraction	The instruments were used to support sustainable lending, addressing the following systemic risks: the high level of borrowers' indebtedness (or excessive credit growth), sectoral concentration in real estate assets and macroeconomic imbalances.
Type of model; sample period and policy calibration (shock)		Descrriptive statistics and OLS with robust standard errors; 2005-2010; calibration: recommendation of LTV < 80%	GMM dynamic panel regression; 2004-2013; (1) in 2003, different DSTI caps for consumer and mortgage loans: 30% for consumer loans and 35% for mortgage loans. The LTV cap was set at 75% for both consumer loans for the acquisition of goods and mortgage loans. (2) 2006 – the total indebtedness limit was 40% of the net income of a household; (3) 2007 – exclusion of explicit DSTI and LTv caps; (4) 2008 – lenders were required to assess debtors' capacity to repay their debt in a stress scenario (5) 2011 – different LTV caps for mortgage loans by currency and stress values for a DSTI in case of consumer loans.
Estimated effects	**Total**	Results show a circumvention of LTV recommendation via appraisal values	A change in regulation leas to [4.6%, 8.8%] reduction in total credit in the first quarter after the measures are introduced
	of which % in the first year		
	of which % in the first two years		
Heteregeneous effects		No information available	Heterogeneity among banks was not tested.
Comments		Calibration of LTV limits should focus on market prices / transaction values.	Higher impact on credit during the expansionary phase

Study		Nymoen (2018)							
Measures		LTV	LTI/DTI	DSTI	Amortisation requirements	LTV	LTI/DTI	DSTI	Amortisation requirements
Country		Eight countries	Four countries	Seven countries	Four countries	Eight countries	Four countries	Seven countries	Four countries
Main motivations for the policy activation and RRE cyclical position		Counter unsustainable household debt and/or housing price growth	Counter unsustainable household debt and/or housing price growth	Counter unsustainable household debt and/or housing price growth	Counter unsustainable household debt and/or housing price growth	Counter unsustainable household debt and/or housing price growth	Counter unsustainable household debt and/or housing price growth	Counter unsustainable household debt and/or housing price growth	Counter unsustainable household debt and/or housing price growth
Type of model; sample period and policy calibration (shock)		2008-2017							
Estimated effects	**Total**	-0.46	-0.23	-0.01	0.07	-1.04	-0.30	-0.03	-0.90
	of which % in the first year	0.05	1.31	-0.95	-2.43	-0.16	-0.79	0.74	-0.21
	of which % in the first two years								
Heteregeneous effects									
Comments									

Study		Shaar (2018)	Tzur-Ilan (2017)
Measures		LTV	LTV
Country		New Zealand	Israel
Main motivations for the policy activation and RRE cyclical position		Reduce high-LTV lending in order to reduce the share of defaulted loans in a servere downturn	Between 2010 and 2014, the Banking Supervision Department of the Bank of Israel adopted a number of macroprudential policies intended to prevent households from overleveraging, maintain financial stability, and address the development of systemic risk in the housing market.
Type of model; sample period and policy calibration (shock)		Descriptive statistics over time using a panel data set; 2006-2016; measure has been recalibrated / modified four times since the introduction in 2013	Diff-in-diff matching (loan level data); 2012M01 – 2013M08; Calibration: In October 2012 introduction of a LTV ratio limit to 75% for first-time home buyers; to 70% for upgraders; to 50% for investors (own 2 homes or more).
Estimated effects	**Total**	The observed average LTV for home buyers drops from 67% in 2012-14 to 55% in 2014-16	Investors were the most affected by the policy change and changed their choice in the housing market: they bought houses that were 22% less expensive, 14% smaller, 24% farther form the center and in neighborhoods that were 18% lower in quality.
	of which % in the first year	N/A	
	of which % in the first two years	N/A	
Heteregeneous effects		More pronounced effect in Aucland (drop in average LTV from 70 to 51% vs a drop from 65 to 54% for the rest of the country). The same trend applies for average DTIs.	
Comments		The paper only contains descriptive statistics	LTV limit did not crowd out borrowers but encouraged them to buy cheaper and lower quality assets, especially farther from the center. Counterintuitive results in the credit market: higher interest rate and higher maturity, due to riskier assets (farther from the center) and increase in unsecured credit. While the objective of hard LTV limit was to reduce borrower risk, this paper finds that in certain respects it even increased.

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Table B.2

Capital-based instruments

Study		Basten (2015)	Ceruti (2017)				
Policy instrument		Countercyclical buffer (CCB) effects on mortgage lending	Composite index of macrorpudential policies referring to financial institutions				
Country		Switzerland	106 countries				
Main motivations for the policy activation and RRE cyclical position		To reinforce bank defenses against the build-up of systemic vulnerabilities; second objective: "lean against the financial cycle" by shifting the "quality" of lenders and borrowers					
Type of model; sample period and policy calibration (shock)		Panel regression on loan-by-loan data; 2008 to 2013; calibration: Introduction of CCB-rate of 1%					
Estimated effects	**Total**	1. Quality effect regarding supply side (mortgage lending of banks), i.e. composition of banks with respect to lender's; 2. Analysis regarding hypothesis whether risk-weighting schemes may amplify the CCB effects	All sample: -8.4 (13.9%)	Advanced ec: -0.9 (1.5%)	Emerging ec.: -6.6 (10.4%)	Open ec.: -4.6 (7.2%)	Closed ec.: -8.3 (13%)
	of which % in the first year	1. Significant quality effects regarding the characteristics of lenders; 2. Consideration of borrower's characteristics in additional risk-weighting scheme for CCB setting does not amplify the CCB's effects	13.88	1.54	10.40	7.21	13.00
	of which % in the first two years						
Heteregeneous effects		CCB effect on a bank's offered mortgage rate runs through two separate channels: first via bank's balance sheet characteristics, and, second via the credit risk term addressing the borrower risk characteristics.	Heterogeneity based on the level of income and capital openness of the countries.				
Comments		CCB changes the composition of mortgage supply (relatively capital constrained and mortgage-specialized banks raise interest rates more than their competitors).	Assessed individually, the impact ranges from -9.5 (limits of FX loans) to concentration limits (29.8) and limits on intra bank exposures (-35.5). Considered together (FX limits and/or countercyclical requirements) the impact amounts to -42.8.				

Study		Ferrari (2017)
Policy instrument		RW add-on on RRE exposures for IRB banks
Country		Belgium
Main motivations for the policy activation and RRE cyclical position		IRB risk weights for Belgian mortgage loans were relatively low (10 percent), and, on average, lower than in other European countries.
Type of model; sample period and policy calibration (shock)		Diff-in-diff panel regression on bank-level data; 2012m1-2015m12 ; calibration: 5 p.p. increase
Estimated effects	**Total**	No statistically significant effect on IRB banks' mortgage rates and mortgage loan growth.
	of which % in the first year	Stronger effects on lending rates and lending growth for banks with higher share of mortgage loans in the first year.
	of which % in the first two years	The effects are temporary and no longer significant in the second year after the introduction.
Heteregeneous effects		Stronger effects on lending rates and lending growth for banks with higher share of mortgage loans in the first year.
Comments		The paper shows that on average the impact of the macroprudential measure on mortgage lending was relatively limited both in terms of statistical and economic significance. As such, this is not surprising, as the objective of the measure was not to curb credit supply per se. On the one hand, this could be interpreted as a positive finding: the evidence shows that banks' resilience to sectoral risk could be raised at low overall cost of foregone credit. On the other hand, this raises the question on what should be the calibration of sectoral capital requirements if they were intended to have material impact on credit supply. Unfortunately, due to potential nonlinearities in banks' reactions to regulatory requirements, the estimates do not allow drawing conclusions on whether a stronger calibration of the measure would have had more sizable effects on mortgage lending.

Study		Nyomen (2018)					
Policy instrument		RW on mortgage loans	CCyB	Interest rate	RW on mortgage loans	CCyB	Interest rate
Country		Five countries	Five countries	Ten countries	Five countries	Five countries	Ten countries
Main motivations for the policy activation and RRE cyclical position		Counter unsustainable household debt and/or housing price growth	Counter unsustainable household debt and/or housing price growth	Control	Counter unsustainable household debt and/or housing price growth	Counter unsustainable household debt and/or housing price growth	
Type of model; sample period and policy calibration (shock)		Dynamic panel data(1998-2017); calibration: variable	Dynamic panel data (2015-2017); calibration: variable	Dynamic panel data (1998-2017); calibration: 1pp	Dynamic panel data (1998-2017); calibration: variable	Dynamic panel data (2015-2017); calibration: variable	Dynamic panel data (1998-2017); calibration: 1pp
Estimated effects	**Total**	Credit growth	Credit growth	Credit growth	House price change	House price change	House price change
	of which % in the first year	-0.72	0.23	-0.07	-0.81	0.38	-0.18
	of which % in the first two years	-3.47	3.09	-0.35	-1.05	0.34	-0.09
Heteregeneous effects							
Comments		Objective of the paper is to help the assessment of macroprudential policies implemented in Norway					

Study		Uluc (2015)	Vandenbussche (2015)
Policy instrument		Bank-specific microprudential capital requirements (for operational, management and business risks)	Broad range of capital based measures (29 types of macroprudential measures)
Country		United Kingdom	CESEE countries
Main motivations for the policy activation and RRE cyclical position		The policy instrument change was not related to the RRE cyclical position	Housing market boom counteraction
Type of model; sample period and policy calibration (shock)		Panel regression on bank-level data (2005Q2-2007Q2); calibration: 1p.p.	Dynamic panel; error correction model (2000-2010); Introduction of CCB-rate of 1%
Estimated effects	**Total**	-5.4% on average mortgage loan size	House price change, credit growth
	of which % in the first year		CAR (Capita adequacy ratio) increase by 1% has average cumulative effect on house prices of 5.7% after four quarters via impact on household credit; further results especially regarding foreign borrowing
	of which % in the first two years		
Heteregeneous effects		Depending on the capital situation of the lender.	
Comments		The findings in this study are based on changes to microprudential capital requirements and are therefore subject to the Lucas Critique, since bank behaviour might change in the presence of macroprudential regulation. Basel II and Basel III will address some of these issues. Clearly, when the change in the capital requirement is at the level of the banking system, rather than individual institutions, loan substitution of competing institutions is likely to be smaller. The reciprocity clause in Basel III would also help to stop substitution by foreign branches. And the internal-model determined risk weights may help to address risk shifting, so long the weights vary with the degree of risk.	Intensity of change of regulation is measured by simple linear transformation ; also for the case of different macroprudential measures which were enacted; authors argue that effect of CAR increase also provides evidence that countercyclical capital buffer is well positioned for use in the case of housing bubbles

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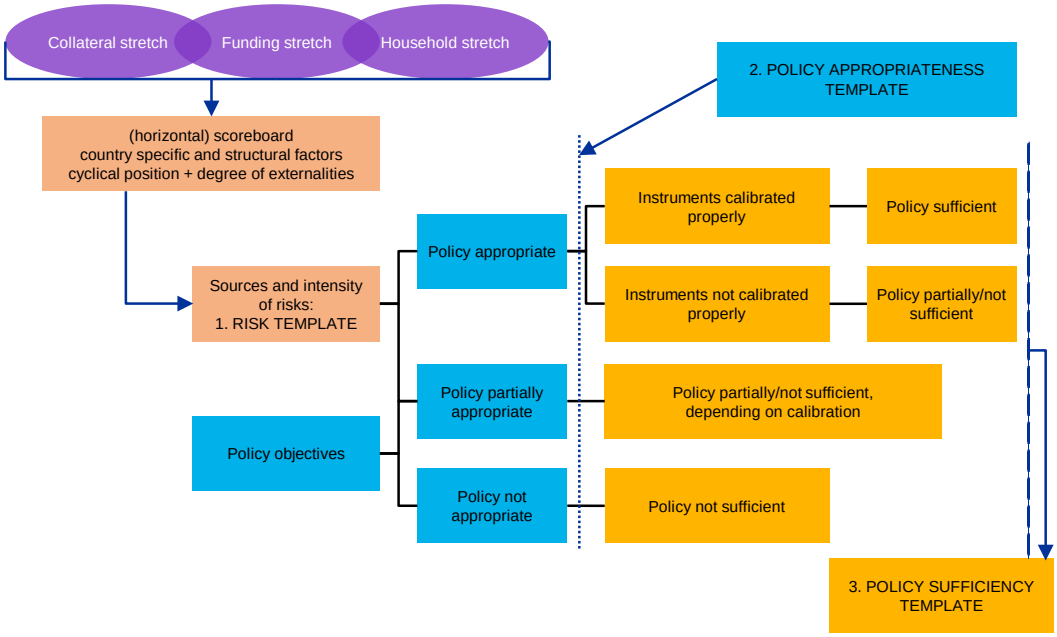
Concluding remarks

The WG REM produced the RRE Report in accomplishment of the medium term mandate, originally received by the General Board in March 2016, to gradually develop a comprehensive guidance for the assessment of vulnerabilities and the related macroprudential policies across the EU countries. To this purpose, the WG REM developed a fully-fledged framework structured in a sequence of three modules, which are meant to be internally consistent (Figure 9).

First, the source and intensity of systemic vulnerabilities coming from RRE are identified and classified across the collateral, funding and household stretches. Second, the appropriateness of macro-prudential measures activated in a country is assessed conditional on the identified vulnerabilities, the actual room for selecting within the possible tool set and a number of country-specific considerations. Third, activated measures, conditional of proving appropriate, are assessed to be or not be sufficient depending on their ability to produce over time beneficial effects, in terms of mitigating systemic risks and increasing resilience, which substantially exceed the expected and unintended costs in the general economy.

Figure 9
The structure of the overall assessment framework



The three modules basically share a common structure, as they start from processing information on the general environment in which the risks and the related policy issues are casted, then the final assessment is obtained by combining general (or horizontal) and country-specific (or vertical) considerations along detailed operative lines, in an effort to enhance the transparency and the accountability of final results.

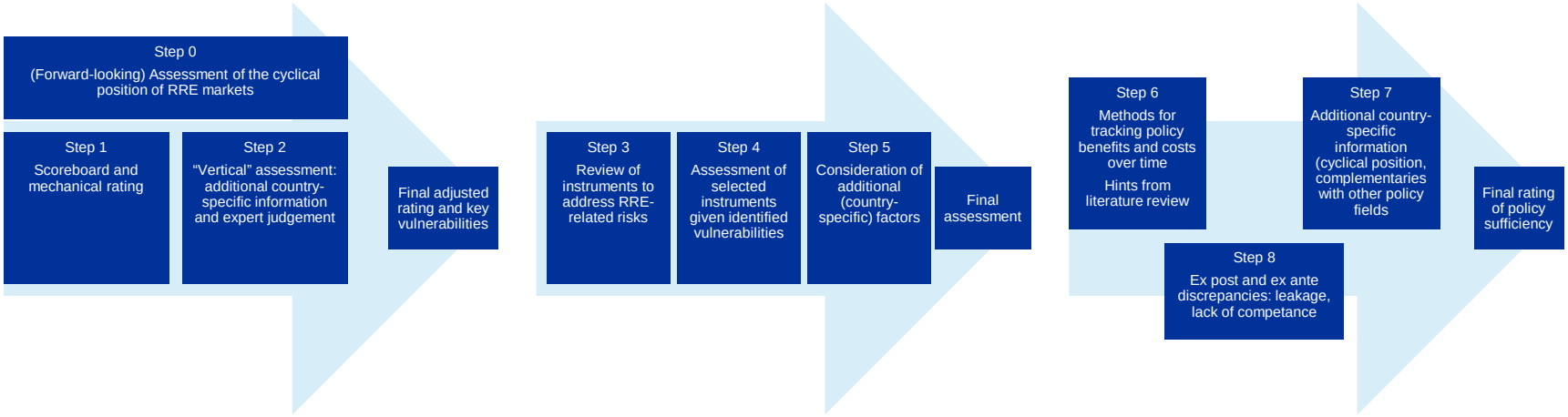
At the end of every module a template is envisaged in which the main building blocks of the ratings are reviewed and explained, with a particular focus on documenting the adopted methods, either quantitative or qualitative, as well as the data sources, either official or experimental, including the possible role of expert judgments in understanding how country-specific factors may adjust the automatic reading of harmonized indicators and/or general methods. Moreover, the three templates are expected to report a non-technical narrative helping a widespread interpretation of the final ratings as well as the key elements underpinning, in sequence, the assessment of risks, policy appropriateness and sufficiency.

Importantly, the templates are meant to enhance the efficient and transparent communication strategy by the ESRB, and should not act as the vehicle for gathering information and sharing views across domestic Authorities and experts.

As it is extensively documented in the report, every module produces an output based on a variety of inputs, which are more and more enriched by the outcomes of previous steps as the process moves forward (Figure 10). In this line, the assessment of risks is informed by the forward looking analysis of the RRE cyclical position since it mostly affects both the information content of common values in scoreboard indicators, e.g. in countries with early or mature recovery, and the probability of sudden turning points. The following assessment of policy appropriateness is influenced , in addition to inputs such as the extent of RRE toolkit generally available and the analysis of policy transmission channels and interactions, by the vulnerabilities already identified as well as by the previous cyclical analysis, which this time weighs on the timing of the activated policy measures. The very final task of assessing the policy sufficiency further builds on the large stock of information gradually collected in previous modules. In addition to the policy appropriateness rating, information on the intensity of risks and on the cyclical position, the sufficiency assessment benefits from the knowledge already gathered about the different degrees by which policy measures are legally binding, as the affect the room for complementary action should substantial discrepancies between ex ante and ex post assessment call for reconsidering the tool calibration.

Figure 10

The sequence of inputs and outputs within the assessment process



The guidance for the assessment of RRE policy sufficiency deserves additional considerations for enhancing their concrete relevance in view of the challenging conditions for sufficiency. As argued in the Report, they require that the activated tools are first appropriate, second suitable to exert over time beneficial effects – in terms of mitigating the identified vulnerabilities and increasing the resilience of the financial system – which exceed the possible costs, intended and unintended, on the general economy. Accordingly, both the effectiveness and the efficiency of policies are keys for the final rating of sufficiency; implicitly, the rating is grounded on data and methods adopted in order both to calibrate the activated tools and to monitor the ensuing benefits and costs over time.

In this respect, the sufficiency guidance developed by the WG REM is deliberately set in a medium term perspective, namely when substantial progress in data, methods and empirical literature are reasonably expected to meet the requirements for an efficient and effective policy calibration. However, the framework is meant to help policy assessment also in current times, although only a few European countries are well equipped to perform this difficult task and the limited empirical literature hampers a general understanding of the policy operation.

In the first place, a policy implication of the WG REM methodology is the urgent need for countries to keep substantially investing in order to fill the large data gap still remaining and, partly connected, to develop the suitable class of methods required to soundly identify and implement a timely policy reaction against possible systemic risks coming from the RRE. As reviewed in the Report, several initiatives on the statistical front are already in place, at the European and the G20 level, and some countries have recently started promising empirical studies on the expected costs and benefits of RRE policy tools. Further efforts in this direction are needed in order to improve the ability to counteract RRE systemic risks whereas they are timely identified.

In the second place, the general claim made by the WG REM is that methods and data sources currently adopted to calibrate and monitor RRE macroprudential policies need to be clearly documented, regardless their state of development (e.g. peer review considerations, expert judgments, fragmented evidence). Importantly, the contingent lack of suitable methods and data do not imply under any respect that the required policy action is worth to be suspended and postponed. On the contrary, for countries where methods and data may be least developed the suggested framework calls for the strongest efforts to combine any available pieces of information and elements of understanding in order to envisage the conditional best choice and implementation of the policy action, especially when evidence points at substantial vulnerabilities.

In the third place, the criteria of net benefits for sufficiency may be very relevant in practice, especially in countries where important complementarities among the macroprudential and other policy fields shape the source and intensity of RRE vulnerabilities. Should the ultimate factors driving the observed risks trace back in the fiscal domain, pursuing an increasingly bold macroprudential action may entail limited benefits against rising costs. This is surely not to cause a policy inaction bias, as the concrete claim of the WG REM framework would be to calibrate the required macroprudential tools possibly in combination with additional levers from other policy fields, thus enhancing the coordination of the country policy makers.

In the fourth place, the WG-REM framework entails that the sufficiency assessment is based on the policy impact on target variables, namely the underlying factors driving the observed risk indicators, rather than directly on those indicators. This comes from the fact that the policy shock takes time to transmit to the final risk indicators, e.g. house prices, while the reaction of key determinants such as the lending standards is much more rapid to observe, thus allowing a timely policy assessment. Moreover, whereas other policy fields weigh on the changes in risk indicators, assessing macroprudential policies in the closer remit of the lending behavior helps identifying if their true contribution to the vulnerability conditions.

Finally, every single module within the framework is meant to be flexible as new data, analytical methods and empirical evidence may become available in the near future. Moreover, the framework is expected to be fine-tuned based also on the experience progressively gained in its practical implementation. In this vein, the guidance has been already tested in dry run sessions carried within the WG REM on a selected number of countries; additional indications have been received from the RRE risk comprehensive review across the European Union that has been just finalized by the ESRB by applying the assessment framework that is documented in full details in the Report.

Members of the Working Group on Real Estate Methodologies

Francesco Zollino	Banca d'Italia (Chair)
Michela Guarnero	ESRB Secretariat (Secretary)

Residential Real Estate workstream (WSA)

Ronald Albers	European Commission
Wanda Cornacchia	Banca d'Italia
Thomas Ferrière	Banque de France
Sara Filipe	Banque centrale du Luxembourg
Alexandre Francart	Banque Nationale de Belgique
Jacek Łaszek	Narodowy Bank Polski
Marco Lo Duca	European Central Bank (Co-Chair WSA)
Katrine Mogensen	Danmarks Nationalbank (Co-Chair WSA)
Vitor Martins	European Commission
Hanna Putkuri	Suomen Pankki
Tomas Reichenbachas	Lietuvos bankas
Nuno Ribeiro	Banco de Portugal
Michael Richter	Deutsche Bundesbank
Marek Rusnak	European Central Bank
Mara Pirovano	European Central Bank
Piotr Sliwka	Komisja Nadzoru Finansowego – C.S. Wyszyński University
Luminita Tatarici	Banca Naţională A României
Eugen Tereanu	European Central Bank
Remco van der Molen	De Nederlandsche Bank

Commercial Real Estate workstream (WSB)

Gerard Kennedy	Central Bank of Ireland
Marco Lo Duca	European Central Bank (former Co-Chair WSB)
Rob Nijskens	De Nederlandsche Bank
Eoin Obrien	Central Bank of Ireland (former Co-Chair WSB)
Krzysztof Olszewski	Narodowy Bank Polski
Alvaro Santos Rivera	European Central Bank
Vaidotas Sumskis	Lietuvos bankas
Johannes Werner	Deutsche Bundesbank (Chair WSB)

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Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website **www.esrb.europa.eu**

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