Report of the Expert Group on Macroprudential Stance – Phase II (implementation)

December 2021

A framework for assessing macroprudential stance

ESRB
European Systemic Risk Board
European System of Financial Supervision

Contents

Executive summary

The ultimate objective of macroprudential policy is to contribute to financial stability by strengthening the resilience of the financial system and counteracting the build-up of systemic risks. To achieve this objective, the European Systemic Risk Board (ESRB) forms a view on the macroprudential policy stance on which it bases risk warnings and policy recommendations. This report sets out operational methods that link the state of the economy – and the financial system – to macroprudential policies and their objectives. It represents Phase II of the Expert Group on Macroprudential Stance and builds on the **conceptual “risk-resilience framework” developed in Phase I** (ESRB, 2019). Within this framework, macroprudential stance is the balance between systemic risk and resilience relative to financial stability objectives, given implemented macroprudential policies; the stance metric represents residual systemic risk in the financial system, relative to a neutral level of risk considered sustainable in the long run.

Macroprudential policy can be represented as a risk management approach to safeguarding financial stability, in which policymakers assess the level of systemic risk compatible with financial stability and adjust their policies accordingly to achieve a neutral stance. This task requires operational methods to measure the components that inform the stance assessment. In line with the conceptual work, the data include indicators of systemic risk and financial stress (e.g. early warning indicators, financial market data), financial institutions’ resilience metrics (e.g. measures of leverage or bank capital), indicators of macroprudential policy actions and structural factors of the economy and the financial system. The key feature across all methodologies is to employ these indicators and examine them using analytical tools to obtain quantitative stance metrics. The analytical tools support policymakers in assessing whether implemented macroprudential policy instruments are too loose or too tight, serving as input for broader policy deliberations.

The proposed toolkit consists of three complementary approaches to evaluate macroprudential stance. Since they emphasise different aspects of risk and policy transmission, they provide different elements to the stance assessment. The use of a suite of approaches also offers flexibility, given the heterogeneous data availability across European countries and can provide robustness for cross-country comparisons. The approaches are:

- **Empirical growth-at-risk (GaR) approach.** In line with risk management considerations, this method forecasts the distribution of future economic growth. The resulting stance metric quantifies future impacts from current vulnerabilities and conditions of the financial system by focusing on the downside risks to growth distribution. Macroprudential policymakers may face a trade-off between limiting extreme negative tail realisations (benefits) and curtailing other parts of the future growth distribution (costs). This approach is especially useful for assessing the impact of variations in cyclical systemic risk over the medium term, as well as the impact of macroprudential policy, and for analysing economic unravelling during stress episodes.

- **Semi-structural approach.** The second method builds on a semi-structural approach for the banking sector based on a macro-micro model which combines macroeconomic dynamics with individual banking data. It derives trade-offs implied by capital buffers to absorb losses within the banking sector and downside risk to real gross domestic product (GDP). A main strength is the endogenous adjustment of bank balance sheets to macroprudential policies following financial shocks or policy implementations – which complements the GaR approach with a separate growth-based metric.

- **Indicator-based approach – relating systemic risk measures to policy stringency.** The third approach consists of an indicator-based aggregation of commonly used metrics for systemic risk and macroprudential policy, developed since the inception of the ESRB, to derive a residual risk and policy stringency metric. The indicators underpin past risk warnings and policy recommendations and are drawn from earlier ESRB reports.[1] The approach complements the growth-based metrics, as it is useful as a tractable tool for communicating stance in specific macroprudential policy areas, with applications to borrower-based and capital-based measures.

By providing quantitative results, the toolkit is intended to benefit the risk and policy discussions within the ESRB and national authorities. The approaches relate to common aspects in risk and policy deliberations and can be used jointly to highlight different aspects. For example, GaR estimations emphasise the risk balance surrounding future economic activity and can quantify the risk of economic reversals due to financial exuberance. The semi-structural approach provides indications of the transmission through the banking sector and how bank-based measures can mitigate negative feedback loops. In turn, the indicator-based approach contributes to the overall assessment over time and across countries, by employing commonly used metrics to capture imbalances and policies in specific sectors. The toolkit is also intended to benefit national authorities in their own analytical approaches, decision-making and – in the long run – external communication.

- **Given the relative youth of macroprudential policy analysis, the three approaches are meant as a basis for deepening discussions on macroprudential stance on analytical and policy dimensions.** The analytical methods will be further refined over time for specific applications relevant to the ESRB and its members. To further test and refine the approaches, they will be applied to selected risk and policy analyses in regular interactions among ESRB members so as to gradually phase them in for regular assessments by the ESRB.
- **The analysis and results in this report are also intended to strengthen the involvement of and interaction with the academic community.** With this in mind, the ESRB's Advisory Scientific Committee publishes a separate report on the macroprudential policy stance, providing considerations on its risk management function for the financial system. In the future, the ESRB intends to collaborate more closely with the academic community on methodological and policy-related aspects of macroprudential stance. The combined approach of involving national authorities and the academic community will help to develop the methodological framework before it becomes fully operational and part of the ESRB's official policy statements.

The country results in this report should not be considered the ESRB's current stance assessments until the approaches are fully implemented and mature. In particular, given the lack of practical experience with the approaches, the country results may be seen as illustrations of

[1] The Working Group on Real Estate Methodologies (WG-REM) developed a methodological framework for assessing both the risks in the residential real estate (RRE) sector and the policy actions implemented by national authorities to tackle the identified risks. RRE risks are analysed in a uniform way across EU countries based on a mechanical scoreboard complemented by country-specific information, while using indicators that are available for all EU Member States.

a stance metric and not conclusively as a desirable policy stance. Importantly, the estimates presented in the report do not include the most recent period and, as a result, do not incorporate the latest macroprudential policy measures. Since the stance framework uses multiple approaches with differing emphasis, it would not be surprising to discover slightly diverging assessments. In this context, the potential differences from the three approaches serve as the basis for further investigation via additional data and analysis, as well as by considering structural differences across countries – a process to be carried out in conjunction with ESRB authorities.

1 Macroprudential policy stance in the European context

1.1 The case for macroprudential policy stance

The ESRB's deliberations on systemic risk and macroprudential policy rely on an operational framework to guide the discussion on macroprudential policy stance. Such a framework supports macroprudential decision-making with analytical tools, mitigates potential inaction biases, helps communicate policy decisions to the public and increases accountability. By providing indications of the interactions between systemic risk assessments and macroprudential policy, it can help manage expectations about future macroprudential policy actions. The stance framework, with its common language, also provides a bridge to other macroeconomic policies – monetary and fiscal policies in particular – and particularly helps to ease policy coordination.

The macroprudential stance framework builds on the conceptual framework developed in Phase I of the Expert Group on Macroprudential Stance.[2] The conceptual part has identified components of the macroprudential stance and has linked the state of the economy and that of the financial system to macroprudential policies and its objectives. Within the "risk-resilience framework" macroprudential stance can be considered by assessing the balance between systemic risk and resilience relative to financial stability objectives given implemented macroprudential policies. The framework characterises macroprudential stance as a metric of the residual systemic risk in the financial system, relative to a neutral risk level defined by the policymaker. As a result, macroprudential policy is proposed as a risk management approach, in which policymakers assess the level of residual systemic risk compatible with financial stability. In implementing this approach, policymakers need a suite of operational stance metrics, which is the focus of this report.

The report outlines three complementary approaches for evaluating the macroprudential stance. The approaches are divided into growth-based metrics and residual risk and policy stringency metrics. The empirical growth-at-risk (GaR) approach and the semi-structural approach quantify the residual risk-based on the distributions of GDP growth forecasts. Although managing economic growth is not the direct objective of macroprudential policy, an absence of financial stability manifests itself in a higher likelihood of deep recessions. Thus, in line with the risk management approach, macroprudential policy involves containing risks and vulnerabilities to limit extreme downside tail realisations (benefit) while at the same time avoiding reductions in other parts of the future growth distribution (costs).[3] The growth perspective is complemented by sector-specific stance metrics combining residual risk and policy stringency. A specific application regards aggregated indicators for borrower and capital-based measures.

The approaches address challenges in the measurement of macroprudential stance, identified in Phase I, both on a conceptual and empirical level. They offer operational policy objectives embedded in the design of the stance metric and provide measures of systemic risk and

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[2] See ESRB (2019).

[3] An important school of thought proposes employing macroprudential policy to manage real GDP growth distribution, in particular downside risks (Brandao-Marques et al., 2020; Carney, 2020; Duprey and Ueberfeldt, 2020; Galán, 2020; European Systemic Risk Board, 2021; Suarez, 2021).

macroprudential policy. The approaches provide reference points for these aspects, but also offer flexibility to allow for differences in relative weights of mean growth and tail risk, or to incorporate specific indicators to capture structural differences across countries. For a holistic stance assessment, the model-based methods may be complemented with non-modelling approaches to account for limitations in the models (e.g. due to short time series). Such limitations will need to be acknowledged and taken into account in any policy applications of the stance methodology, while growing experience with macroprudential policy and additional data will further improve the empirical qualities of the models.

1.2 The methodological toolkit for stance assessments

The proposed toolkit consists of three complementary approaches to evaluate macroprudential stance. They emphasise different aspects of risk and policy transmission, thereby providing different facets to the stance assessment. The use of a suite of approaches also offers flexibility given the heterogeneous data availability across European countries and can provide robustness for cross-country comparisons. The approaches have different strengths and weaknesses (see also Table 1):

- **Empirical GaR approach.** In line with risk management considerations, this method forecasts distributions of future economic growth. The resulting stance metric quantifies future impacts from current vulnerabilities and conditions of the financial system by focusing in particular on the downside risks to growth distribution. Macroprudential policymakers may face a trade-off in limiting extreme negative tail realisations (benefits) and curtailing other parts of the future growth distribution (costs). This approach is especially useful for assessing the impact of variations in cyclical systemic risk over the medium term as well as the impact of macroprudential policy, and for analysing economic unravelling during stress episodes.

- **Semi-structural approach.** The second method builds on a semi-structural approach for the banking sector, based on a macro-micro model which combines macroeconomic dynamics with individual banking data. It identifies trade-offs implied by capital buffers to absorb losses within the banking sector and downside risk to real GDP. One of its main strengths is the endogenous adjustment of bank balance sheets to macroprudential policies following financial shocks or the implementation of macroprudential policies. This means that it complements the GaR approach with a separate growth-based metric.

- **Indicator-based approach relating systemic risk measures to policy stringency.** The third approach consists of an indicator-based aggregation of commonly used metrics for systemic risk and macroprudential policy, developed since the inception of the ESRB, to derive a residual risk and policy stringency metric. The indicators underpin past risk warnings and policy recommendations and are drawn from earlier ESRB reports.[4] The approach complements the growth-based metrics and is particularly useful as a tractable tool for

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communicating stance in specific macroprudential policy areas with applications to borrower-based and capital-based measures.

Table 1

Overview of the three stance approaches

Model	Empirical GaR model	Semi-structural model	Indicator-based aggregation
Features	• Model-based • Stance based on growth metric	• Model-based • Stance based on growth metric (other feasible metrics, e.g. capital)	• Indicator-based • Stance based on scoring metric
Strengths	• Results fully data-driven, no strong assumptions on preferences • Easily implementable • Growth-based metric & decomposition eases communication • Data easily available • Growth-based metric has economic underpinning	• Traces key transmission channels of macroprudential policy • Accounts for detailed policy features (calibration & buffer phase-in) • Growth-based metric has economic underpinning • Captures banking sector heterogeneity	• Uses well-known risk, resilience and policy indicators • Grounded in existing policy approaches (e.g. WG-REM) • Easy to understand and to communicate • Data easily available
Weaknesses	• Policy index does not account for stringency of policies • Limited in capturing transmission channels • Consistency with authorities' forecasts may be limited • Assumption of the model's functionality	• Results depend on the pre-specified transmission channels (others may be seen as relevant) • Focused only on bank capital policies and bank lending • Data availability (granular data needed)	• Thresholds rely on expert judgement and lack economic underpinning • Limited experience (short time series) • Challenge to aggregate across sectors for holistic assessment
Expected angle for use in policy analysis (ESRB)	Summary perspective	Feasibility to be investigated	Sectoral application

The tools emphasise specific aspects of the transmission of risks and macroprudential policies and can provide distinct stance assessments. The differences underline the importance of using more tools at the same time and using additional information and expert judgement to formulate a final assessment. Analysing the factors that contribute to the overall stance – and their potential discrepancies – is an important part of the policy work where additional information is helpful. Further work will match the (sectoral) applications of the different methods to the policy questions.

1.3 Use of the tools in European institutions

The toolkit is intended to benefit both the ESRB and national authorities. The Expert Group developed the tools in order to strengthen the ESRB's analytical assessment. However, the codes and guides are also available to all national authorities for implementation and further refinement in support of internal decision-making and external communication. The role of the ESRB and national authorities in assessing macroprudential policy stance may differ, with implications on the key choices of the toolkit design. The ESRB facilitates the development of consistent assessments of macroprudential policy stance in its Member States. Therefore, it will benefit from agreed methodologies for cross-country assessments, taking into account country specificities in a structured manner.

Stance tools are intended to enrich, and be enriched by, existing processes within the ESRB. The three approaches are designed to support the ESRB's risk and policy discussions by providing quantitative assessments on risks and macroprudential policy. They are intended to provide additional inputs to the existing processes within the ESRB, and not to replace them. Additionally, more targeted analyses and sound exercise of expert judgement remains essential. Through the practical use of these tools in regular risk and policy assessments, they can – and should – be further refined and developed.

National authorities can also benefit from the methodological and policy reference for their decision-making. The common stance toolkit can assess the extent to which policies in a given Member State are aligned with policies in other Member States. Investigation into the driving factors behind these differences may subsequently inform national authorities' decision-making. National authorities can further adapt and refine the toolkit to take into account specific domestic features that cannot be fully emphasised in the common reference specifications.

The following sections provide details on the respective approaches, including calibrations and preliminary country results. Section 2 describes the GaR-based approach for EU27 Member States developed by the Expert Group. Section 3 describes semi-structural models, using the Banking euro area sector stress test (BEAST) model developed by the European Central Bank (ECB) as an example of this class of models. Section 4 describes indicator-based approaches developed by the Expert Group for the assessment of borrower and capital-based measures in the EU27 Member States. Section 5 concludes with further guidance on the use of the methods in policymaking, with a focus on their use in the ESRB.

2 GaR estimation for the EU27

The GaR framework assesses macroprudential stance based on forecasts of GDP growth distribution using quantile regressions. Quantile regressions, introduced by Koenker and Basset (1978), offer a parsimonious and robust method to estimate the effects of explanatory variables such as systemic risk, financial stress or macroprudential policy on the projected GDP growth distribution. Unlike ordinary least squares regression methods, the approach can estimate the effect on the tails of the real economic growth distribution and can thereby capture the differentiated impact of financial conditions for upside or downside risks to GDP. Cecchetti and Li (2008), Adrian et al. (2019) and Chavleishvili et al. (2021) have all found that financial conditions have significant effects on downside GDP tail risk.

The focus on the distribution of forecasted real GDP growth allows macroprudential policy makers to assess and potentially manage future growth distribution at varying horizons. Although managing economic growth is not the direct objective of macroprudential policy, an absence of financial stability manifests itself in a higher likelihood of deep recessions.[5] Numerous authors, therefore, propose macroprudential policy to manage real GDP growth distribution and in particular downside risks (see Brandao-Marques et al., 2020; Carney, 2020; Duprey and Ueberfeldt, 2020; Galán, 2020; ESRB, 2020; and Suarez, 2021). Indeed, underlying financial vulnerabilities may have detrimental effects for future financial stability when shocks materialise. While macroprudential policy itself cannot affect the timing and size of these shocks, it can actively manage the risks associated with these shocks by implementing counteracting measures.

2.1 A stance metric based on GaR

2.1.1 Elements for macroprudential policy stance

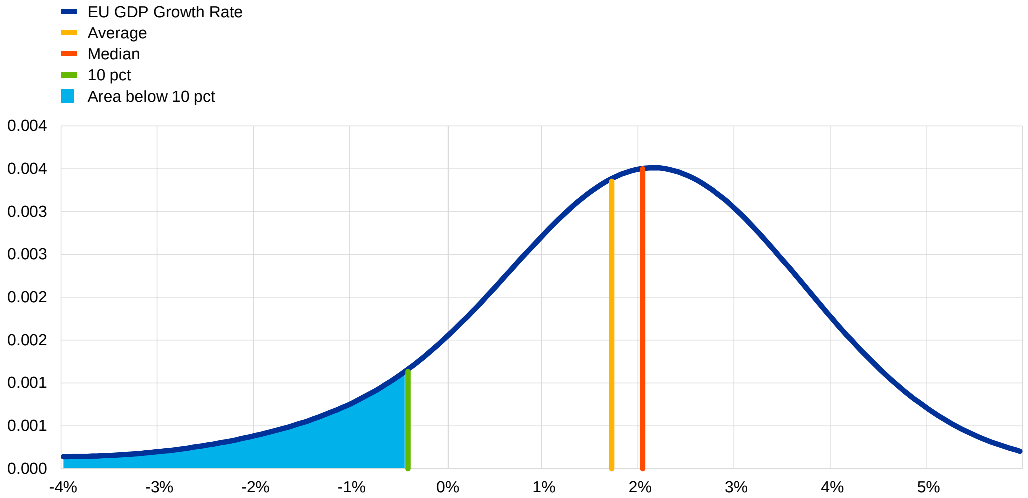
The conduct of macroprudential policy requires risks to real economic activity stemming from financial imbalances to be managed in a forward-looking manner. Periods of particularly low expected growth rates in the left tail of the distribution would indicate that downside risks to the economy are large. The (unconditional) historical average annual real GDP growth rate for the EU between 1995 and 2020 was 1.7% and -0.4% for the 10th percentile (Figure 1). A look at the overall EU growth distribution reveals a stronger downward tail (left skewness), reflecting the downside risks to the EU economy. These downside risks may be due to several factors and policies across countries. Heterogeneous productivity growth, demographic factors or other positive or negative economic and financial shocks, structural features may influence the growth distribution. For example, small open economies tend to be more strongly affected by external shocks and the structural features of banking systems may shape the transmission and potential amplifications of shocks.

5 Real GDP remains the key metric for economic activity; financial crises manifest themselves in large GDP losses. The focus of the estimation on real GDP growth is in line with the holistic approach to macroprudential policy. However, the methodology is equally applicable for specific sectors of the economy or specific financial transmission channels (e.g. credit growth). To capture the tail growth rate, we focus on the 10th percentile of the growth distribution.

Figure 1

Moments of real GDP growth distribution in the EU

(kernel density distribution of EU annual growth)



Sources: Eurostat and ESRB Expert Group calculations.
Notes: The moments of the distribution are computed on annual real GDP growth based on the available data since 1995. The heterogenous availability across countries also underpins the available data structure in the estimation.

Financial imbalances, structural features and macroprudential policy are only three of the factors which have an impact on growth distribution. As low growth rates in the tail of the distribution may be related to factors outside of the scope of macroprudential policy, it is important to identify the drivers in the macroprudential realm. The GaR estimation framework aims at identifying and quantifying the impacts on the growth distribution related to systemic risk, financial stress and macroprudential policy. If detrimental outcomes to the growth distribution are driven by financial imbalances that macroprudential policy can influence, the macroprudential stance would be considered loose. To further formalise the risk management aspect of macroprudential policy, the “stance space” helps to relate the median to the tail of GDP growth.

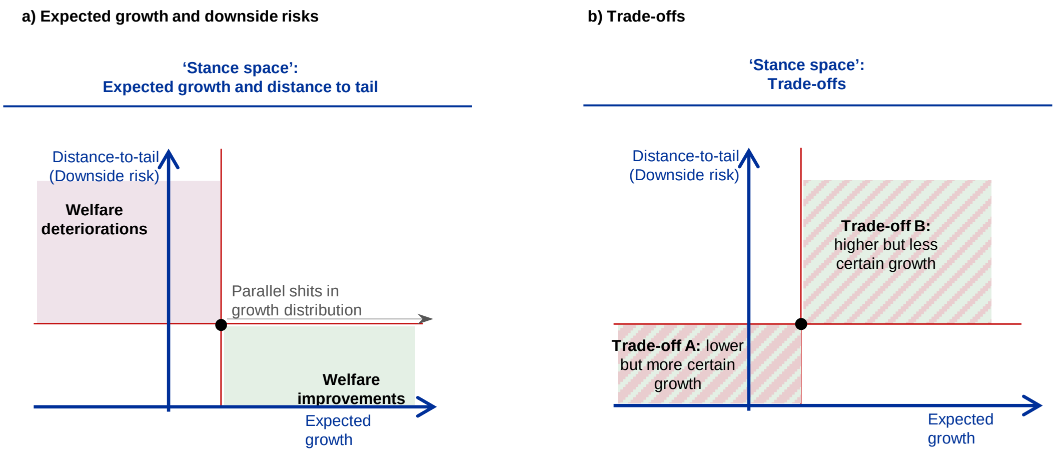
2.1.2 Monitoring stance within the stance space

The stance space can help to analyse the vulnerabilities of the real economy relative to its expected growth by relating the median to the tail of the growth distribution. As a result, it transposes risk-return considerations from the asset pricing literature to the macro-financial domain and offers a risk-growth metric. In the context of GaR estimations, the stance space illustrates the forecasted growth outlook together with the distance to the tail captured by the 10th percentile.

The stance space illustrates the trade-offs by macroprudential policymakers, managing risks surrounding the outlook for economic growth. Figure 2 illustrates the stance space in which countries can be placed according to their specific growth outlook (x-axis) and their distance to the tail (y-axis). Movements to the right from this position indicate higher expected growth at constant distance-to-tail, i.e. with unchanged downside risks. Instead, downward movements reduce downside risks at unchanged expected growth.[6] These two movements taken together span an area of welfare improvements relative to the initial position (bottom right in panel a), whereas adjustments of the growth distribution in the opposite direction would entail welfare deteriorations. The stance space also identifies combinations that represent trade-offs between expected growth and downside risks (panel b). The bottom-left corner implies lower downside risks at the expense of lower expected growth whereas the top-right corner captures higher expected growth but with larger downside risks.

Figure 2

Stance space – expected growth and downside risks



Source: EG Macroprudential Stance.

Notes: Distance-to-tail is a measure of downside risk (uncertainty). In the estimation framework, it is captured by the difference between the median and the 10th percentile. Panel a: lower welfare is achieved via a shift to the top-left and higher welfare via a shift to the bottom right; panel b: the stance space also illustrates trade-offs between expected growth and growth in the tail of the distribution).

The specific trade-off policymakers would consider appropriate depends on structural macro-financial features, the effectiveness of macroprudential policy and the aversion of policymakers to downside risks. Risk-neutral policymakers would focus on maximising expected growth, disregarding any potential trade-offs for the tail of the distribution. Welfare improvements would be represented by shifts to the right, independent of any vertical movements. In turn, an infinitely risk-averse policymaker would aim at lowering downside risks, thereby reducing distance-to-tail (downward movements), independently of the implications for expected growth. The specific trade-off which policymakers would find acceptable will depend on the tolerance for downside risks, but also on the effectiveness of macroprudential policy instruments to counteract changes in expected and tail growth from macro-financial shocks.[7]

The distance-to-tail as the main stance metric has the advantage of focusing on the relative importance of risks embedded in the lower tail of the growth distribution, relative to its central tendency. It implicitly reflects the objective of maintaining the shape of the forecasted growth distribution, while accounting for the fact that the distribution may shift in its entirety for

6 This is achieved by symmetrically reducing uncertainty of the distribution surrounding expected growth.

7 See derivations for a normative distance-to-tail from micro-foundations together with discussions on the role of risk preferences in Suarez (2021) and European Systemic Risk Board (2021).

factors outside of the macroprudential policy remit. Using distance-to-tail as the main stance metric, a tighter stance is characterised by lower distance-to-tail (reduced downside risks) relative to a reference distance. Although this can be the result of lower systemic risk or financial stress relative to the prevailing macroprudential policies in place, it may also result from tighter macroprudential policy at given risk and stress values. In either case, macroprudential policy would be too tight given the economic and financial environment. The metric is independent of parallel shifts in the growth distribution – due to such things as changes in long-term demographic trends – and does not alter the stance assessment. In addition, it particularly lends itself to cross-country comparisons, where countries have heterogeneous structural factors and long-term growth rates. The subsequent focus for the stance assessment will therefore be on distance-to-tail and will be complemented by separate implications on expected growth where this is useful.

2.2 Empirical model

While a normative distance-to-tail would be desirable to assess macroprudential stance, an empirical approach can single out the contributions of the main factors that influence macroprudential stance. The econometric GaR model estimates the impact of systemic risk, financial stress and macroprudential policy on the GDP growth distribution up to sixteen-quarters ahead in a country panel. These three types of variables constitute the key components for macroprudential stance considerations.

The reference GaR specification is an unbalanced panel with country fixed effects for 27 countries estimated between the first quarter of 1999 and the fourth quarter of 2019 and recursively assessed out-of-sample. While the quantile estimation can estimate the entire distribution of forecasted real GDP growth over any horizon, the focus is on the median (as a proxy for expected growth) and the 10th percentile (as proxy for the tail) eight-quarters ahead.[8] To obtain a stance metric comparable across time and countries, the panel accounts for structural features of the economies across countries not only by applying country fixed effects but also by explicitly considering interactions of structural variables with other regressors.[9]

An estimated stance metric based on the panel quantile regressions lends itself to applications in ESRB risk and policy deliberations. It specifically addresses questions of the type: What is the short and medium-term impact of systemic risk on the outlook of the real GDP growth distribution? How does financial stress amplify vulnerabilities and how can macroprudential policies enhance financial stability? By providing answers to these questions, the GaR framework aims to identify key aspects of the transmission of systemic risk and macroprudential policy, and their quantitative contributions to the overall policy stance.

The use of GaR for the stance assessment requires four steps: the selection of input data, the estimation of effects on GDP growth, the computation of stance metrics and the country-

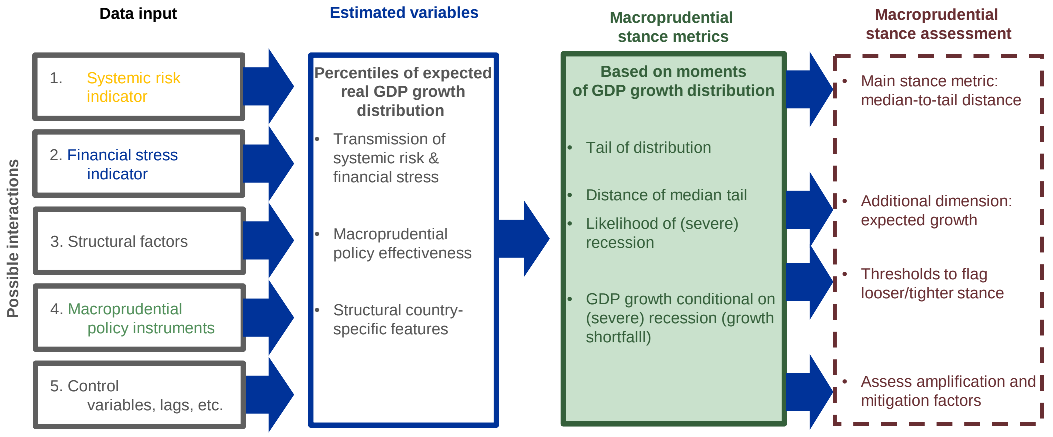
[8] The choice of eight quarters balances forecast accuracy over the shorter-term horizon and the importance of the longer-term horizon for the transmission of financial imbalances and policy.

[9] Technically, the specifications considered account for country fixed effects which separate out unknown structural features that shape the GDP growth distribution from those that can be explained by the variations in the regressors. A second specification explicitly considers openness and the concentration of lending by banks through their interaction with systemic risk. A third specification, with structural variables but without country fixed effects, is omitted here given the more limited cross-country application. Only a few structural variables combine these characteristics of (i) varying over time, (ii) covering a sufficiently long time period for the countries considered, and (iii) being of macroprudential relevance.

specific stance assessment based on specific thresholds (Figure 3). The input data (explanatory variables) consist of a systemic risk indicator (SRI), a financial stress indicator (Country-Level Index of Financial Stress or CLIFS), a measure of macroprudential policy and structural variables (size, openness, bank concentration, etc.). Each of these variables is computed at the country level and enters the panel quantile regression across 27 countries to estimate the median and tail (10th percentile) of the real GDP growth distribution averaged over an eight-quarters horizon.[10]

Based on the forecasted growth distribution, the median-to-tail distance serves as the main metric for macroprudential stance. The ESRB (2021) has also proposed the use of the distance-to-tail metric. The framework allows alternative metrics to be computed, where needed, and estimates of the likelihood and severity of GDP contractions to be produced. In a final step, the stance metrics are normalised to serve cross-country comparisons over time and thresholds provide indications for signalling whether a tighter or looser stance is appropriate. The individual indicators used as variables are discussed in turn below.

Figure 3
Methodological components for macroprudential stance assessment based on GaR



Source: ESRB Expert Group on Macroprudential Stance.

2.2.1 Systemic risk and financial stress indicators

GaR estimation frameworks have used financial conditions indices to summarise a range of financial variables that influence the real economy. When employing financial conditions indices for growth forecasts, studies generally find a short-term effect of FCIs on real GDP growth. Adrian et al. (2019) use the National Financial Conditions Index (NFCI) constructed by Brave and Butters (2011) and find that shocks to the NFCI have strong negative effects on economic activity. IMF (2017) and Aikman et al. (2019) find similar results based on a Financial Conditions Index (FCI) by Koop and Korobilis (2014) for many countries. Aikman et al. (2019) include a broader set of vulnerability indicators that contain measures of credit growth, external deficits and house price

[10] A shorter time horizon would increase forecasting accuracy with the potential risk of assessments chasing short-term movements in the data. For robustness, the Expert Group also tracked implications for shorter and longer horizons and covered one, four, eight, twelve and sixteen quarters.

growth, in addition to the FCI. These types of indicators are commonly used to measure build-up of financial vulnerabilities. Using this broader set of indicators, the authors find a relationship between increasing medium-term tail risks to growth and rapid credit growth, house price growth and large current account deficits.

The estimation framework for macroprudential stance differentiates indicators of systemic risk that reflect the build-up of financial vulnerabilities and indicators of financial stress that capture the materialisation of risk. This distinction is useful to capture periods of elevated vulnerability (systemic risk), in line with the early warning literature, and periods in which risks have materialised, reflected in stress episodes with larger asset price volatility, interest rate spreads and deteriorated risk sentiment. Three commonly used indicators have been initially considered to measure financial stress for the stance framework:

(i) Financial Conditions Index (FCI) by Koop and Korobilis (2014);

(ii) Composite Indicator of Systemic Stress (CISS) by Holló et al. (2012);

(iii) Country-Level Index of Financial Stress (CLIFS) by Duprey et al. (2017).

The estimation used the following indicators to measure the build-up of financial vulnerabilities.

(i) Systemic risk indicator (SRI) by Lang et al. (2019).

(ii) Financial stability risk index (FSRI) by Deghi et al. (2018).

(iii) Basel gap, calculated as the deviation of credit-to-GDP ratio from its long trend – calculated in accordance with Basel Committee on Banking Supervision guidelines.[11]

The chosen indicators for the panel of EU countries needs to be available for a wide range of countries over a long period of time with good prediction abilities of the tail of the GDP growth distribution. The forecasting ability of the indicators are assessed using the tenth percentile of the eight-quarters-ahead average real GDP growth based on recursive out-of-sample evaluation using the loss function of the panel quantile regression[12] and a measure of goodness of fit using the Pseudo R2 by Koenker and Machado (1999). In this comparison the CISS, either combined with the SRI or the Basel gap, provides good forecast performances across the two metrics (Table 1). However, the CISS is a euro area-wide indicator. To capture country developments the GaR specification of choice uses the similarly constructed CLIFS as it provides information at the country level.

[11] Additional details on the indicators and the estimation results can be found in Annex 1.

[12] Recursive out-of-sample evaluation, based on the loss function of the panel quantile regression, aimed at selecting the specification with the lower loss in predicting the specified quantile of real GDP growth h-quarters ahead. The window used for the recursive out-of-sample evaluation was from the first quarter of 2008 to the third quarter of 2016.

Table 1

Performance of combinations of systemic risk and financial stress indicators

Risk indicator	Stress indicator	Loss ratio	Pseudo R2
SRI	FCI	.8219 (5)	.2273 (7)
	CISS	.7760 (2)	.3617 (1)
	CLIFS	**.8209 (4)**	**.2980 (3)**
FSRI	FCI	.8429 (6)	.1902 (9)
	CISS	.9942 (8)	.2448 (5)
	CLIFS	1.004 (9)	.2235 (8)
Basel gap	FCI	.7448 (1)	.2282 (6)
	CISS	.8196 (3)	.3041 (2)
	CLIFS	.8677 (7)	.2609 (4)

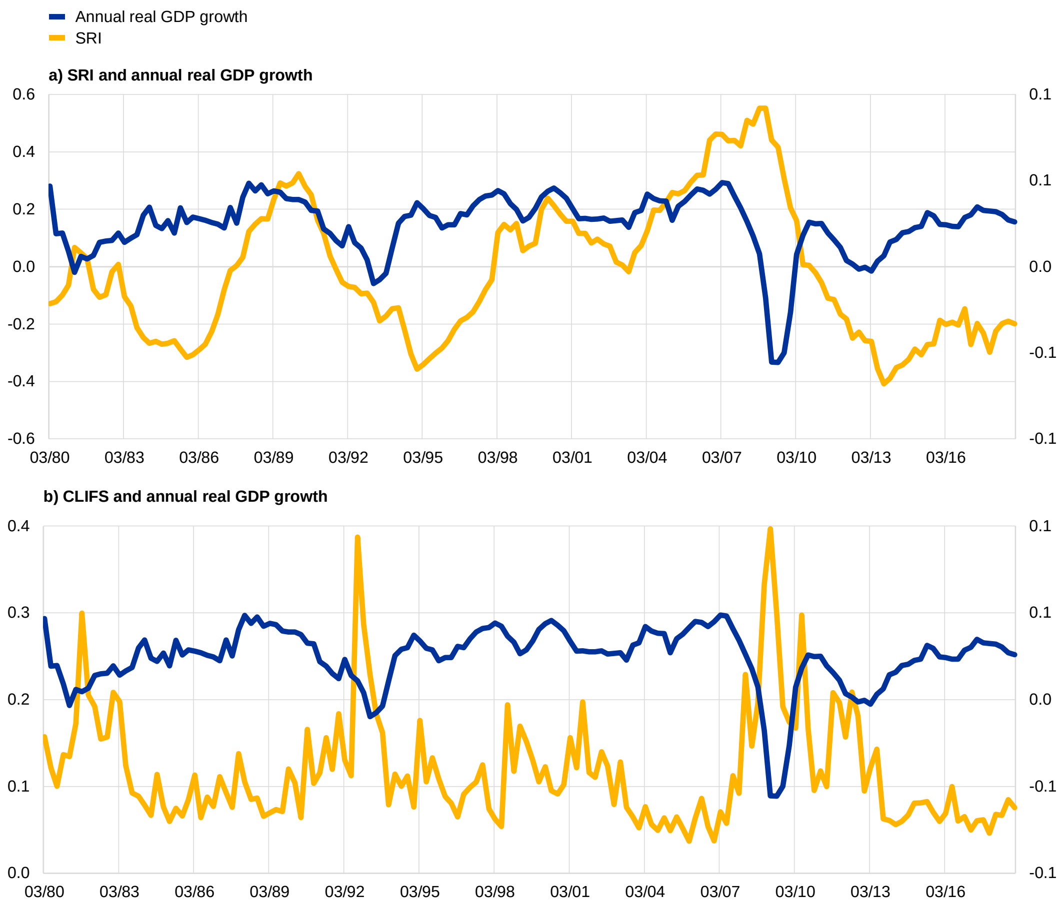
Notes: Results based on a regression with one risk and one stress indicator, and GDP and lagged GDP growth as control variables for predicting the 10th percentile of average annual GDP growth eight-quarters ahead. The loss ratio is a measure of good prediction properties using a recursive out-of-sample evaluation (from Q1 2008 to Q3 2016), based on the loss function of the panel quantile regression and normalised using a regression with controls only. A value of 1 implies the indicators provide no additional information for forecasting.

Based on the forecasting performance and the preference for country-specific indicators, the specification considered includes the SRI as systemic risk indicator and the CLIFS as financial stress indicator. The SRI combines individual indicators of systemic risk with good early warning properties three to four years ahead of European financial crises (Lang et al., 2019). The indicators are selected from among a large set of ESRB risk categories of credit developments, property prices, private sector debt burden, mispricing of risk and external imbalances.[13] The composite indicator is a weighted average of the six best performing early warning indicators, it includes the two-year change in bank credit-to-GDP ratio (with a weight of 36%), the current account-to-GDP ratio (20%), the three-year change in residential real estate (RRE) price-to-income ratio (17%), the three-year growth rate of real equity prices (17%), the two-year change in debt service ratio (5%), and the two-year growth rate of real total credit (5%). In turn, the CLIFS (Duprey et al., 2017) assesses stress by capturing developments in three financial market segments: (i) equity markets: stock price index, (ii) bond markets: ten-year government yields, and (iii) foreign exchange markets: real effective exchange rate, computed as the trade volume-weighted geometric average of bilateral exchange rates. To account for inflation differentials, the stock prices and government bond yields are inflation-deflated.

[13] See Recommendation ESRB/2014/1 on guidance for setting countercyclical buffer rates and specifically Recommendation C on guidance on variables that indicate the build-up of system-wide risk associated with periods of excessive credit growth.

Chart 1

Systemic risk, financial stress and real GDP growth



Source: European Central Bank. Notes: Lines indicate the median of the indicators across EU countries (unbalanced panel). The estimation framework employs the individual country series. The scale of the SRI represents the deviation from the historical median expressed in multiples of the historical standard deviation. Real GDP growth is in percentage points. CLIFS is a pure number normalised to lie between 0 and 1.

The systemic risk and financial stress indicators differ in their effect on future real GDP growth. The SRI captures the variations in financial imbalances and vulnerabilities, predominantly with medium-term effects on real GDP growth (Chart 1, panel a). This reflects the early warning properties of its six sub-indicators to provide signals for European financial crises.[14] The CLIFS, as an indicator for the materialisation of financial stress, has short-term implications for real GDP growth, spiking during systemic crisis events accompanied by extreme negative outcomes of real GDP growth (Chart 1, panel b). Taken together, the two are useful indicators of the financial conditions that affect the short to medium-term forecast of real GDP growth distribution and can provide indications of the term structure of systemic risk.

[14] Indicators are normalised by subtracting the median and dividing by the standard deviation of the pooled indicator distribution across countries.

2.2.2 Macroprudential policy measures

The GaR estimation framework considers macroprudential policy measures by distinguishing between capital-based and borrower-based measures (BBM). The macroprudential policy indexes (MPIs) for these two different measures are constructed building on the Macroprudential Policies Evaluation Database (MaPPED; Budnik and Kleibl, 2018). The "dummy-type" indices are obtained by assigning +1 for tightening and -1 for loosening policy decisions, in line with other studies.[15] The cumulative MPI for country i used in the quantile regression is obtained by dynamically accumulating the net macroprudential changes $m_{i,t}$ from tightening and loosening within each quarter:

$$MPI_{i,t} = MPI_{i,t-1} + m_{i,t}$$

The cumulative MPI implies that each policy change has permanent effects on the indicator's level until macroprudential takes a reverse decision, deactivates the original decision or compensates it by loosening other borrower or capital-based macroprudential policies. A visual inspection of the cumulative MPI series[16] reveals a growing frequency of macroprudential policy actions starting with the global financial crisis, especially for capital-based measures. As regards borrower-based instruments, a marked cross-country heterogeneity can be observed, with a more frequent use in central and eastern European countries and Greece relative to other countries. As a result of the more numerous tightening decisions, the resulting cumulative MPI is upward trending. To overcome a potential econometric problem from non-stationarity, the MPI is applied as a twenty-quarter difference to emphasise changes in the cumulative MPI (see also Boar et al., 2017, and Claessens et al., 2021, for a similar choice). In the empirical framework, this transformation measures the effects of macroprudential policy decisions over the last five years as the effects of macroprudential measures on GDP growth may require time to unfold (Akinci and Olmstead-Rumsey, 2018). Additional robustness assessments have been conducted to evaluate alternative transformations and policy variables in which the marginal effects of the macroprudential policy remained very similar.[17] The choice of the macroprudential index involves challenges and limitations for interpretation and policy use:

- **Measurement: extensive vs. intensive margin**.

  The MPIs reflect the extensive margin of macroprudential policy as it measures frequency and direction of macroprudential policy decisions but does not capture the intensity of the policy itself (Akinci and Olmstead, 2018; Meulman and Vander Vennet, 2020). It thus falls short of

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15 Claessens et al. (2013), Cerutti et al. (2017), Bruno et al. (2017), Altunbas et al. (2018), Akinci and Olmstead-Rumsey (2018), Gambacorta and Murcia (2019), Poghosyan (2020) and Everett et al. (2021) are studies using similarly constructed MPIs. The MPI is constructed in such a way that, when several interventions occur within the same quarter, they are summed for that specific quarter. For example, if two tightening measures are implemented within one quarter, the MPI takes the value 2, if a tightening and a loosening measure are implemented the resulting MPI indicates no change. If the intervention is characterised in MaPPED as "other or with ambiguous impact" it is assigned the value of 0. Further details on the construction of the macroprudential policy indicators are provided in the Annex.

16 The Annex reports the cumulative capital and borrower-based MPI for individual EU countries together with the combined buffer requirements in the corresponding country.

17 These include linear detrending of the accumulated MPI, either as country-specific trends or as a trend across countries. Additionally, to account for the resilience of the financial system, we conducted robustness assessments using two additional specifications that each included an additional variable: one with the aggregate leverage ratio and another with the aggregate CET1 ratio of the national banking sector.

quantifying the size (or intensity) of policy adjustments on such things as capital ratios or lending restrictions in the form of loan-to-value ratios for BBM. The measurement of the intensive margin of macroprudential measures is challenging, given the diversity of policy tools and their specific implementations across countries, and also because they tend to be only occasionally binding and aggregation across binding constraints is not feasible. Thus, the construction of a fully quantitative policy indicator that captures both margins remains an important step for development. Nevertheless, for capital-based measures, a regression of the official combined buffer requirements (CBR) on the accumulated MPI indicates that, on average, a capital-based macroprudential policy corresponds to CET1 capital of 0.87 of risk weighted assets.[18]

- **Identification of the macroprudential policy effects and endogeneity**.

  The panel estimation may be subject to three recurrent econometric limitations, relevant for policy interpretations:[19]

  - **Endogeneity:** Reduced-form regressions cannot estimate the endogenous changes of macroprudential policy to economic and financial conditions measured by other indicators. It may further be subject to "reverse causality" by which policy measures are adopted to counteract financial imbalances ahead of downturns caused by financial stress, giving rise to an erroneous inference of macroprudential policy on growth.

  - **Direct versus indirect transmission channels:** A direct MPI effect is at work if it affects GDP by curtailing consumption or investment activities, whereas an indirect channel arises if macroprudential decisions affect GDP growth via their effects on the measure of systemic risk. For example, an increase in capital requirements may improve loss-absorbing capacity and reduce risk-taking in the banking sector, thereby muting credit asset price growth and implicitly the SRI. Empirically, the direct and indirect effects on GDP growth can be identified with a two-stage procedure. Based on this procedure, the direct channel is quantitatively more important than the indirect channel, but the latter remains non-negligible (see Box 1).

  - **Historical pattern of macroprudential policy measures:** Macroprudential policy has evolved as a self-standing policy area following the global financial crisis. While some policy measures may be defined as macroprudential policy, systemic measurement only exists after 2010 and the use of macroprudential measures is concentrated in the time since then. Such historical clustering may generate a bias in the deployment and effectiveness of macroprudential measures, given the specific economic and financial conditions experienced in this period, and so may limit the validity of empirical results.

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[18] The resulting relationship is based on an unbalanced panel regression covering the EU countries for which the CBR is available. In particular, the CBR is regressed on the contemporaneous level of the accumulated capital-based MPI.

[19] A further source of concern relates to the potential omission of controls for any shocks contemporary to the adoption of the macroprudential measure, such as those arising from monetary policy actions - which can react in response to the developments of cycles.

Box 1

Direct and indirect channels of macroprudential measures

Macroprudential measures are implemented to mitigate the build-up of systemic risks and/or to strengthen the resilience (loss-absorbing capacity) of the financial system. If these measures are effective, they will affect the levels of systemic risk and financial stress in the economy. Accordingly, macroprudential policy actions can affect the real GDP growth distribution – either directly or indirectly – via its effect on systemic risk and/or financial stress. The reference specification for growth-at-risk (GaR) only reveals the direct channel. While the estimated direct channel may suffice for specific applications it may omit a potentially important transmission channel being part of the effectiveness of macroprudential policy. The omission may particularly affect policy counterfactuals in which the indirect transmission channel should be accounted for.

To account for the indirect transmission, this box considers a two-stage procedure to estimate the overall effect of macroprudential policy actions on the distribution of GDP growth. The first stage derives the component of the SRI and the CLIFS which is not attributable to changes in the MPI. In this way, the headline values of the SRI and the CLIFS are purged from the effects of past macroprudential policies. To achieve this, we regress the SRI and the CLIFS on four lags of the capital-based, as well as the borrower-based, MPI. Each MPI corresponds to the twenty-quarter-change of the corresponding cumulative policy indicator. The residuals, denoted by Rsri and Rclifs, reflect those movements in the indicators which are not explained by movements in the macroprudential policy indicators. The first-stage regression results indicate that a tightening of macroprudential policy measures has a small significant negative effect on systemic risk (SRI) (see Table A). In contrast, only capital-based measures exert a significant negative effect on the CLIFS.

Table A
Impact of MPI on SRI and CLIFS

	SRI/CLIFS and MPI	
	(1)	(2)
Dependent variables:	SRI	CLIFS
mpi_cb *(t-1)*	**-0.0407***	**-0.00686***
mpi_cb *(t-2)*	-0.000330	0.000186
mpi_cb *(t-3)*	0.00169	0.00125
mpi_cb *(t-4)*	0.00569	-0.00177
mpi_bb *(t-1)*	-0.0411	-0.00514
mpi_bb *(t-2)*	0.0275	0.00214
mpi_bb *(t-3)*	0.0214	0.00125
mpi_bb *(t-4)*	**-0.0541***	-0.00162
Constant	-0.0735	0.156***
Observations	1,306	1,400
R2	0.026	0.020
Number of country_id	28	28

*** p<0.01, ** p<0.05, * p<0.1

Notes: Linear regressions with country fixed effects. The sample includes all EU countries as well as the United Kingdom and covers the period 2007-20. "mpi_cb" - capital-based MPI; "mpi_bb" - borrower-based MPI. Both cumulative MPIs are transformed into twenty-quarter differences.

In the second stage, the SRI and the CLIFS in the baseline equation are replaced by their purged counterparts: $\mathrm{Q}^{\tau}_{\mathrm{GDP}_{t+h}} = \beta^{\tau}_1 \mathrm{Rsri}_t + \beta^{\tau}_2 \mathrm{Rclifs}_t + \rho^{\tau}\mathrm{MPI}_t + u^{\tau}_{t+h}$.[20] The coefficient ρ^{τ} measures the overall effect of changes in the macroprudential policy indicator MPI on the the τ-th quantile of the GDP distribution h-quarters ahead. Relative to the reference specification, the coefficients while gaining only slightly in magnitude, become more positively significant. This effect is especially pronounced in the case of the capital-based MPI. Charts A and B illustrate this for the case of the coefficients on capital-based and borrower-based MPIs considering only the direct effects in the reference specification (panels a and c) or the combined effect of direct and indirect effects (panels b and d).[21]

The second-stage results indicate that changes in macroprudential policy are mainly transmitted directly to the quantiles of the future GDP growth distribution. However, the indirect channel operating through the effects of MPI on systemic risk (SRI) and/or financial stress (CLIFS) is also non-negligible. It works towards strengthening the link between macroprudential policy changes and GDP growth. An empirical explanation for the nevertheless small limited indirect channel is provided by the first-stage regression results (Table A) which indicate that, while being significant, the two MPIs have a very low explanatory power for the SRI and the CLIFS as indicated by the low

[20] Country fixed effects and interaction terms between the individual variables are also included in the quantile regression.

[21] The estimates are based on a sample covering the 27 EU countries and the United Kingdom over the period 2007-20.

R^2. Accordingly, the cyclical behaviour of the purged versions Rsri and Rclifs is almost the same as that of their underlying SRI and CLIFS.

Chart A

Regression coefficient of capital-based MPI with and without indirect effects

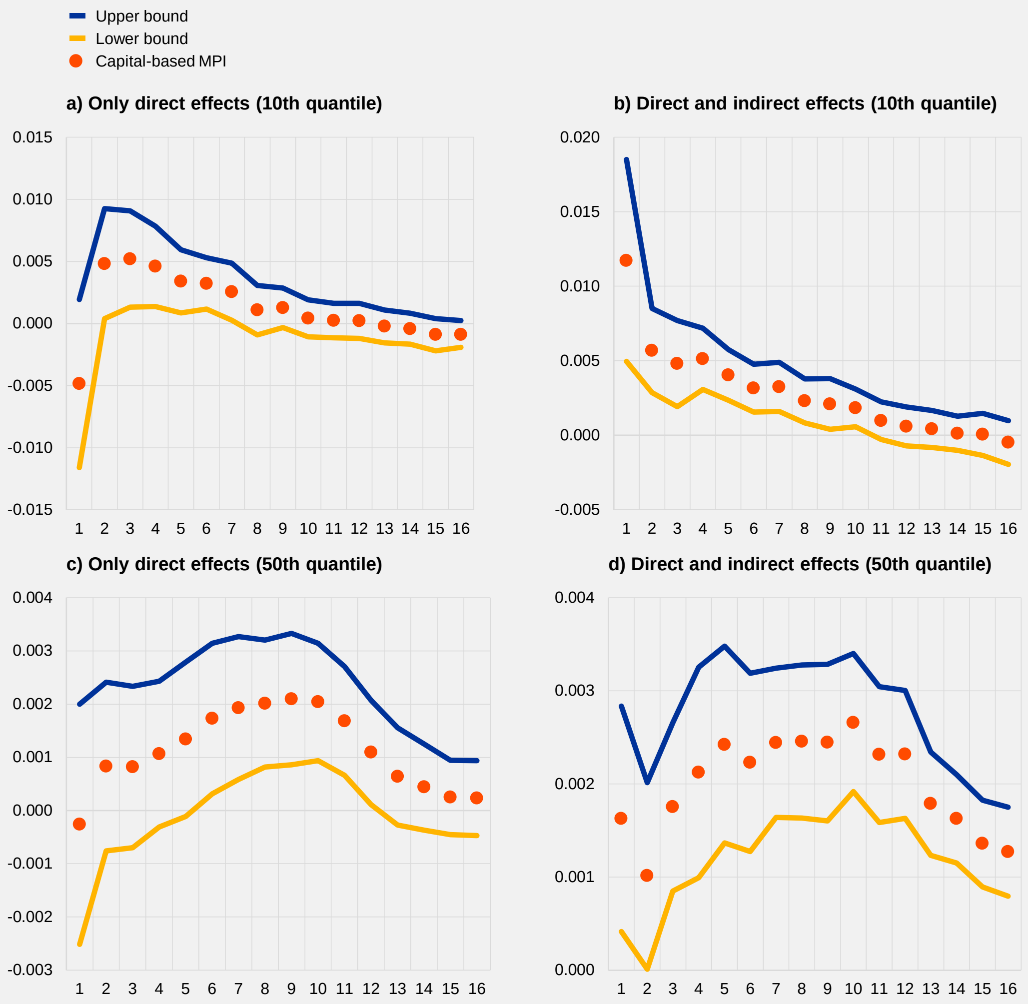
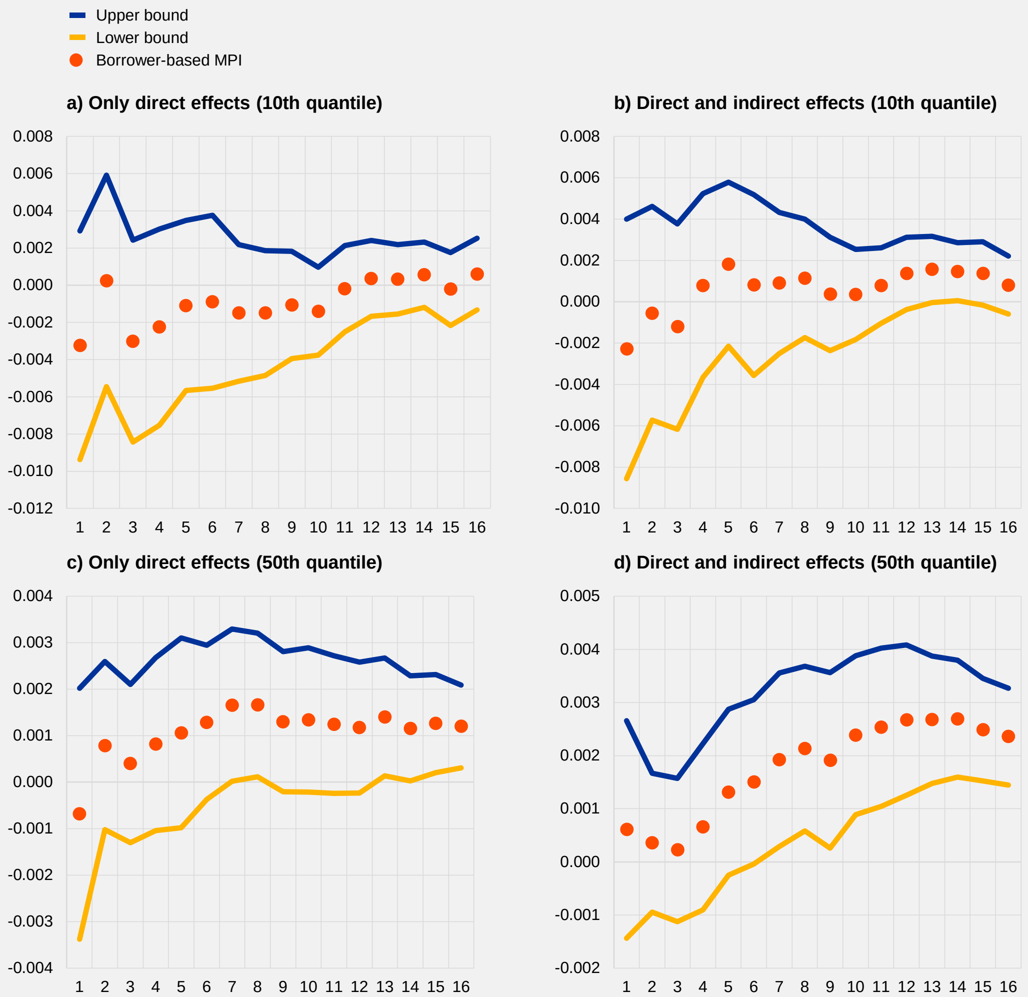


Chart B

Regression coefficient of borrower-based MPI with and without indirect effects



Source: ESRB Expert Group on Macroprudential Stance.
Notes: Coefficients of capital-based MPI (Chart A) and borrower-based MPI (Chart B) in panel quantile regressions of the 10th and the 50th GDP growth quantile on the MPIs as well as SRI, CLIFS and lagged GDP growth. Left column – direct effect of MPIs on GDP growth quantiles, i.e. based on the actual SRI and CLIFS. Right column – overall effect of MPIs on GDP growth quantiles, i.e. based on "purged" SRI and CLIFS. Unbalanced panel covering 27 EU countries.

2.2.3 Structural variables

Macro-financial structures in European countries are relevant for the assessment of macroprudential stance because they may be affected by different financial shocks which may differ in their transmission. Certain countries (e.g. small open economies or those with concentrated banking system exposures) may be relatively more exposed to specific financial shocks. Given potentially differing transmission, these same economies may exhibit relatively higher tail risk through the financial cycle than their larger, less open and less concentrated counterparts. Consequently, the macroprudential policy stance of countries sharing similar macro-financial structures may, of necessity, differ from country groups with other structures.

Understanding what those characteristics are, and the extent of the role they play in determining tail GDP growth, forms part of the remit of the working group. The structural characteristics examined for the assessment of stance fall into two broad categories:

- **Macroeconomic factors:** economic size, trade openness, sovereign debt level and dependency upon foreign direct investment;
- **Banking system factors:** size (relative to GDP), concentration by market sector (Herfindahl-Hirschman Index), as well as share of total banking system assets held by the largest three or five banks.

By considering a structural factor in the regression, parts of the time-varying underlying structural features of the financial system and the economy are accounted for. The time-invariant structural features remain embedded in the country fixed effects of the panel estimation. We think that in the macroprudential stance context this approach is most relevant for the transmission of systemic risks.

Table 2

Structural variables considered and their summary statistics

Structural Variable	No. of Observ-ations	No. of Countries	Avg. No. of Quarters	Panel Mean	Panel Standard Dev.	Panel Max	Panel Min
GDP share (Small Country Effect)	2903	28	104	0.07	0.12	0.60	0.00
Trade Openness	2810	28	100	0.28	0.16	1.07	0.08
HH Index (Bank Conc. - Market Share)	2268	28	81	0.11	0.08	0.41	0.01
Bank Concentration (3 bank share)	2394	28	86	69.08	16.81	100.00	25.70
Bank Concentration (5 bank share)	2268	28	81	59.67	18.66	99.36	16.68
Govt. Debt to GDP Ratio	3925	28	140	54.20	32.49	182.31	3.44
Debt Service Ratio	3143	28	112	0.00	0.02	0.15	-0.13
FDI to GDP Ratio	308	22	14	76.04	76.47	338.85	12.61

Source: ESRB Expert Group on Macroprudential Stance.
Notes: Source data taken from the ECB's Statistical Data Warehouse. Panel coverage runs from Q1 1970 to Q3 2019, where data are available. Coverage for some structural variables is not available until later, as the table illustrates.

To identify the effects of structural factors within the stance context, they need to (i) vary over time, (ii) cover a sufficiently long time period, and (iii) be of macroprudential relevance. Only a few structural variables combine these characteristics. As a result, this approach can be viewed as a complementary approach to quantify the contribution of specific structural variables to the GDP growth distribution. Among the indicators that combine all three characteristics, the concentration of bank exposures measured by the Herfindahl-Hirschman Index (HHI) is statistically significant for tail risk through the term structure of growth forecasts and, under certain prevailing systemic risk conditions, it amplifies downside risks to growth. It is also economically and financially relevant as a high bank exposure concentration fails to diversify credit extension and therefore is likely to spread risk throughout the financial system and to the economy, further increasing downside risk. The implication of this is that macroprudential policy will have to take into account the effect of this country specificity in its design and implementation.

2.2.4 Estimation results

The estimation results for the panel regression provide indications of the impact of systemic risk, financial stress, macroprudential policy and structural variables on the forecasted growth distribution. The econometric results are combined into two sets of results. The first set provides the estimated coefficients on all variables on the 10th percentile and the median within the panel regression. The second set focuses on the term structure of systemic risk, financial stress and macroprudential measures – i.e. the marginal effect of a shock over time. Table 3 provides an overview for the eight-quarters-ahead horizon across the reference specification without country-specific factors and one with structural variables.

Table 3

Key estimation results from the main specifications for eight-quarters ahead

(dependent variable: average annualised real GDP over eight-quarters ahead at 10th percentile and median)

		Reference specification 10th pctle	Reference specification median	With structural factors 10th pctle	With structural factors median
Risk and stress	SRI	**-.0233***** (.0042)	**-.0062*** (.0035)		
	CLIFS	-.0146 (.0142)	**-.0276**** (.0109)	-.0135 (.0127)	**-.0295***** (.0111)
	SRI x CLIFS	**.0376*** (.0204)	**-.0284*** (.0167)	.0032 (.0169)	-.0242 (.0160)
Macroprudential policy	Borrower-based MPI	-.0018 (.0018)	.0002 (.0008)	**-.0029*** (.0017)	.0002 (.0008)
	Borrower-based MPI x SRI	**-.0028**** (.0013)	.0003 (.0008)	-.0023* (.0012)	.0004 (.0008)
	Borrower-based MPI x CLIFS	**.0145**** (.0071)	**.0107*** (.0062)	**.0164**** (.0077)	.0089 (.0059)
	Capital-based MPI	.0013 (.0010)	.0005 (.0005)	.0008 (.0009)	.0001 (.0005)
	Capital-based MPI x SRI	.0003 (.0009)	.0003 (.0012)	-.0005 (.0010)	.0002 (.0011)
	Capital-based MPI x CLIFS	**-.0160**** (.0065)	**-.0107**** (.0046)	**-.0143**** (.0067)	**-.0085*** (.0048)
Structural variables	Bank concentration (HHI)			-.0802 (.0575)	**-.0846*** (.0507)
	Bank concentration x SRI			**-.1586***** (.0260)	**-.0725***** (.0268)
Control variables	Real GDP growth rate	-.0886 (.0604)	-.0097 (.0295)	-.0811 (.0624)	-.0227 (.0297)
	Lagged real GDP growth rate	**-.1622***** (.0263)	-.0360 (.0235)	**-.1782***** (.0263)	**-.0410*** (.0218)
Number of observations		1,631	1,631	1,631	1,631

Source: ESRB Expert Group on Macroprudential Stance.
*Notes: Bootstrapped standard errors are in parentheses. Significance levels: *10%, **5%, ***1%. Dependent variable is average annualised eight-quarters-ahead GDP growth.*

The negative coefficients on SRI and CLIFS indicate that higher systemic risk and financial stress lead to lower GDP growth at the 10th percentile of the GDP growth distribution and thus generate lower forecasts for the tail of real GDP growth. The cross-product of SRI and CLIFS provides evidence of amplification between systemic risk and stress as financial stress has a more detrimental effect on average median growth eight-quarters ahead when vulnerabilities, captured by the SRI, are elevated. Bank exposure concentration, used in the regression as an additional structural factor, both in level and when interacted with SRI, has a mostly statistically significant impact on GDP growth, but especially on downside risks, with higher concentration furthering increasing tail risks.

The effects of macroprudential policy on the downside risk of GDP growth is heterogeneous. The BBM, captured by the MPI of BBM, have an insignificant effect when considered in levels. In exuberant times they tend to negatively affect the future tail of the GDP distribution and, instead, support the GDP growth distribution when financial stress is elevated. Tighter BBM have been found to be beneficial for limiting GDP contractions in times of stress.[22] Capital-based measures are statistically significant for tail growth only when interacted with CLIFS and exhibit a negative sign. A tightening of capital-based measures during financial stress amplifies downside risks to average GDP growth eight-quarters ahead. Conversely, a release of capital requirements in stress periods and help mitigate downside risks to GDP. These results broadly corroborate findings by Duprey and Ueberfeldt (2020) and Brandao-Marques et al. (2020), who identify positive effects of the use of macroprudential policy on the downside risk of GDP growth. By accounting for interactions with the cycle, Galán (2020) finds that tightening BBM during economic expansions improves GaR, while loosening capital measures during crises has important positive effects on the left tail of GDP growth.

The intertemporal trade-offs and the term structure of GaR are important for the stance assessment (Chart 2). The GaR framework allows the marginal effects of a one standard deviation increase of its main variables (SRI, CLIFS, MPIs) on the 10th percentile of averaged GDP growth to be identified for one-quarter to sixteen-quarters ahead. The one standard deviation shock to SRI (panel a), the CLIFS (panel b), MPI for BBM and for capital measures is applied while all other variables are at their median. The overall marginal effect of each variable is thus the combination of the coefficients from Table 3 of the variable itself and all the cross-products considered.

An increase of systemic risk (SRI) tends to unfold its detrimental effects on the tail of the growth distribution beyond the eight-quarter horizon. The effect of a one standard deviation increase in SRI of 0.62 points, with all other variables at their median (CLIFS equal to 0.09, MPI of BBM equal to 0 and MPI for capital measures equal to 1), implies the largest negative effect eight and sixteen-quarters ahead of the shock, with an impact on the 10th percentile of average annualised GDP growth of -1.2 and -1.1 percentage points respectively for the eight-quarter and sixteen-quarter-ahead horizon. For these horizons, the main contribution stems from the SRI, but for the shorter horizon (one-quarter ahead), the amplification effect on financial stress (measured by the interaction between SRI and CLIFS), is the most relevant effect for downside risk. Thus, rising systemic risk amplifies the growth effects of financial stress in the short term and has lasting effects on downside risks of European economies.

An increase of financial stress (CLIFS) impacts the growth distribution in the first and fourth quarters after the shock, while its effect on the tail wanes the longer the forecast horizon (Chart 2). The increase in CLIFS of 0.1 points (its pooled historical standard deviation) with all other variables at their median (SRI equal to -0.06, MPI of BBM equal to 0 and MPI for capital measures equal to 1) generates a reduction in the tail of the annualised average GDP distribution of -1.6 and -1.3 percentage points respectively one and four-quarters ahead, and no impact after that. This is also consistent with previous studies of the impact of financial conditions and cyclical risk on the downside risk of GDP growth. Using a sample of advanced economies, Aikman et al.

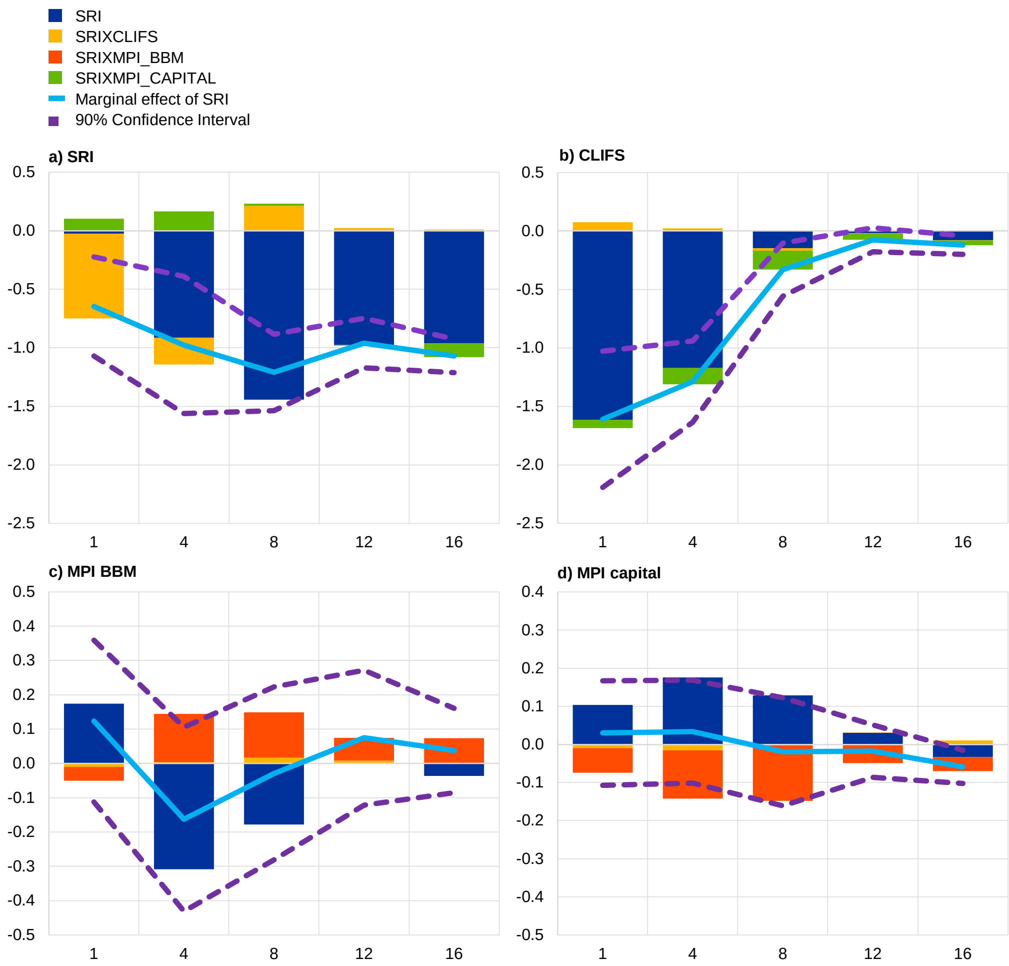
[22] The negative coefficient in the cross-product with the SRI may be interpreted as reverse causality, whereby these measures are generally introduced in times of booming real estate markets, foreshadowing crisis periods triggered by these same markets.

(2019) find that variables related to cyclical risk imbalances predict deteriorations of the tail risk of GDP growth. Galán (2020) finds similar results using a sample of emerging and advanced economies and identifies that, while stress events have important negative effects in the short-run, credit growth and house price appreciation have negative effects on the downside of mid-term GDP growth.

Chart 2

Marginal effects variables on tail GDP growth (10th percentile)

(x-axis: projection horizon in quarters, y-axis: marginal effect, percentage points)



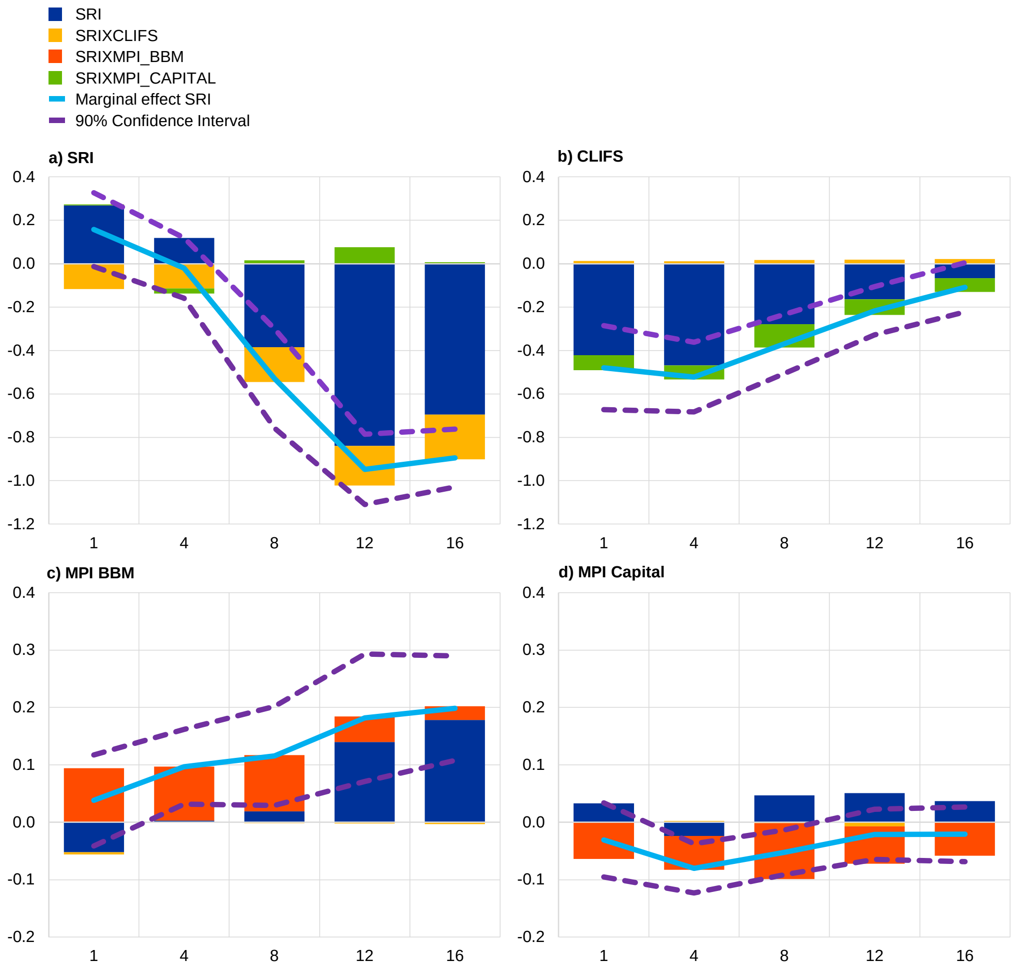
Source: ESRB Expert Group on Macroprudential Stance.
Notes: Marginal effect measures as one standard deviation increase of SRI (panel a), CLIFS (panel b), MPI BBM (panel c) and MPI capital (panel d) on 10th percentile of GDP growth distribution. All other variables taken at their pooled median value.

A tightening of macroprudential policies seems to have no significant effect on the tail of the GDP growth distribution through the direct channel. As noted in Box 1, the reference specification only reveals the direct channel, omitting the indirect transmission channel where macroprudential policy contributes to reducing financial vulnerabilities and stress, leading to a decrease in downside risk. This indirect channel, which is deemed relevant in Box 1, is hidden in the marginal effects of SRI and CLIFS: a tightening of a macroprudential policy has a negative immediate effect on these variables (estimated coefficients of lag 1 of MPIs in Box 1) and this decrease will reflect positively on the tail of GDP (symmetric effect to the one represented in Chart 2). These findings can be updated in the future as more experience is gained with macroprudential policy instruments and their measurement is refined.

Chart 3

Marginal effects variables on median GDP growth (50th percentile)

(x-axis: projection horizon in quarters, y-axis: marginal effect, percentage points)



Source: ESRB Expert Group on Macroprudential Stance.
Notes: Marginal effect measures as a one standard deviation increase of SRI (panel a), CLIFS (panel b), MPI BBM (panel c), MPI capital (panel d) on the 50th percentile of the GDP growth distribution. All other variables taken at their pooled median value.

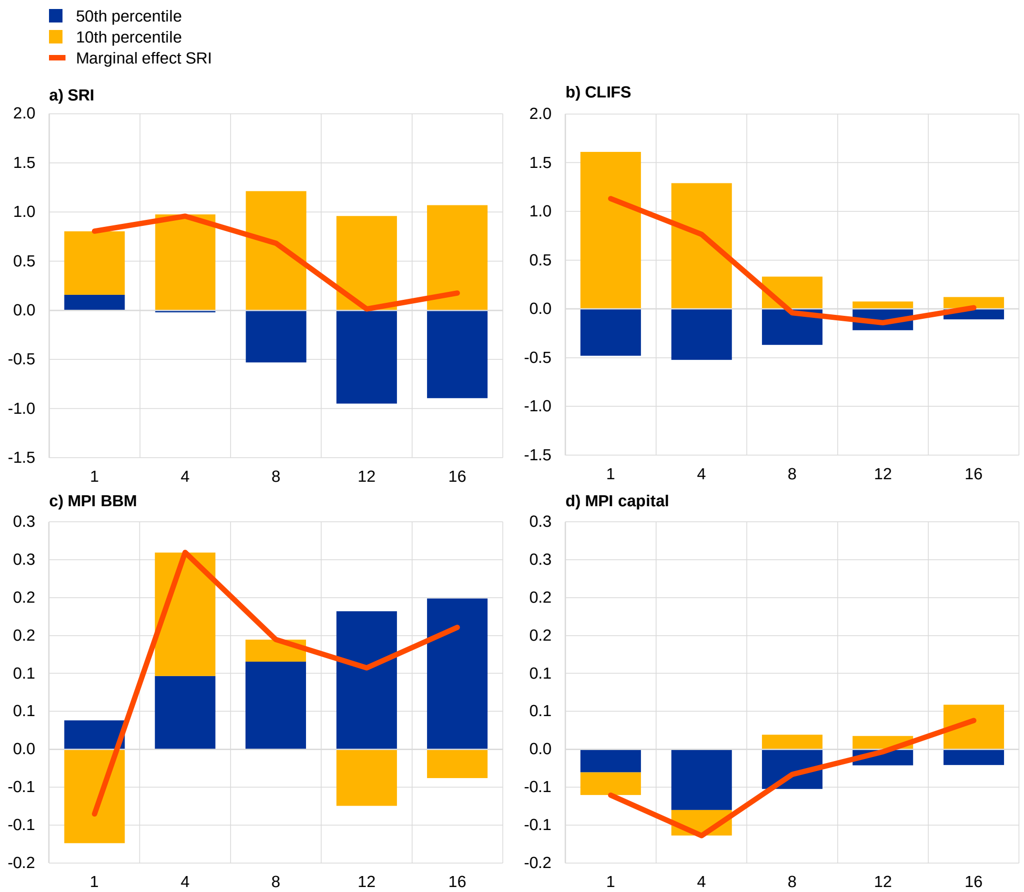
A comparison with the marginal effects on median GDP growth reveals qualitatively similar effects to those on the tail, but with significant differences for the stance assessment (Chart 3). Looking at the CLIFS and SRI, it is possible to see that the magnitude of higher financial stress (CLIFS) or increasing vulnerabilities (SRI) is usually larger at the tail than at the median. Importantly, the SRI tends to raise median growth in the short term, providing indications of a term structure of financial imbalances. As regards the results for financial stress, these are consistent with previous studies based on US data. Adrian et al. (2019) identify that tighter financial conditions observed during stress periods have important negative effects on the left tail of the GDP growth.

These effects are larger than those on the median, which increases the left skewness of the GDP growth distribution.

Chart 4

Marginal effects variables on median-to-tail distance of GDP growth (stance metric)

(x-axis: projection horizon in quarters, y-axis: marginal effect, percentage points)



Source: ESRB Expert Group on Macroprudential Stance.
Notes: Marginal effect measures as a one standard deviation increase of SRI (panel a), CLIFS (panel b), MPI BBM (panel c), MPI capital (panel d) on the 50th percentile of the GDP growth distribution. All other variables taken at their pooled median value.

When considering the median-to-tail distance of GDP growth for macroprudential stance, the decomposition provides the term structure of their relative contributions of financial and macroprudential variables (Chart 4). A one standard deviation increase in SRI contributes to a larger median-to-tail distance up to eight-quarters ahead. This effect is mostly driven by an increase in downside risk, measured by the 10th percentile, while median growth remains unaffected. From there on, the SRI-induced median-to-tail distance falls back broadly to its original distance, driven by the deterioration in median growth, while tail growth remains unaffected. Specifically, an SRI increase of 0.62 points (one standard deviation), with all other variables at their median, implies an increase in the median-to-tail distance of 0.80 percentage points of annualised GDP growth one-quarter ahead, rising to 0.96 percentage points four-quarters ahead and lowering again to 0.68 percentage points eight-quarters ahead. The dynamics indicate the detrimental effects of financial imbalances that lower growth outlook in the medium to long term by shifting the growth distribution downward. The short-term effects of financial stress are evident through their interaction with the imbalances. Amplification with financial stress contributes to increases in the median-to-tail distance of the GDP growth distribution one to four-quarters ahead via the increase in downside risks while having almost no effect on median growth.

On the policy side, the tightening of a borrower-based measure initially leads to a decrease in the median-to-tail distance (as the measures reduce downside risk) but subsequently raises it over time. A tightening of BBM by a one standard deviation reduces the median-to-tail distance by an initial -0.09 percentage points, but this turns into an increase of +0.1 to +0.26 percentage points four to sixteen-quarters ahead. In the first quarter, the tightening of a borrower-based measure has the expected effect of reducing downside risk but at no cost in the median outlook. In the fourth and eighth quarters subsequent to a borrower-based policy tightening action, as measured by the index, the GDP growth distribution shifts to the right as both median and tail increase. After that, the median always increases while downside risk decreases but to a lesser degree, implying a better outlook and less uncertainty. This surprising finding calls for some explanations. First, the quantification considers all other variables at their median when the risks and stress are close to their long-term average. Second, they consider the direct channel of macroprudential policy on the GDP distribution, and do not account for the measures' potential effect in reducing systemic risk and financial stress over the forecast horizon, an effect picked up in the contributions of the CLIFS and SRI (symmetric effect of the one shown for SRI and CLIFS in Chart 4). Finally, BBM have been very heterogeneously implemented across countries since 2010 and additional data as well as measurement possibilities with these measures may provide refined insights in the future.

The tightening of capital measures contributes to a decrease in the median-to-tail distance in the short term by limiting downside risk but reducing median GDP growth. Over the first four quarters, the benefits from capital-based macroprudential measures to limit downside risks comes with a trade-off for the median growth outlook – reducing downside risk and decreasing medium-term growth. The effects are reversed over time and overall are limited quantitatively. Here again, the quantification exclusively considers the direct mechanism. The main caveat of only considering the direct channel of macroprudential policy in the reference specification is that it hides the total macroprudential policy effect. This is especially relevant when employing the macroprudential stance framework for decision-making and should be taken into consideration, in addition to the somewhat limited effectiveness of the direct macroprudential policy channel.

2.3 Country results

The estimates in the previous section can be applied to compute stance assessments over time across EU countries. Three types of results by country are considered. First, the median-to-tail distance of annualised GDP growth across countries, averaged over eight quarters, together with the contributions of systemic risk, financial stress and macroprudential policy as the key drivers of stance. Second, time series of the median-to-tail distance and contributions to track changes as the median-to-tail distance is computed in deviations to the long-term moments of the distribution. The third result provides the forecasted median and tail growth rate in difference to the estimated country fixed effects to take account of the structural differences across countries.

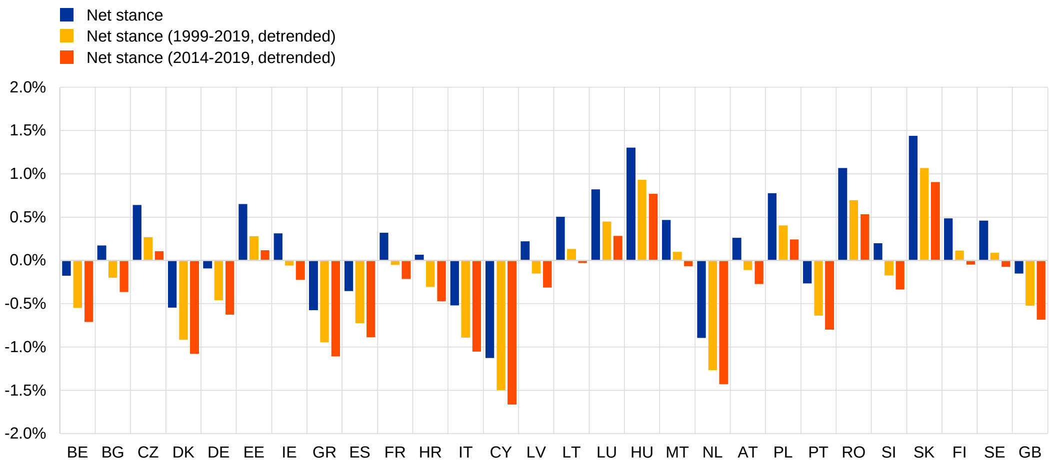
2.3.1 Results based on the reference specification

The median-to-tail distance considered as one stance metric, subtracts the annualised eight-quarter growth rate at the 10th percentile from the median of the distribution. For numerous idiosyncratic and structural factors the median-to-tail distance differs across countries, both in the short and long run. Chart 5 reports the median-to-tail distance across EU countries for the second quarter of 2018, chosen as an example reference point for the analysis, by purging the country-specific fixed effects from panel regression.[23] A more positive value indicates that tail growth rate is more distant to the median growth rate relative to the country's own fixed effect. It thus indicates a looser stance relative to such an estimated historical reference and reflects higher net systemic risks. Employing this stance indicator, which excludes the fixed effects, allows country specificities to be taken into account when conducting cross-country comparisons within the EU. The fixed effect takes account of the full dataset used for the estimation. The introduction and strengthening of macroprudential policy as an independent policy area after the global financial crisis may indicate a stronger change in the distribution, requiring a separate reference point. Using historical averages as alternative reference points may be useful to illustrate the changes in the growth distribution and the implications for stance assessments, while bearing in mind the caveats associated with heterogeneous data availability between western and eastern European countries. Using the averages for 1999-2019 or 2014-19, the stance metric indicates a generally lower distance between median and tail growth, though its extent varies across countries (Chart 5). Given the dependency of the empirical findings on past data, it remains for the policymaker to assess whether these longer-term shifts in the distribution should be considered a permanent structural change that do not need to be actively counteracted by policy or if they should be interpreted as tighter conditions that require policy intervention.

Chart 5

Cross-country comparison on the impact of detrending on the median-to-tail distance

(median-to-tail distance for eight-quarters ahead)



Source: ESRB Expert Group on Macroprudential Stance.
Notes: The net stance metric purges estimated country fixed effects from the headline estimation. In the detrended versions, the

23 The country fixed effects at the 10th and the 50th percentile capture the heterogeneity in the distribution of real GDP growth which is not explained by the variables in the regression (SRI, CLIFS, MPIs and time-varying structural variables of the financial system, if included).

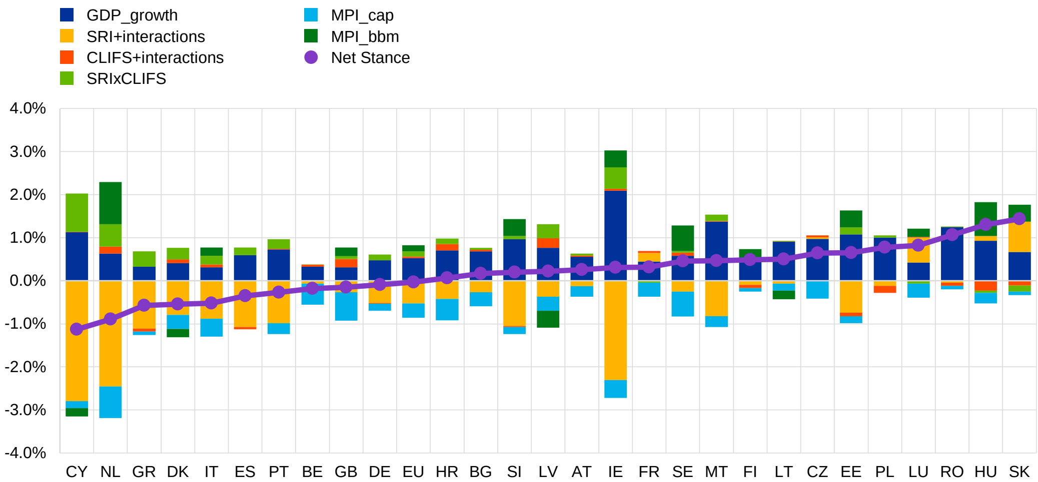
estimated values of the 10th and 50th percentile are subtracted from the average growth for these percentiles over 1999-2019 and 2014-19 respectively, instead of purging the fixed effect. The reference period is Q2 2018.

A decomposition of the aggregate stance metric into its components provides the individual contributions from the cyclical variations in systemic risk, financial stress and macroprudential policy (Chart 6). Taking the stance metric with purged country fixed effects as a reference, most countries negative contributions from the SRI are revealed, which in particular reflects a set of relatively subdued credit dynamics in the second quarter of 2018 – especially when compared to the period before the global financial crisis. In the stance assessment, the subdued developments are interpreted as overall tighter conditions as they reduce the distance of median-to-tail average growth expected over the next eight quarters. The contributions of financial stress are broadly negligible, given their relatively subdued levels, but also because of their short-term effects on GDP. A decomposition of median-to-tail growth one or four-quarters ahead would reveal more sizeable contributions. Nevertheless, the relatively subdued SRI and benign stress conditions provide positive contributions to the stance metric, reflecting the below-average values in both variables which mutes interactions in most countries. In turn, macroprudential policies related to capital-based measures contribute towards a tighter macroprudential stance for all countries by limiting downside risks, but also by reducing median GDP growth. BBM have a loosening effect for certain Member States (see estimation results and caveats in Section 2.2.4).

Chart 6

Cross-country comparison of macroprudential stance and its cyclical drivers

(median-to-tail distance for eight-quarters ahead, percentages)

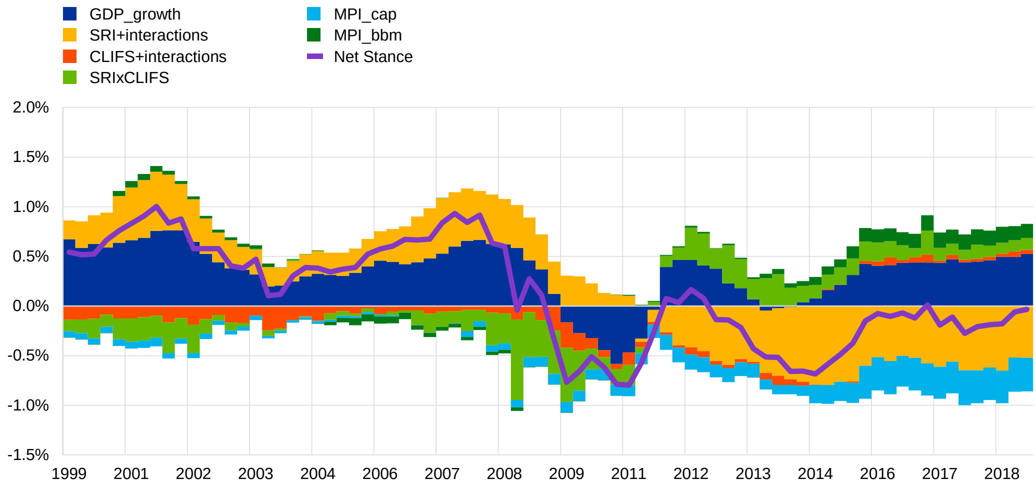


Source: ESRB Expert Group on Macroprudential Stance.
Notes: Estimates exclude country fixed effects. Positive values indicate a looser stance, negative values a tighter stance. The reference date is Q2 2018.

Chart 7

Macroprudential stance: median-to-tail decomposition for the EU

(median-to-tail distance for eight-quarters ahead based on median across EU countries, percentages)



Notes: Values are obtained by weighting individual country MTD results by nominal GDP (if data are available for the respective data point). Interactions between MPIs and SRI/CLIFS are added to the SRI/CLIFS contributions (referred to as "interactions" in the legend). The latest observation is for Q2 2018.

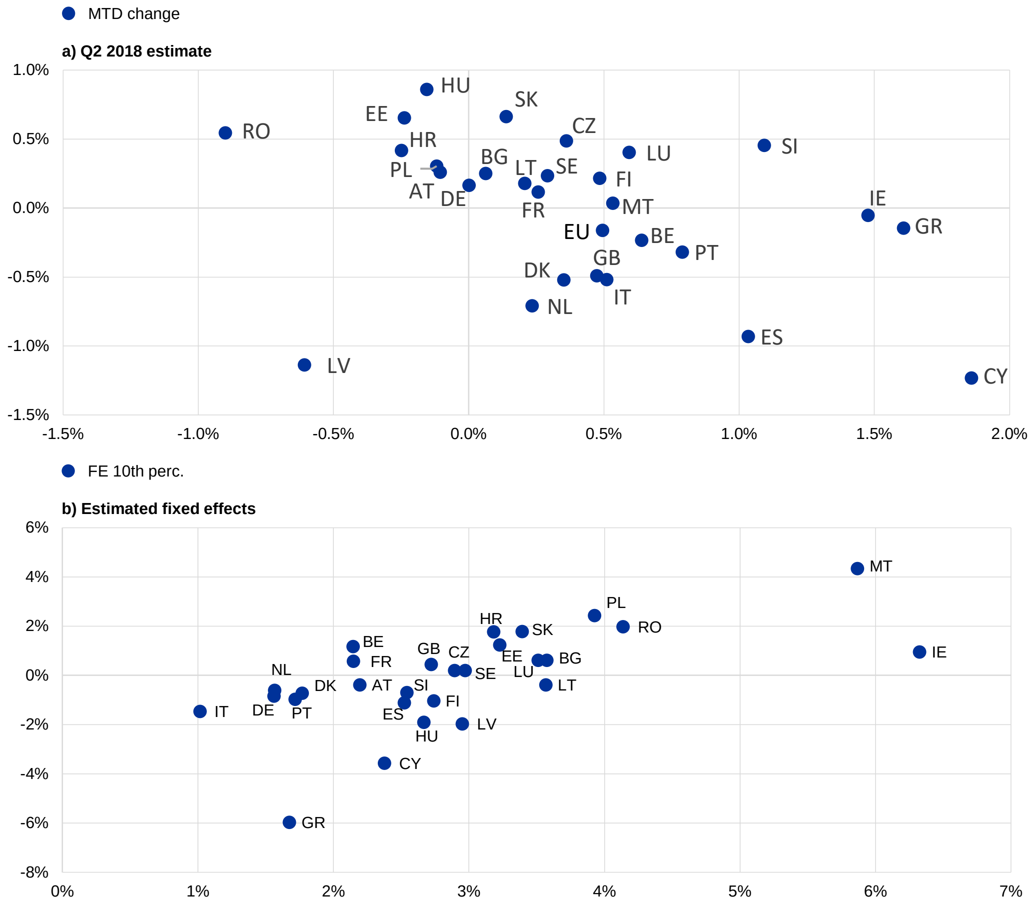
The cross-country comparison of macroprudential stance provides a direct comparison across countries and can be complemented by its country-specific time series including underlying drivers. A static snapshot may not do justice to the underlying dynamics for some countries, especially if characterised by reversals either in the headline figures or underlying components. Using the median of EU countries, Chart 7 reports the median stance and individual contributions by applying the coefficients from the panel estimation to the median time series across EU countries. This decomposition reveals the strong reversal in SRI contributions and illustrates the tightening contribution emanating from the interaction of the CLIFS and the SRI when the global financial crisis occurred, as the amplified stress widened downside risks. The illustration also indicates the gradually tighter contributions – always averaged at the eight-quarter horizon – from capital-based measures and the effects from BBM (see discussion in Section 2.2.4).

To further illustrate assessments based on the stance metric, the decomposition of cyclical contributions can be presented in the "stance space", separately from the country fixed effects. Countries with cyclically subdued expected growth in the second quarter of 2018 – driven by systemic risk, financial stress and macroprudential policy – are captured in panel (a) in Chart 8. In turn, countries with a lower median-to-tail distance can be found in the lower half of the same panel, these are countries for which the left half of the GDP growth distribution is more compressed than the estimated reference distribution. Taken together, countries in the top-left are faced with by lower growth and higher downside risks whereas countries in the bottom-right quadrant experience higher growth and reduced uncertainty for their growth outlook. Panel (b) in Chart 8 illustrates the country fixed effects that capture the estimated time-invariant structural characteristics of the GDP growth distribution for European countries. Countries in the top-right quadrant have a large expected median GDP growth based on the estimation, but it is coupled with high uncertainty.

Chart 8

Estimated cyclical and structural median and tail growth

(panel a: x-axis: difference to estimated long-term median growth, y-axis: difference to estimated median-to-tail distance; panel b: x-axis: estimated long-term median GDP growth (FE), y-axis: estimated long-term growth rate at 10th percentile (FE))



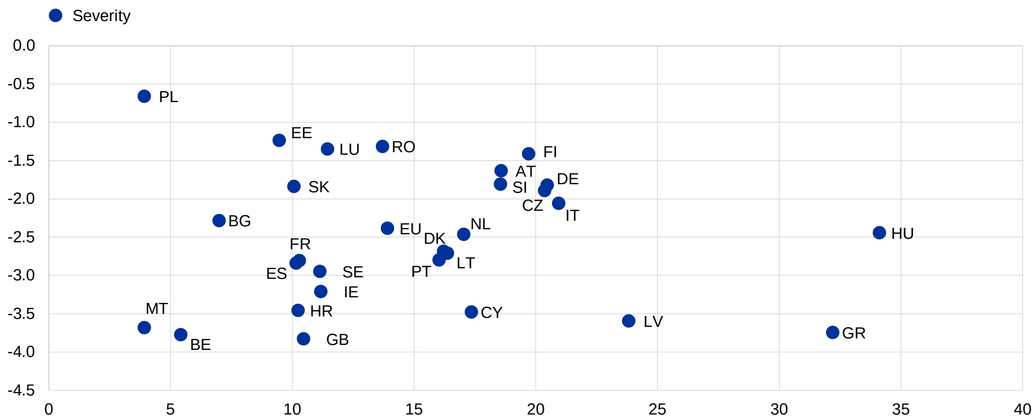
Source: ESRB Expert Group on Macroprudential Stance.
Note: The reference period is Q2 2018.

EU countries are characterised by very different forecasts for the growth distribution relative to their long-term specification. When comparing the two panels it emerges that higher expected GDP growth rates have been coupled with larger downside risks (as reflected in the positive correlation in panel b), but in the second quarter of 2018 (panel a) the cyclical situation induced by risk stress and policy points to an inverse relation with higher downside risks estimated for countries characterised with a subdued median growth outlook after considering the country-specific characteristics.

The GaR estimations can further be used to characterise the likelihood and severity of negative growth episodes over the forecast horizon. In the case of an eight-quarter forecast horizon, the probability of average negative growth – dependent on financial and macroprudential conditions – can be determined by identifying the percentile which forecasts an average growth rate of zero. The severity of such a negative growth episode is then obtained as the integral over all quantiles up to the one that generates zero growth. Naturally, the probability and severity are highly correlated, but the specific shape of the tail of the distribution implies potential deviations across countries. Using data up to the second quarter of 2018, Chart 9 illustrates the probability (x-axis) and the severity (y-axis) of negative average growth for an eight-quarter-ahead horizon. Given the financial conditions and macroprudential policies, Greece, Hungary and Latvia exhibit high probabilities of negative average growth, driven by the specific conditions in the second quarter of 2018 as well as the country-specific structural growth distribution. In turn, in the event of a negative growth episode, Belgium, the United Kingdom, Greece, Latvia, and Malta would face annualised average contractions of more than 3.5%.

Chart 9
Probability and severity of negative growth forecasts

(percentages)



Source: ESRB Expert Group on Macroprudential Stance.
Notes: The probability of average negative GDP growth over eight-quarters ahead is shown on the x-axis; the average growth conditional on growth being negative over eight quarters is shown on the y-axis. Estimates include country fixed effects dependent on available sample length. To compute the probability and severity without encountering the issue of percentile crossing, a power function interpolation was implemented to smooth over the conditional distribution.

The different variables derived from the GaR framework provide complementary information emphasising different aspects of the GDP growth outlook. To summarise the information, Table 4 highlights median-to-tail distance across countries together with the probability and expected severity of contraction. These estimates are obtained based on data up to the second quarter of 2018. The next section analyses the contribution of structural factors to tail risk, in recognition of the fact that cohorts of countries sharing common macrofinancial structural characteristics may experience more adverse outcomes than others and may be relatively more sensitive to policy actions.

Table 4

Key metrics across countries for Q2 2018

Country	Median-GaR (10) (net stance)	Probability of contraction	Severity of contraction
EU	-0.03%	13.91%	-2.39%
BE	-0.18%	5.42%	-3.77%
BG	0.17%	6.99%	-2.28%
CZ	0.64%	20.48%	-1.82%
DK	-0.54%	16.21%	-2.68%
DE	-0.09%	20.37%	-1.89%
EE	0.65%	9.46%	-1.24%
IE	0.31%	11.18%	-3.21%
GR	-0.57%	32.20%	-3.74%
ES	-0.35%	10.29%	-2.81%
FR	0.32%	10.17%	-2.84%
HR	0.07%	10.24%	-3.46%
IT	-0.52%	20.95%	-2.06%
CY	-1.13%	17.36%	-3.48%
LV	0.22%	23.83%	-3.60%
LT	0.51%	16.37%	-2.71%
LU	0.82%	11.45%	-1.35%
HU	1.30%	34.12%	-2.44%
MT	0.47%	3.92%	-3.68%
NL	-0.89%	17.05%	-2.46%
AT	0.26%	18.58%	-1.63%
PL	0.78%	3.92%	-0.66%
PT	-0.27%	16.04%	-2.80%
RO	1.07%	13.70%	-1.31%
SI	0.20%	18.55%	-1.81%
SK	1.44%	10.07%	-1.84%
FI	0.49%	19.71%	-1.41%
SE	0.46%	11.13%	-2.95%
GB	-0.15%	10.47%	-3.83%

Source: ESRB Expert Group on Macroprudential Stance.
Notes: Median – GaR (10) is the median-to-tail distance, computed net of fixed effects. The probability of contraction is found by searching for the percentile where growth becomes negative, while the severity of recession averages over the percentiles below negative growth. The probabilities of negative GDP growth and of the severity of contractions are conditional on financial conditions.

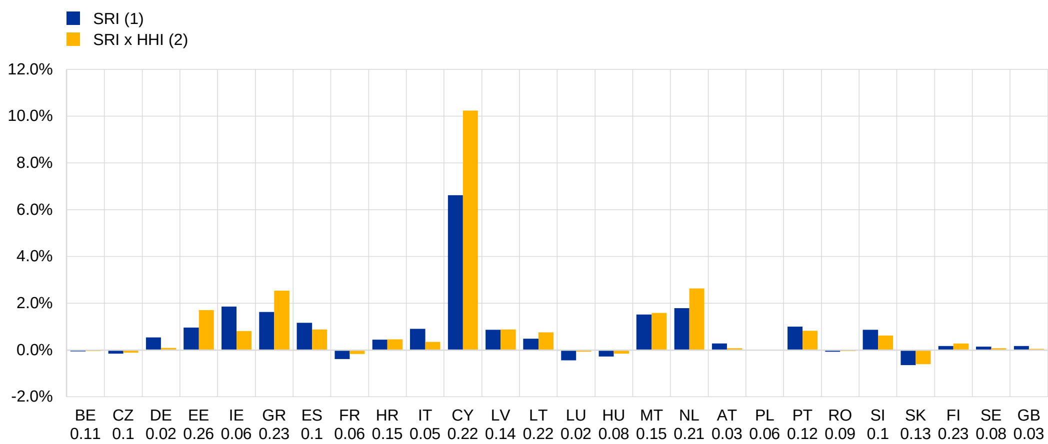
2.3.2 The role of structural factors in selected countries

The effect of the chosen structural variable can be assessed via the amplification through systemic risk, measured by SRI. For this, we compare two specifications: (1) the SRI without structural variables, and (2) the SRI interacted with the structural variable. Chart 10 (10th percentile) and Chart 11 (50th percentile) consider the contribution of the SRI on the eight-quarter-ahead GDP growth prediction using the estimated coefficients. For the 10th percentile the estimated coefficient for the SRI is -0.023 in the first model and in the second model with the interacted term (SRI x HHI) it is -0.159. This implies that the contribution of SRI in increasing downside risks will be higher when bank exposure concentration measured by the Herfindahl-Hirschman Index exceeds the threshold of 0.147.[24] Otherwise, low bank exposure concentration will mitigate the effect of increases in systemic risk (SRI) on downside risk to GDP growth. When applying the results to data for the third quarter of 2018,Chart 10 indicates that for countries with higher bank exposure concentration, such as Cyprus or the Netherlands, the mitigation of downside risks (10th percentile) of the negative value of SRI is amplified by their high bank exposure concentration. In turn, for countries with low banking system concentration, such as Ireland or Spain, the growth effect of low systemic risk (negative SRI) is mitigated, thereby reducing downside risk by a smaller magnitude than in the reference specification.

Chart 10

Concentrated banking exposures: cross-country comparison of SRI contribution modelled with and without structural factors

(eight-quarters ahead, 10th percentile)



Source: ESRB Expert Group on Macroprudential Stance.
Notes: Observed data from Q3 2018 multiplied by the estimated coefficients of Model 1 (no structural variable) and Model 2 (with structural variable). The value under the country code is the Herfindahl-Hirschman Index for Q3 2018. The reference date is Q3 2018.

When considering the same analysis for the median of the forecasted growth distribution, the amplification effects of structural variables is more prominent. In this case, the estimated

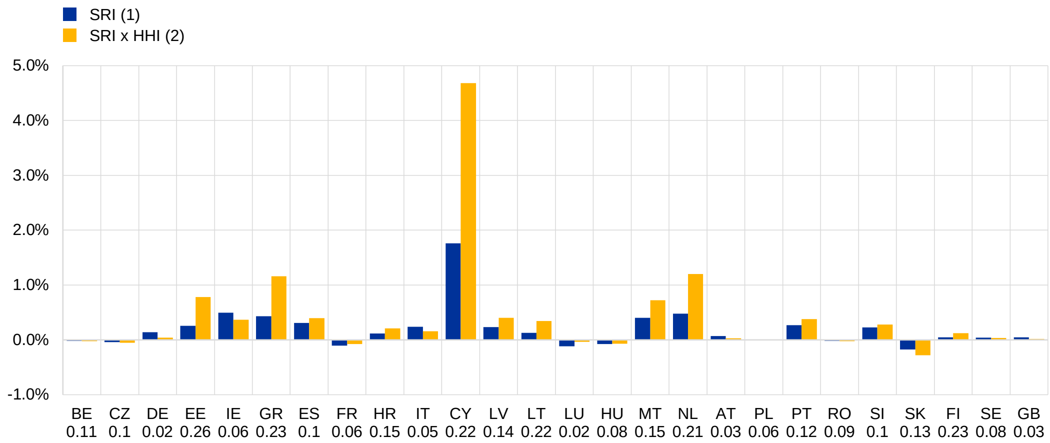
[24] Using the same value of SRI for the two specifications (e.g. of 1) will result in SRI decreasing the 10th percentile in (i) Specification 1) -0.023, and (ii) Specification 2): $-0.159 \times HHI$. These two contributions are equal when $HHI = (-0.023)/(-0.159) = 0.147$. If $HHI > 0.147$ the contribution of Specification 2), that interacts HHI with SRI, will have a more negative impact on the 10th percentile than the specification with SRI stand-alone (1).

coefficient for SRI is -0.003 in the first model and -0.073 for the model with the interaction (SRI x HHI). As a result, the relevant concentration threshold for amplifying effects on the growth median stands at 0.086, lower than the 0.147 for the 10th percentile, and amplifications occur already at lower levels of bank concentration. In summary, the introduction of structural variables can offer empirical insights into the transmission and amplification of systemic risks or of other variables to assess the stance and potential policy responses, including potential adjustments to the structural features of the economy and the financial system.

Chart 11

Cross-country comparison of SRI contributions (with and without structural factors)

(eight-quarters ahead, 50th percentile)



Source: ESRB Expert Group on Macroprudential Stance.
Notes: Observed data from Q3 2018 multiplied by the estimated coefficients of Model 1 (no structural variable) and Model 2 (with structural variable). The value under the country code is the Herfindahl-Hirschman Index for Q3 2018. The reference period is Q3 2018.

3 Semi-structural macro-micro model

The measurement of GaR for macroprudential stance can be pursued with different models. A candidate model should assign a role to macroprudential policies, be able to reflect the evolution of systemic risks and to map both these elements into the full distribution of variables of interest such as output growth (see related Figure 1). Because of the emphasis on the lower tail of the forecasted distribution, the model should also be able to reflect potential asymmetries of economic forecasts.

Structural or semi-structural approaches enrich the GaR-based assessment of stance by focusing on the selected transmission channels of systemic risk and macroprudential policies. The empirical GaR approach in Section 2 builds on historical data variability to estimate the impact of policies and risks on expected tail outcomes, including as a result all historically relevant impact channels of these variables on the GDP distribution. A structural approach disentangles relevant impact channels ex ante and allows their relative roles in different periods to be pinned down. This is especially useful when the relevance of the different channels is expected to evolve in the future relative to the historical period (e.g. due to structural breaks) or when there is a need to communicate what has driven a change in stance assessment.

Semi-structural approaches, by striking the middle ground between plainly empirical and fully structural models, offer additional flexibility to integrate different types of information. This property made semi-structural models a popular choice in forecasting for monetary policy purposes, where forecasts would encapsulate the information derived from satellite models (e.g. short-term forecasting tools or expert intuition) and to economically explain the result. These properties can also be beneficial in the assessment of macroprudential stance, where information on financial system balance sheets, systemic risk indicators and supervisory policy can be combined to provide a “best we can say for now” type assessment.

The semi-structural model used as illustration in this section, the BEAST model, encapsulates the joint dynamics of individual banks and European economies.[25] The model looks at behavioural reactions of banks which are subject to capital requirements – tracking their balance sheets and profit and loss accounts in great deal of detail. It also captures two relevant feedback loops: the real-financial feedback loop (between the banking sector and the economy) and the solvency-funding cost feedback loop (within the individual banks). The macroprudential stance assessment derived from this model incorporates detailed and rich transmission channels, emphasising the transmission through the banking sector and, in particular, bank lending to the non-financial private sector.

3.1 Properties of a semi-structural approach to stance assessment

The empirical and semi-structural GaR approaches share many commonalities (Figure 4). Both of them model macroeconomic aggregates, specifically GDP growth, and analyse the

[25] For a description of the model, see Budnik et al. (2020a) and Budnik et al. (2019). The model is discussed and developed further within the Macro-Micro (MaMi) workstream of the Work Group on Stress Testing of the FSC.

propagation of risks and macroprudential policies in the financial sector. However, while with the quantile-regression method, the evolution of the financial sector is implicitly captured by the systemic risk, financial stress and aggregate structural indicators; the semi-structural approach models the banking sector in a high level of detail. A rich set of equations maps macro-financial conditions in banks' balance sheets or their behavioural reactions. Both approaches treat macroprudential policies exogenously – being decided by policymakers. Where the two methods differ is that the quantile-regression approach considers a broad set of policies measured by the individual decisions – but not their intensity; while the semi-structural approach focuses on capital-based policies and takes full account of their calibration as well as announced policy changes. The last and most technical aspect is interpretability of shocks giving rise to uncertainty in the forecast of output growth. The reduced-form quantile-regression approach may say nothing about the sources of shocks pushing economies into tails of output distribution, while the semi-structural approach relies on either reduced-form or structural exogenous and uncorrelated shocks.

Figure 4

Comparison of a quantile regression and the semi-structural approach (BEAST model)

BEAST	Quantile regression
Macroeconomic equations of endogenous variables e.g. GDP	Macroeconomic equations of endogenous variables e.g. GDP
Bank-level equations of endogenous variables e.g. CET1 ratios	Risk indicator
Exogenous variables e.g. O-SII buffer rate	Exogenous variables e.g. O-SII policy index
Structural shocks e.g. aggregate demand shocks	Reduced-form shocks e.g. residuals of GDP equation

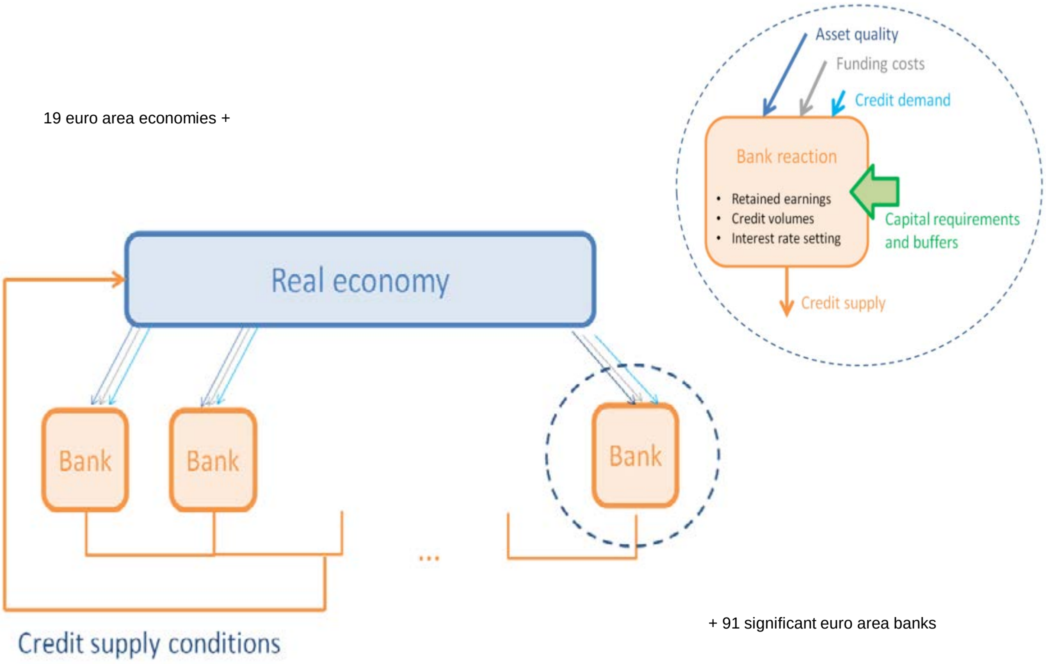
Source: ECB.

The BEAST is a semi-structural model linking macro and bank-level data regularly used by the ECB for macroprudential stress testing and policy assessment. The approach focuses on modelling banks' adjustments of loan and other asset volumes, together with behavioural responses on their liability structure (Figure 5). It also projects the evolution of loan pricing, funding costs and profit distribution policies in line with empirical bank-level evidence. Finally, the model aggregates the impact of these responses by individual banks on the credit supply and lending rates to the real economy. While the baseline model focuses on the euro area, on occasions it has been extended to the EU27.[26] This can be performed subject to easing of data confidentiality limitations.

The model is regularly applied to stress testing and policy assessment exercises. As a stress testing application, it provides the basis for the ECB's regular macroprudential stress test[27] and more regular risk assessments in its Financial Stability Review.[28] It has also been used for a GaR-based study of the effects of Basel III finalisation in 2019 and in 2021,[29] for the impact assessment of the non-performing loans (NPLs) policies in Europe, the coronavirus (COVID-19) mitigation policies or for the assessment of buffer use (and subsequent replenishment).[30]

Figure 5

Schematic illustration of the BEAST



Source: Budnik et al. (2019).

The macroeconomic module of the model singles out each euro area economy and captures the joint dynamics of its core macro-financial variables. This set of macro-financial variables in country blocks includes real GDP growth, general price inflation, a set of variables relevant from a financial stability perspective such as house prices, equity prices, unemployment rates, and the representation of monetary policy by short-term interest rates and the size of the ECB balance sheet. The latter two variables allow monetary policy developments to be captured accounting for

26 In particular the model was extended to all EU countries and Norway for the purpose of delivering the cost-benefit analysis of the Basel III finalisation in response to the EC Call for Advice in 2019 (**Basel III reforms: impact study and key recommendations – Macroeconomic assessment**, EBA Report in 2019 and in 2021 (not yet published). In both instances, the data on non-euro area banks were shared with the consent of the relevant authorities and for the purposes of a particular project.

27 Budnik et al. (2019). A similar exercise was also prepared in 2020 (at the end of the ECB vulnerability analysis).

28 For the most recent application, see Budnik et al. (2020b).

29 See Budnik et al. (2021a); Budnik et al. (2021b).

30 Borsuk et al. (2020).

conventional and unconventional policy measures. The basic structure of the macroeconomic block relies on the structural panel Bayesian VAR with long-run priors, stabilising the long-run dynamics of the system at values consistent with long-run trends and stylised facts. Countries are interconnected by trade spillovers.

The model encapsulates scenario and parameter uncertainty. To test scenario uncertainty, each economy is exposed to a dozen shocks. These are drawn from their empirical distributions to generate multiple stochastic scenarios. The empirical distributions of shocks are described by estimates under the parametric assumptions in estimation of the macroeconomic block (multi-variate normal) or can be bootstrapped. Geometric block bootstrapping is applied here, which recognises the time series nature of the model. Additionally, there is also a narrower set of idiosyncratic bank-level stochastic shocks, such as banks' operational risk shocks. The model also allows full distributions of the parameters from the macro module to be used, adding parameter uncertainty to forecast distributions.

The semi-structural approach captures asymmetry in the distribution of output growth forecasts based on the non-linearities of banks' behaviour. For instance, banks will deleverage most aggressively when they breach regulatory capital requirements. This feature allows a meaningful interpretation of amplifications in the lower tail of the growth distribution.

The strengths and weaknesses of a semi-structural GaR approach are summarised in Figure 6. The model enhances the assessment of macroprudential stance with narrative building and ensures consistency of the underlying economic and risk outlook. The model has sound long-run properties, backed by tailored estimation techniques, and can be used for building longer horizon-conditional forecasts. These long-term properties help in capturing the transmission lags in macroprudential policies or the persistence of systemic risks. Among the challenges of the semi-structural approach are data requirements, costs of model maintenance and reliance on selected structural assumptions (e.g. that the Modigliani-Miller theorem does not hold).

Figure 6

Strengths and weaknesses of a semi-structural approach like the BEAST

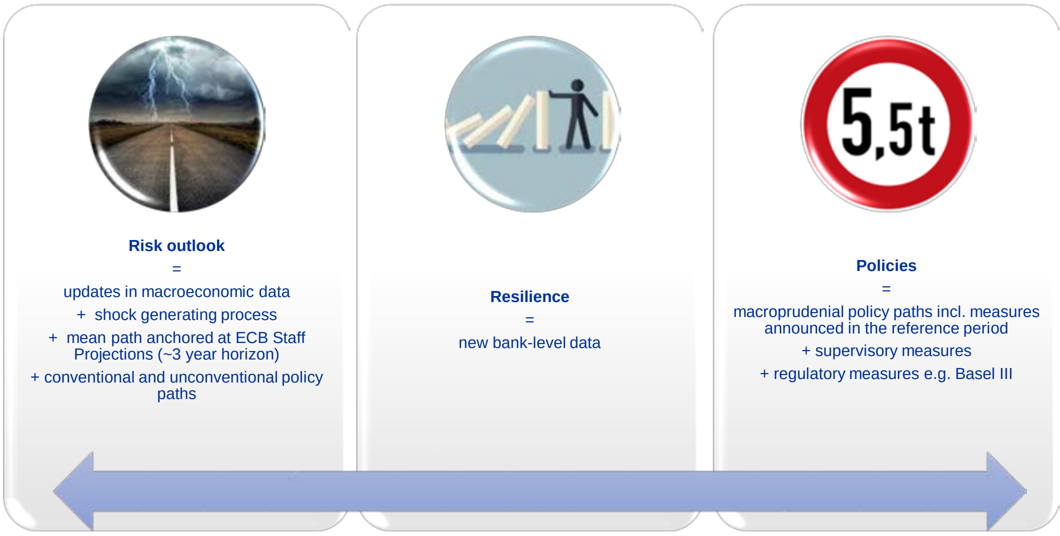
Strengths	Weaknesses
Transmission channels & narrative	Reliance on bank-level confidential data
Long-run properties and tracking of transmission lags	Costs of model use & maintenance
Consistent picture of multiple variables & bank-level detail	Banking sector coverage with largest banks
Applicability of various policy instruments & their interactions	Fixed set of systemic risk propagation channels

Source: ECB.

3.2 Elements of stance assessment

One of the advantages of the model is its ability to incorporate many sources of relevant information. The update of historical macroeconomic data, structural shocks and expected future conditions all provide a comprehensive risk outlook at a point in time (Figure 7). The assessment includes all historical information on macro-financial variables as well as updated information on the shock-generating processes.

Figure 7
Mapping information updates to stance assessment



Source: ECB.

The mean forecasts of macroeconomic variables are anchored on the comprehensive projection exercises by Eurosystem and ECB staff. The projections are published four times a year (in March, June, September and December).[31] Anchoring the mean path ensures that the macroeconomic outlook reflects the assessment of future macro-financial conditions derived from those models best suited to this purpose. This information is supplemented by the forecast of the size of the ECB's balance sheet to incorporate information on existing and announced unconventional monetary policy programmes. Beyond the horizon specified in the Eurosystem and ECB staff exercises, the model follows its endogenous dynamics.

The assessment incorporates supervisory information about individual banks' balance sheets sourced from FINREP and COREP. This includes changes in bank lending, trading books, bank liabilities, items of bank profitability and own funds. As a result, the model not only captures system averages, but also the heterogeneity of solvency across individual banks. This element maps into a comprehensive picture of system resilience at any point of time.

The model includes a very comprehensive set of macroprudential policies, be they already implemented, being phased-in or announced, including their interaction with supervisory and regulatory changes. The focus of the model is on capital-based policies, covering capital conservation buffers (CCoB), countercyclical capital buffers (CCyB) and systemic risk buffers (SyRB) as well as buffers for other systemically important institutions (O-SII) and global systemically important institutions (G-SII). The assessment incorporates information on each instrument and allows the effects of a buffer that will only become binding in the future to be considered. This information is supplemented with detailed bank-level information on Pillar II requirements and buffers. The model replicates the fact that breaching macroprudential buffers

31 https://www.ecb.europa.eu/pub/projections/html/index.en.html.

triggers restrictions on the maximum distributable amounts. Additionally, model formulas enable the effects of profit distribution restrictions (if binding) to be included.

Figure 8
Significant regulatory changes in 2018-20

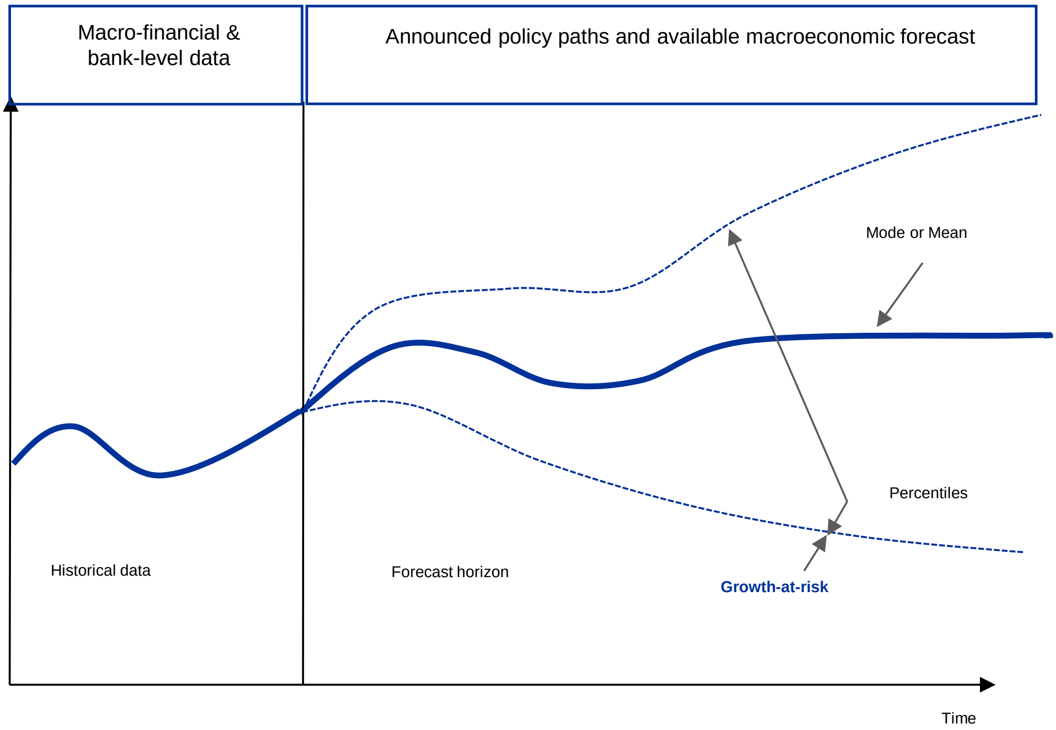
Source: ECB.

The interaction of the banking sector with regulatory policies is important, given the many changes adopted in the past or announced for the future. Figure 8 summarises the main characteristics of the policies, including their announcement dates. First, the Basel III finalisation, initially scheduled to be introduced in 2021 and postponed until 2022 in response to the COVID-19 pandemic, will translate into higher effective capital requirements and buffers (including macroprudential buffers) and will affect the distribution of risks in the system, given the differing impact for internal ratings-based (IRB) and standardised approach (STA) banks. Second, the supervisory coverage expectations introduced as an element of the NPL guidance in 2018, will affect banks' capacity to build up capital buffers in the years to come. Third, changes resulting from CRD5/CRR2, partially frontloaded to 2020, directly affect capital requirements by, for example, changing the composition of Pillar II minimum requirements.

Figure 9 summarises the essence of stance assessment based on the macro-micro semi-structural model. The data and the forward-looking information available at a particular point in time, are fed into the model. This is then used to run multiple stochastic simulations, tracking the evolution of economies and banks under thousands of alternative but plausible scenarios. Stochastic simulations make it possible to derive full distributions of all endogenous variables including GDP or its growth rate. The moments relevant for the stance assessment are then available at the horizon of interest.

Figure 9

Schematic illustration of stance assessment



Source: ECB.

3.3 A macroprudential policy exercise and stance

To build an intuition about the semi-structural stance assessment, this report includes a counterfactual exercise for macroprudential policy for the euro area.[32] We assess the stance for each reference quarter between the fourth quarter of 2017 and the fourth quarter of 2019, relying only on the information available until then. The assessment fully takes into account information lags (e.g. bank-level data are available with around two-quarters lag and national accounts with around one-quarter lag).

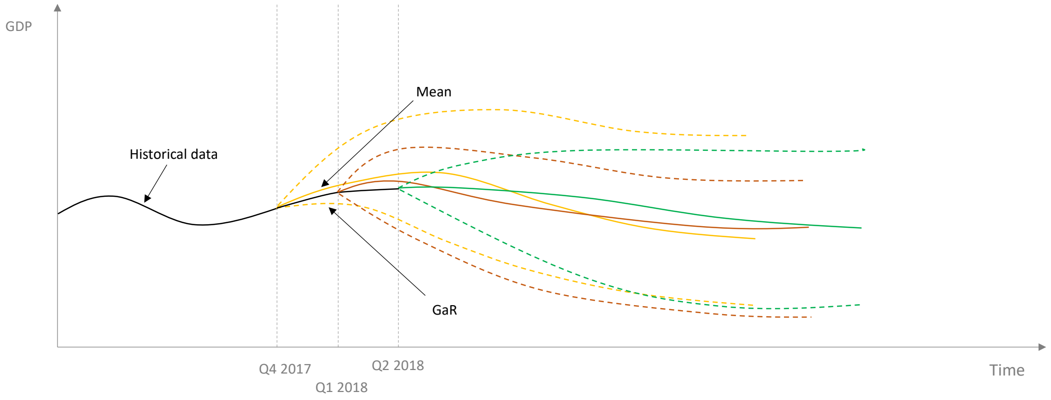
Repeating the procedure period-by-period results in a recursive out-of-sample forecast of the full distribution of endogenous variables.[33] Chart 12 illustrates the main concept of the exercise. For each quarter the mean and the lower tail of the GDP forecast are measured. For example, the stylised mean and GaR for the fourth quarter of 2017 are marked with red lines, for the first quarter of 2018 with green, and the second quarter of 2018 with blue in Chart 12. These are then read at the same reference horizon e.g. three- or five-years ahead, as shown in Chart 14 for GaR. These are finally compared over time as illustrated in Chart 13.

[32] Macroprudential policies in euro area countries are mainly decided at the national level. This exercise is not meant to indicate that macroprudential policies are implemented at euro area level.

[33] The out-of-sample approach deviates from the in-sample approach to assess stance, followed in the earlier chapter discussing the results on the empirical GaR.

Chart 12

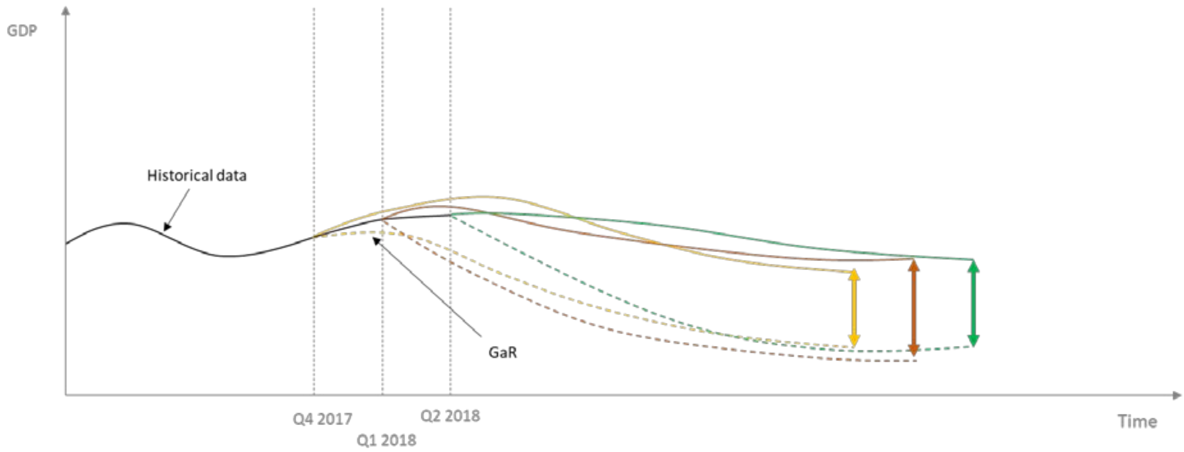
Schematic illustration of multi-period confidence forecast



Notes: Yellow solid line represents the mean multi-year forecast with the cut-off date Q4 2017. Yellow dashed lines represent high and low percentile of the forecast distribution. Orange lines correspond with the analogous forecast from Q1 2018, and green, from Q2 2018.

Chart 13

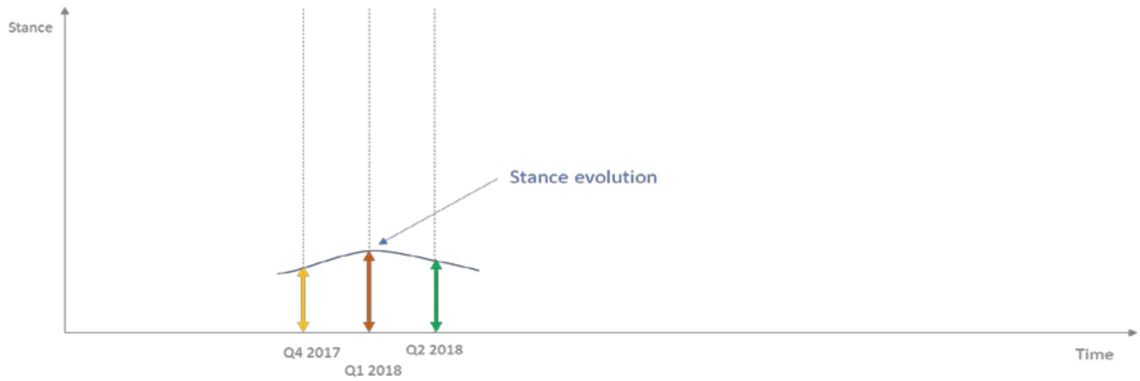
Schematic illustration of multi-period confidence forecast with the emphasis on the mean and a lower percentile (GaR)



Notes: Yellow solid line represents the mean multi-year forecast with the cut-off date Q4 2017, and yellow dashed line represents its low percentile of the forecast distribution (as in Chart 12). Orange lines correspond with the analogous forecast from Q1 2018, and green, from Q2 2018. Arrows illustrate the measurement of macroprudential stance as a difference between the mean and lower percentile of each forecast.

Chart 14

Schematic illustration of the evolution of stance measures as the difference between the mean and a lower percentile (GaR)



Source: ECB.

The evolution of macroprudential stance based on the semi-structural model can be compared under different policies for a five-year-ahead forecast (Chart 12). The focus of the assessment is on longer-horizon forecasts, which can accommodate lags in the transmission of prudential measures.[34] The limit of good forecast quality at longer horizons is loosened up in the semi-structural model compared to the quantile-regression approach, by considering long-run trends in the model. The stance metrics is derived as the difference between the cumulative real GDP change for the mean and the 10th percentile of the distribution. This stance metric is compared between the benchmark outcome and the counterfactual outcome considering no change in macroprudential, supervisory and regulatory policies since the end of 2017.

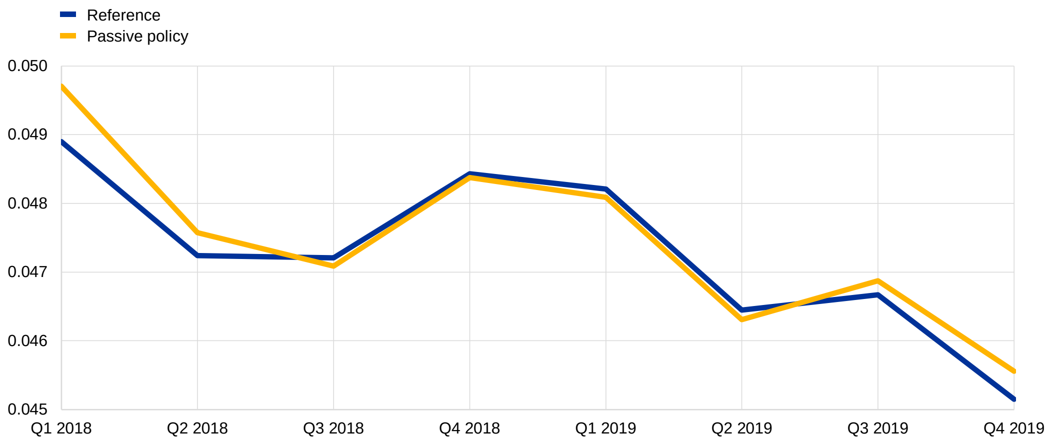
The macroprudential stance based on the semi-structural model is characterised by a downward trend following 2018, given a declining distance of mean-to-tail growth outlook (Chart 15). The difference between the reference and the "no policy change" scenarios indicates that policy adjustment in the period contributed positively to this trend.[35] This conclusion would be also supported by the expected shortfall metric, which – though it tends to show higher absolute values for the GaR stance – depicts similar trends.

[34] See, for example, Budnik and Rünstler (2020), who document substantial macroprudential policy lags in the United States.

[35] A look at 2020 shows an abrupt increase in the distance between GaR and mean growth at the onset of the COVID-19 pandemic. However, the stance normalised towards the end of the year.

Chart 15

Semi-structural GaR: mean versus the 10th percentile of the euro area output change five-years ahead



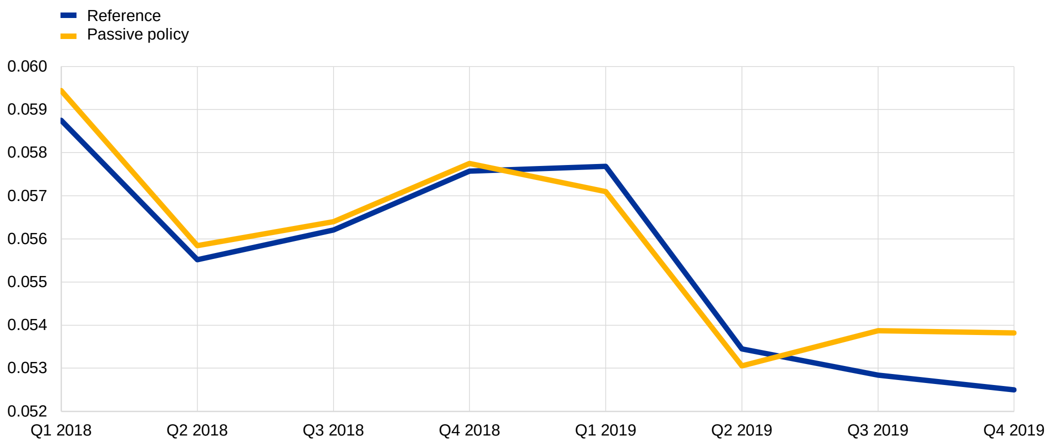
Source: ECB.

Notes: "Reference" marks the assessment of stance under actual policies. "Passive policy" marks a counterfactual exercise in which policies are assumed to remain unchanged from the end of 2017 until the end of 2019. Higher values stand for a looser stance.

The relative impact of macro-financial policies can be best illustrated by the underlying trends in the distance between the lower tail and mean of lending growth. Private sector lending dynamics are not only often seen as an intermediary target of macro-financial policies but are also more directly influenced by them than output growth. Chart 16 summarises the information on GaR type metrics for bank lending volumes to non-financial private sectors. As with GDP semi-structural GaR stance metrics, there is a slow downward trend in the series marking increasing resilience of the banking system and the economy.

Chart 16

The assessment of risks to euro area-wide private sector lending by mean versus 10th percentile



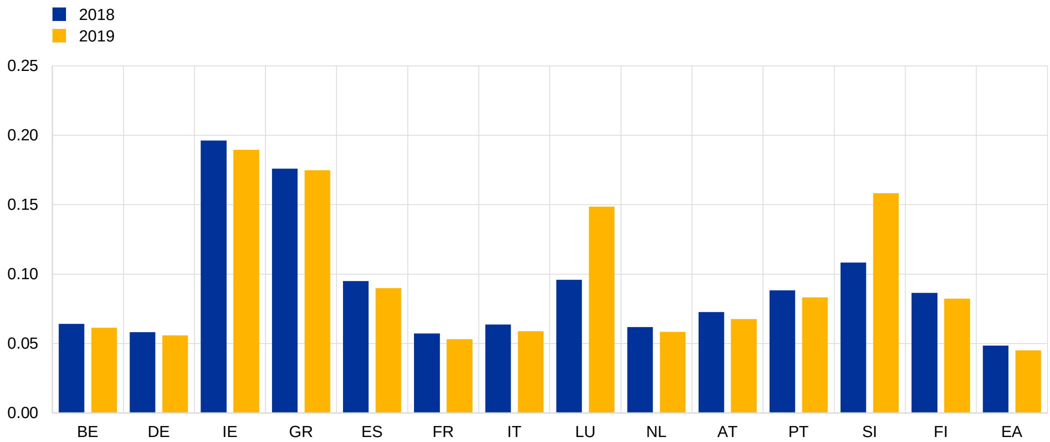
Source: ECB.

Notes: "Reference" marks the assessment of stance under actual policies. "Passive policy" marks a counterfactual exercise in *which policies are assumed to remain unchanged from the end of 2017 until the end of 2019. Higher values stand for a looser stance.*

The semi-structural GaR stance across selected countries is characterised by a high degree of co-movement. The differences in the average level of stance for 2018 and 2019 across countries generally reflect differences in the relative output variability, with a higher level of stance in smaller countries such as Ireland, Greece and Slovenia, and lower in larger economies such as Germany and France (see Chart 17 and discussion in Section 2). However, the country-level changes are more informative, with a very general trend toward strengthening of stance before the COVID-19 pandemic, at least partially reflecting a coordinated effort of the macroprudential and supervisory authorities after the 2008 crisis.[36]

Chart 17

Country examples for the semi-structural GaR stance, 2018-19



Note: Higher values signify a looser stance. EA = euro area.

3.4 Remarks on the use of the semi-structural model

The semi-structural approach can accommodate the interplay between macroprudential and monetary and supervisory policies. Additionally, the semi-structural BEAST model can explore a very rich information set, including the information about current and future policies, detailed information about the banking sector at any juncture, and the relevant forecasts of macro-financial variables from the Eurosystem projections. Including the latter binds the assessment of the macroprudential stance even closer to monetary policy stance, with the same forecasts informing monetary policy decisions.

The merits of the semi-structural approach can be exploited based on other models already available to Member States. By exploring alternative structural models, policymakers may be able to emphasise other transmission channels, introduce more country specificities or re-use infrastructures already supporting central banks' monetary policy.

[36] At the end of 2020, the stance in many countries returned to its pre-2018 stance levels, which similarly transmits a reassuring message.

4 Stance assessment for sectoral policies

Macroprudential policy is fundamentally multidimensional – both in the risks it targets and the policy tools it deploys. While overall financial stability is the most important objective, there is a role for more targeted concepts of stance. These concepts assist macroprudential authorities in setting and communicating their policies with respect to specific types or sources of risk.

Indicator-based approaches can complement GaR in several ways. First, policymakers might disagree about the role of economic growth in assessing macroprudential policies. Second, the GaR models tend to be rather high-level (especially empirical GaR, for macro-micro use depending on specification and granularity) and unable to provide adequate guidance on macroprudential policies applied at sectoral or instrument level. Third, aggregation of indicators, as chosen by previous ESRB work, into a stance assessment might be a natural position to leverage on existing sectoral knowledge and align stance with the existing assessment practices in the ESRB.

This chapter will first establish an overall framework for setting a sectoral-based indicator for stance, anchored in the risk-resilience conceptual framework. Then it will consider ways to implement this in the most common areas of macroprudential intervention in the EU to date: bank capital measures and BBM for residential real estate (RRE) related risks. It should be noted that the same framework can be applied to develop an indicator for other areas of macroprudential interest, such as non-banks. As more data become available, and as the macroprudential toolkit expands, similar stance indicators can be developed for these other areas of interest.

4.1 Sectoral stance as a comparison between risk and resilience

As noted in the introduction to this report, stance is a measure of the tolerance of policymakers to residual risk in the economy and financial system. Thus, it can be calculated as a net measure. The residual risk is obtained by assessing the aggregate risk and subtracting any exogenous and/or policy-induced resilience, the policymaker can then assess this against their personal judgement of the appropriate neutral level of residual risk. As risk increases (either cyclically or due to changes in the underlying structure of the economy – through financial deepening, for example), or the level of exogenously generated resilience falls (through, for example, lower levels of bank capital), policy should tighten, in order for a neutral stance to be maintained.

This framework allows for an increase in the risk environment, both due to factors beyond the policymaker's control and because of trade-offs that improve productivity. In our financial deepening example above, it may be better for the economy as a whole to increase debt levels, as this can serve to boost overall productivity. However, that debt comes with risks, and macroprudential policy must react to those risks.

Stance as characterised here should be viewed as a positive measure of risk tolerance, rather than a normative measure of optimal policy. This approach does not incorporate a specific trade-off between tail outcomes and the rest of the distribution. Thus, policymakers facing different cost trade-offs may have justifiably different levels of tolerance to residual systemic risk.

For each sector, it is important to carry out three steps when developing the sectoral indicator.

- **Step 1:** Calculate the numerical indicator of exogenously determined risk and resilience.
- **Step 2:** Select and define the numerical indicator(s) of policy-determined resilience.
- **Step 3:** Undertake a rigorous comparison of the numerical indicators, either on an informal judgement basis or on a modelling basis.

The remainder of this section will outline the process for each of these three steps. The remaining two sections will apply those processes to two sectors in which macroprudential policy is most commonly applied – RRE and banking.

4.1.1 Step 1: Identification and measurement of risk and resilience indicators

All risk and resilience metrics considered should be substantively outside the direct control of the macroprudential policymaker. That is, they should be akin to a target variable, as in monetary policy. However, it is notable that in some cases policymakers can exert influence over a small subset of the total risk space (e.g. RRE measures target only new, not existing, mortgages). In that case, the aggregate value may be considered as a risk variable, as today's policymaker must effectively take the mortgage stock as exogenous.

The methodology for calculating the risk indicator is set out in steps 1a-1c.

- **Step 1a: Identify the necessary dimensions of risk and resilience, and their associated metrics.** Candidate metrics can be obtained from previous risk assessments undertaken by the ESRB or national authorities, as well as from the relevant empirical literature. The metrics should be evidence-based: that is, where possible, they should be shown to be linked to financial crises probabilities.
- **Section 1b: Bucket the indicators to allow for comparable weighting across indicators.** Bucketing is preferable to raw values or percentiles of the variable as it is more transparent and protects from extreme values driving the results. The level of the thresholds for each bucket are subject to judgement and can be informed by national authority's knowledge of indicator distributions in time or across countries.
- **Step 1c: Collapse the dimensionality of the metric, to obtain a single indicator.** Due to the multidimensional nature of financial system risk, it is likely that in most cases, more than one risk, and more than one source of resilience will be targeted within each sector. In the absence of a well-established methodology for aggregating the risk metrics, it is proposed to

use a simple weighting methodology.[37] Simple weighting helps in interpreting the results and makes them more transparent and comparable. This methodology requires all metrics to be weighted into a single indicator for risk, and a single indicator for resilience. At this stage, weightings would be subject to judgement, and chosen by the national macroprudential authority or the ESRB as deemed appropriate. More formal analysis can determine the weighting system that best reflects the overall risk environment, but as a starting point the simple weighting scheme enables sufficient flexibility to account for country specificities in any overall assessment.

4.1.2 Step 2: Determining the policy indicator

In many ways, the methodology for calculating the policy indicator is similar to that for calculating the risk indicator. The main ways in which the two processes diverge are the absence of a significant volume of empirical literature, and a need to ensure the focus is kept on policy impact, rather than on the raw number of policy actions.

The policy indicator should focus on metrics that are substantively under the control of the macroprudential policymaker. Policy indicators should feature explicitly in the stance, i.e. not only indirectly, through having influenced risk and resilience indicators observable in the market. The basis of calculation for the relevant metrics should therefore reflect this degree of control. For example, if a policy applies to new flows rather than to stocks, the flow should form the basis for the measure.

The methodology for calculating this indicator is noted in steps 2a – 2d.

- **Step 2a: Consider the full list of policies in place, as well as any substantively controlled metrics from the empirical literature**.
- **Step 2b: Simplify the list of policy measurements to as few dimensions as possible.** That is, rather than describing each policy measurement separately, an effort should be made to determine which underlying "lever" is being "pulled" by which policies. This approach allows dimensionality to be reduced, while retaining flexibility for policymakers and limiting incentives for unwarranted policy proliferation. For example, assume that Country 1 has two capital buffers – Buffer A and Buffer B – and Country 2 only has Buffer A. However, in Country 2, the level of Buffer A is the same as the combined levels of Buffer A and Buffer B in Country 1. Then, the relevant metric is the sum of Buffer A and Buffer B – otherwise, weighting will cause Country 2 to have a looser stance.
- **Step 2c: Bucket the indicators to allow for comparable weighting across indicators.** As with the risk indicators, bucketing is preferable to raw values or percentiles of the variable as it is more transparent and protects from extreme values driving the results. The level of the

[37] Going forward, more sophisticated weighting schemes can be investigated. For example, weights can be set so as to optimise a policymaker's objective function (which can be, but does not have to be, country-specific). Different weighting schemes might be used to generate a plausible range of stance assessments. National authorities have more space to experiment with weighting schemes compared to the ESRB which needs to rely on a relatively standardised common methodology.

thresholds for each bucket are subject to judgement, and can be informed by the national authority's knowledge of indicator distributions over time or across countries.

- **Step 2d: Weight the bucketed policies to obtain a single metric.** Due to the multidimensionality of the macroprudential policy domain, policies might not be able to be represented by a single indicator to the satisfaction of the policymaker. In that case, the reduced list of metrics can then be weighted to produce a summary indicator of policy-induced resilience, as with the risk and exogenous resilience. Similar to the other indicators, the selection of weights for overall resilience indicators will be subject to judgement.

4.1.3 Step 3: Combining risk, resilience and policy to assess residual risk

Since stance is equal to the residual gap between risk, resilience and policy, the size of the gap must be determined.

The simplest method of comparison is to utilise policymaker judgement. The policymaker can simply establish the degree to which the risk, resilience, and policy metrics have moved and assess – using judgement – whether the two movements are in alignment. The assessment can then be communicated through the use of case studies.

However, the judgement approach leaves some issues unresolved. First, if risk and resilience move in different directions while policy remains constant, it is obvious that the stance has changed. But if they both move in the same direction, judgement will be required to determine whether the stance has loosened or tightened. For the same reason, the judgement-based approach cannot provide an objective check on the sufficiency of any policy response.

Consequently, macroprudential authorities might prefer a model-based mapping between risk, resilience and policy. While we expect that this will be developed as the transmission mechanisms between resilience and risk become clearer through time and additional research, the Expert Group has suggested using the simple model below at this time.

$$Stance = (risk\ indicator) - (resilience\ indicator) - (policy\ indicator)$$

Before combining them, each indicator should be rebucketed. This ensures that all indicators are on a comparable spectrum and have a clear score allocation, and it removes outliers.

Once the value is calculated, if a comparison is desired then a verbalised stance assessment can be obtained. Changes in the level of the raw variable will be sufficient to determine policy direction, but for comparison purposes it may be preferable to explicitly define stance as loose, neutral or tight. These levels would be calculated by bucketing the stance variable, with the bucket thresholds determined using judgement. In order to reduce threshold effects, it is suggested that "grey zones" are established between the categories.

The model abstracts from timing. In some cases, due to transmission mechanisms, there may be a delay between policy announcement and the effects of policies on risk and

resilience. Furthermore, the effect of policies may decline over time, in which case, consideration may be given to applying an additional time-variant weighting to one or more policies. Alternatively, some of those complex issues could be dealt with using the micro-macro model (see Section 3).

One benefit of this approach is that it is not necessary in every case for the metrics to be perfectly aligned with their indicator. Crowding-out will almost certainly occur between the indicators to some degree, and this may differ across countries. However, for this approach, simplifications can be made to what is deemed to reflect risks, resilience or policy on the basis that a corresponding increase in one metric can be matched by a corresponding decrease in another. This reduces the need to net out or gross up indicators to exactly match the degree of risks or resilience. The result is a simpler and more robust indicator of stance, but one whose components cannot easily be interpreted separately.

To form an interpretation, it must be noted that stance, as measured by this approach, is essentially a measure of the national authority's tolerance of net systemic risk. If actual net systemic risk is lower than the national authority's tolerance even without policy intervention, it is not possible to measure the national authority's tolerance. For example, if management capital buffers in a country are very high – and risks are very low – the macroprudential authority can appear to have a tight stance, even if no policy action is taken. In such a situation it is preferable to ensure that stance is measured as tight, in the event that the macroprudential authority does choose to intervene.

In such a situation, the interpretation of the stance will differ for that country. The interpretation should be that stance is a measure of the minimum level of tolerance a national authority has to net systemic risk, or "maximum tightness". The national authority may have a looser stance than is measured but cannot have a tighter one. Situations where this interpretation is appropriate are noted throughout the report. These measures of stance are not comparable across countries, except to the degree that they are looser than in those countries where policies have been implemented.

4.2 Borrower-based measures for residential real-estate-related risk

The methodology and the results presented in this section complement GaR-based analyses for the BBM area. It employs risk, resilience and policy indicators that are commonly used by and understandable to policymakers. By their aggregation, it produces an overall stance assessment describing how BBM implemented in a country corresponds to the level of risk in the country's RRE lending segment and existing levels of resilience in the household sector.

The BBM stance narrows the concept of broader macroprudential stance to a segment of the market that is of high importance to macroprudential policy. Still, the stance on the RRE market can be impacted by risk in other areas of macroprudential policy and the overall resilience of the financial system, which is not necessarily fully captured by indicators related to RRE alone. A broader assessment of macroprudential stance can be reached by accounting for vulnerabilities and resilience stemming from the capital position of the banking sector. This aspect is presented in the next section.

The stance for BBM has been found to broadly reflect the assessment of the RRE risk presented by the ESRB on two occasions in 2016 and 2019. It suggests that such a stance indicator, being a consistent measure to be used across countries, can be a useful measure for policy discussions. Besides that, the stance assessment can also be analysed in the time series dimension, whether its evolution corresponds to the views of national authorities on their policy set-up. Such analysis is made possible by the inclusion of a country-specific disaggregation of the stance index in the next section.

The BBM measure of stance can be easily expanded to include other variables and aggregation mechanisms. Currently the approach reflects expert knowledge stemming from the ESRB Working Group on Real Estate Methodologies (WG-REM), as well as data limitations. The measure of stance can be enriched with other variables, if available, and alternative weighting schemes.

4.2.1 Methodology

The aggregation builds on the conceptual phase (Phase I) by distinguishing risk, resilience and policy segments. The stance for BBM consists of three elements:

1. **Identification and measurement of risk and resilience.** This part has been extensively researched by WG-REM and in academic literature.
2. **Measurement of borrower-based policies.** The harmonised measurement of the level of policy stringency at the country level is necessary to compare the package of policies implemented with the level of risk and resilience. These approaches to measuring policy stringency are both novel and interesting in their own right. As with all harmonised approaches, country specificities, where appropriate, would have to be considered in any formal assessment.
3. **Aggregation to produce a stance assessment.** A combination of the indicators in the three building blocks of **the stance project's conceptual phase** – risk, resilience and policies – formulates the stance.

The baseline equation for BBM stance in the RRE:

$$STANCE_{RRE}^{BBM} = \sum_{i=LTV,DSTI} w_i^{STANCE}\{[Risk_i - Resilience_i] \cdot SystemicImportance - Policy_i\}$$

where w_i^{STANCE} is the weight of two components related to value-based restrictions (loan-to-value – LTV) and income-based restrictions (debt-service-to-income – DSTI) (LTV and DSTI stance respectively). The weight increases with the size of the residual risk. $[Risk_i - Resilience_i]$ reflecting the combined effect of the build-up of risk and resilience in the two main segments related to the collateral (connected to LTV stance) and funding/Household stretches as identified by the WG-

REM.[38] $Systemic\ Importance$ reflects the size and potential spillovers from the RRE market to the financial system and the economy. $Policy_i$ reflects the policy actions taken in the given segment of the market.

Scores in the above categories are measured using a bucketing approach. Calibrating functions that would convert these raw values into risk, resilience and policy stringency scores is no trivial task. Currently, buckets are easier to calibrate and verify with policymakers. This procedure limits the risk of extreme observations driving the results and facilitates qualitative assessment. Risk, resilience and policy indicators are clustered into four buckets, ranging between 0 and 3, that can be interpreted as in Table 5. To preserve its amplificatory role and to avoid nullifying the residual risks evaluation, Systemic importance is exempted from assuming a bucket score of 0, and it is also clustered in four buckets as in Table 5. The indicative bucketing thresholds are shown in Section 4. As the formulas below show, numerical bucket scores will play an important role in subsequent steps.

Table 5
Bucketing interpretation

Bucket score	Risk	Resilience	Systemic importance amplifiers	Policy
0	Low	Low	Not applicable	Loose
1	Medium	Reduced	Limited	Medium
2	Elevated	Medium	Medium	Restrictive
2.5			Elevated	
3	High	High	High	Stringent

This stance indicator reflects the following principles:

- **Matching stretches and policy variables.** The stance indicator matches particular policy measures with a corresponding primary risk category. Two segments of policies are distinguished – related to value-based restrictions (LTV) and income-based restrictions (DSTI). These policy decisions operate through different channels and reflect different risks, with those risks closely aligned to the stretches defined in the WG-REM report. LTV limits are expected to affect risk related to the collateral stretch I, while DSTI limits influence the funding (F) and household (H) stretches. In the case of house price overvaluation and/or exuberant developments in house price booms, the communication can be expected to be based on indicators belonging to the collateral stretch. In situations of exuberant developments in lending conditions, communication is likely based on indicators from the funding and household stretches. As a consequence, these segments should be treated separately in the stance approach. The collateral stretch indicators do not currently include model-based results

38 According to WG-REM methodology, three stretches have been identified: Collateral, Funding and Household. In the stance approach, the Households indicators are included in the resilience part of the Funding component.

for overvaluation, as the accuracy of these estimates was contested, with four indirect measures of the stretch being used instead.[39]

- **Amplifiers.** Systemic importance/spillovers (S) amplifies all the other stretches (C, F, H). We allow for the residual risk indicator severity to be scaled by the degree of systemic importance or the potential for spillovers. The systemic importance dimension is determined by three factors, namely: (1) the share of housing investment in GDP, (2) the degree of banking sector exposures to real estate, and (3) the degree of banking sector exposures to the construction sector.
- **Weighting the two policy segments.** Aggregation of stances with respect to value-based restrictions (LTV) and income-based restrictions (DSTI) should be based on the relative size of the residual risk in the respective areas in a given country.

Table 6 outlines a shortlist of key indicators that could be used by the ESRB when communicating the stance for the RRE sector. This list is indicative and represents a common starting point for measuring and communicating risk and resilience in the RRE sector across Member States. A relatively fixed methodology would enable cross-country comparison by the ESRB. National authorities can deviate from it by either (i) using only some indicators, depending on the risk situation and the policy mix in their jurisdiction; or (ii) complementing it with alternative indicators deemed more appropriate given country specificities. There might be situations that make it necessary to aggregate the risk indicators; these essentially relate to the existence of multiple sources of systemic risk in the RRE sector and/or specific structural features of the RRE market that would amplify the risks originating in one (or a combination) of the sources.

The list is a combination of risk indicators defined by the ESRB Working Group on Real Estate Methodologies (WG-REM) and indicators that were found to be good predictors of crises obtained from the literature on real estate, banking and/or financial crises. The latter have been classified along the stretches used by the WG-REM to assess risks and vulnerabilities in the EU RRE sector.[40]

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[39] In cases where the measures of household price overvaluation are robust, the percentage of overvaluation may be the most straightforward measure of the risk in the collateral stretch dimension.

[40] In the WG-REM, the selection of indicators within stretches was motivated by the literature on real estate bubbles and early warning models, and attempted to strike a balance between cross-country coverage and completeness.

Table 6

Risk and resilience indicators

Collateral (C)	Funding (F)	Household (H)	Systemic importance/spillovers (S)
C1 RRE price growth	**F1** Mortgage credit growth	**H1** HH sector DTI	**S1** Housing investment-to-GDP
C2 RRE price gap	**F2** Mortgage credit-to-GDP ratio	**H2** HH sector DSR	**S2** Bank exposure to RRE in relation to capital
C3 Price-to-income ratio	**F3** HH credit-to-GDP gap		**S3** Bank exposure to construction in relation to capital
C4 Price-to-rent ratio			
C5 LTV (observed on the market)			

Note: Blue denotes risk indicators. Green denotes resilience indicators. Red denotes risk amplification indicators.

Step 1: Following the WG-REM approach, all indicators are first normalised on a four-step scale. Bucketing based on the thresholds established for each indicator in the WG-REM report is used for indicators that are included in the WG-REM methodology and have quantitative thresholds defined.[41] For the other indicators, thresholds are indicatively set – based on expert judgement – taking into account the value of the indicator relative to the whole sample (cross-country/time) distribution (see Section 4 for details on threshold values). This ensures that all indicators are first normalised and then weighted across stretches and compared against policy indicators.

Step 2: Risk and resilience variables are aggregated to provide an indicator for residual risk in both value-based (R1) and income-based (R2) segments.[42] The four dimensions of the WG-REM approach – three stretches and systemic importance – constitute a starting point to measure risk and resilience. In using the WG-REM findings, the indicators in the collateral and funding stretches are considered to be pure risk indicators, whereas the household stretch indicators can be considered resilience indicators. When combined in this manner (risk minus resilience), they provide an approximation of residual risk. This residual risk is classified into four buckets, ranging from 0 to 3, representing a low-medium-elevated-high risk scale. The formulas for the Value and Income segments are as follows:

- **Value-based segment:** Risk in the collateral stretch, after taking existing resilience into account, weighted by systemic importance: $r1 = \left(\frac{C1+C2+C3+C4}{4} - C5\right) \cdot \left(\frac{S1+S2+S3}{6}\right)$, where r1 is residual risk in the value-based segment, C1 to C4 are bucket scores for risk indicators, C5 is the bucket score for the resilience indicator, S1 to S3 are bucket scores for systemic importance (divided by 2 to reduce the multiplicative effect of high importance – note high

[41] According to the WG-REM methodology, high values for the resilience metrics (H1) debt-to-income (DTI) and (H2) debt service ratio (DSR) corresponded to a bucket score of 0. Therefore, high values of DTI and DSR did not increase the resilience of the financial system. Within the stance approach, a different configuration has been tested and implemented. High values of DTI and DSR correspond to a bucket score of -1 and therefore contribute to worsen the assessment of residual risk. For further details, see Annex 2, Table A.7.

[42] In principle, the indicators used for resilience could be those that reflect households actively engaged in the market in a given period (buying RRE and drawing down new or refinanced mortgages). Such data are not readily available across all countries, and aggregates for the entire household sector are used in those instances. See Section 4.2.3.

systemic importance multiplies the risk not by 3, only by 1.5). Calibration of these formulas are, at the current juncture, based on expert judgement.

- **Income-based segment:** Risk in funding and household stretch, after taking existing resilience into account, weighted by systemic importance: $r2 = \left(\frac{F1+F2+F3}{3} - \frac{H1+H2}{2}\right) \cdot \left(\frac{S1+S2+S3}{6}\right)$, where r2 is residual risk in the income-based segment, F1 to F3 are bucket scores for risk indicators, H1 and H2 bucket scores for resilience indicators, S1 to S3 bucket scores for systemic importance (divided by 2 to reduce the multiplicative effect of high systemic importance as described above).

Step 3: Policy is represented through LTV and DSTI limits, or their equivalents, for a standardised loan. Policy stance for the value-based and income-based segments is computed in the following way:

- **Value-based segment:** Residual risk in the collateral stretch is compared with the stringency of LTV limits: $LTV\ stance = R1 - P1$, where R1 is the bucket score for residual risk in the value-based segment and P1 the bucket score for the policy indicator.

- **Income-based segment:** Residual risk in the funding and household stretch is compared with the stringency of DSTI limits: $DSTI\ \ stance = R2 - P2$, where R2 is the bucket score for residual risk in the income-based segment and P2 the bucket score for the policy indicator (see Table 5).

Measurement of macroprudential stance in the RRE area requires numerical representation of BBM policy limits. Ideally, the entire spectrum of BBM could be characterised by a single policy variable, comparable across countries and across time. Such a policy variable could be then compared to the actual level of risk and resilience, in order to deliver a stance assessment for RRE in a given country.

Representing the entire spectrum of BBM in a single number is challenging. There are at least four reasons for this. First, there are seven types of BBM currently in place in different parts of the EU that need to be combined in the policy variable. These types can be roughly divided into three groups as outlined in Table 7 below. Second, measures differ across countries in the scope of application and the range of exemptions. Third, input variable definitions, most notably “income” or “value”, are not harmonised across countries. Finally, measures are implemented through a range of legal instruments spanning from mere guidance on sound lending practices to binding and legally enforceable limits. Going forward, a metric that classifies limits along their bindingness would be beneficial. This would make it possible to differentiate between hard measures and recommendations.

Table 7

Spectrum of BBM

Value-based debt restrictions	Income-based restrictions	
	Income-based debt restrictions	Income-based debt servicing restrictions
Mortgage loan-to-value limits (LTV)	Debt-to-income limits (DTI) Mortgage loan-to-income limits (LTI)	Debt service-to-income limits (DSTI) Amortisation requirements Term limits Household interest rate stress testing

The proposed approach uses LTV and DSTI limits as the main policy variables and expresses some of the other restrictions in their equivalents. LTV, as the only indicator related to the valuation of collateral, is distinct from the income-based restrictions. The income-based restrictions can be aggregated, as debt servicing restrictions can be shown to be transformations of the income-based debt restrictions. Given the fact that EU countries use Debt-/Loan-Service-to-Income (DTI/LSTI) limits more often than D/LTI limits, the proposed approach focuses on DSTI as the main policy variable and recalculates other income-based restrictions in their equivalents. Moreover, as different rules apply to different loan market segments, the proposed approach needs to define a standardised loan in order to evaluate the policy variable. The limits applicable to such standardised loans then enter the policy variable for a given country. The choice of this standardised loan matters and the market share of the standardised loan might differ across countries. Nevertheless, the definitions of standardised loans enable comparison of the limits without any knowledge of the composition of the mortgage lending markets in the EU. The standardised loan was chosen as a loan granted to an applicant with average income in the given country, buying a permanent residence in a metropolitan area (the collateral location does not play any role for now, as the past and present limitations are all country-wide). The applicant should not use exceptions, such as speed limit or exceptions for first-time buyers, as these might blur the cross-country comparisons. Given the plethora of BBM used and their often-differentiated character across market segments, arriving at a single policy indicator is challenging. Details concerning the matching between various BBM measures and loan standardisation can be found in the Annex. The extent to which the standardised loan reflects the current market conditions or policy design in a given country should be considered when formal assessments are being concluded. For example, first-time buyers may form a significant part of the overall market, or the definition of income for policy purposes may not be the net disposable income.

The degree of legal bindingness varies. The proposed approach considers any borrower-based measure reported to the ESRB database by the national authority which (i) contains a quantitative limit, (ii) goes beyond a general requirement for banks to be prudent in lending, and (iii) can be monitored to ensure its compliance by the supervisory authorities. The fulfilment of conditions (ii) and (iii) is in some case ambiguous and expert judgement must be exercised. In general, both legally binding and recommended limits are used without distinction, as there is anticipation that recommended limits will be followed by banks. If a national authority disagrees with the classification or observes significant non-compliance, it might consider removing the non-binding limit from the policy indicator. A mechanistic attitude could be adopted in this respect, for example downgrading non-binding measures by one or considering more buckets,[43] though there is a risk that it might not capture well the difference in bindingness to facilitate cross-country and across-time comparison.

Step 4: Overall $STANCE_{RRE}^{BBM}$ is calculated by taking a weighted average of the LTV stance and DSTI stance: $STANCE_{RRE}^{BBM} = LTV\ stance \cdot w_{LTV}^{STANCE} + DSTI\ stance \cdot w_{DSTI}^{STANCE}$, where the weights are set in a way which attributes greater weight to areas with a higher level of residual systemic risk (Table 8)[44].

Table 8

Aggregating value-based and income-based residual risk into overall BBM stance

Difference in bucket scores for residual risk for value-based segment and income-based segment (R1 – R2)	Weight attributed to the value-based segment w_{LTV}^{STANCE}	Weight attributed to the income-based segment w_{DSTI}^{STANCE}
-3	0.25	0.75
-2	0.33	0.67
-1	0.42	0.58
0	0.5	0.5
+1	0.58	0.42
+2	0.67	0.33
+3	0.75	0.25

The overall BBM stance indicator can then be mapped into a verbalised stance assessment. Higher values of the overall stance denote situations with higher residual risk or with less stringent policies implemented. The stance indicator can be mapped to verbalised stance assessment, based on a simple conversion as shown in Table 9. The cut-off values were selected based on expert judgement, though the knowledge of the distribution of the stance indicator over time and across countries can provide insight into the appropriate thresholds. Going forward, those thresholds could be refined based on insights from national authorities.

Including grey areas in the stance assessment might help prevent excessive oscillation between a "loose" and "neutral" or a "neutral" and "tight" result. This is in line with the stance being a mere quantitative guide in macroprudential policy decisions, with additional information expected to be taken into account in practical policymaking. This could include the wider set of judgements discussed in Section 4.2.3.

43 For example, a non-legally binding measure with characteristics form Bucket 2 can be allocated to Bucket 1.

44 The logic of the weighting scheme is the following. First, the weighting scheme assigns a minimum 25% and maximum 75% weight to each segment. Second, if the levels of residual risk differ maximally, the riskier segment receives 75% weight. If the level of residual risk is comparable in both segments, the weight is equal for both segments. Thirdly, between these extremes, the weight increases linearly in the difference in bucket scores.

Table 9

Mapping of overall stance values to verbalised stance assessments

Value of the overall stance indicator	Stance assessment
Above 1.5	Loose stance
(1; 1.5]	Grey zone for loose stance
(-0.5; 1]	Neutral stance
(-1.5; -0.5]	Grey zone for tight stance
-1.5 and below	Tight stance

4.2.2 Country results for stance in the area of BBM

The BBM stance has been calculated for a number of EU countries, subject to data availability. The evolution of the overall BBM stance index is presented in Table 10. The numbers reflect the scores shown in Table 5, while the colours mirror the verbalised stance assessment presented in Table 9. The index could not be computed for some countries for which the ESRB does not currently have the data it requires to calculate the stance. However, national authorities can in these instances still potentially use data available to them to calculate the stance for their economies.

Given the relatively short time span and length of the financial cycles, frequent shifts of stance are not necessarily to be expected. In most instances, the stance is relatively stable, suggesting that policies mimic the evolution of risk. Nonetheless, this stability is not a sufficient condition for stance to be deemed appropriate – it can simply remain too loose (or too tight) for a long period of time.

Table 10

Overall BBM stance index

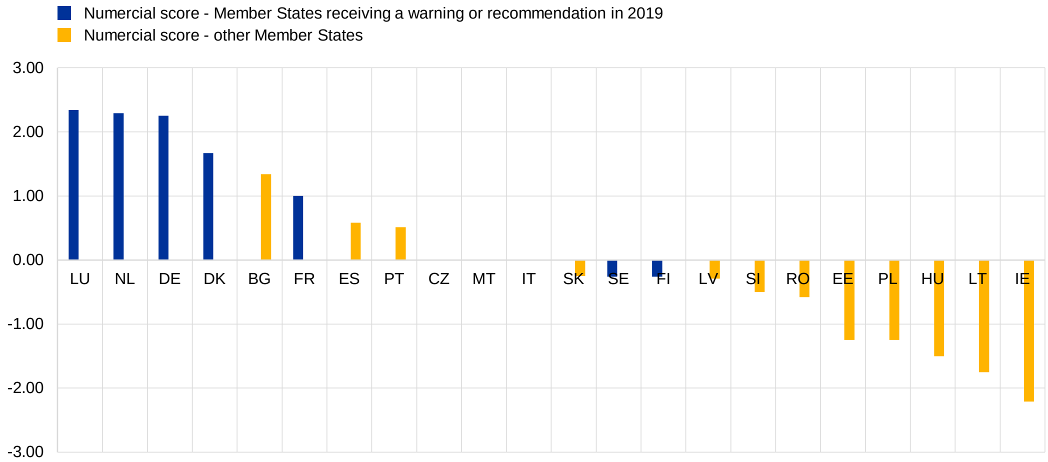
Numercial score	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	ESRB W 2016	ESRB W/R 2019
BE																	W	R
BG					0.0	0.0	0.0	0.0	1.3	1.3	1.3	1.3	1.3	1.3	0.6	0.6		
CZ	0.3	0.3	0.3	1.1	0.3	-0.3	-0.3	-0.3	-0.3	0.4	0.4	0.0	0.0	0.0				W
DK	0.2	0.2	0.2	0.2	1.0	1.0	1.7	1.7	1.7	1.7	1.7	1.7					W	R
DE	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3						W
EE	-1.3	-1.3	-0.8	-0.8	-0.8	-1.3	-0.2	-0.2	-0.8	-0.8	-1.3	-1.3	-1.3	-1.3	-1.3	-0.8		
IE	-2.2	-2.2	-2.2	-2.2	-2.2	-2.2	-2.2	-2.2	-2.2	-2.2	-2.2	-2.2	-1.1	-1.1	-1.8	-1.8		
GR																		
ES	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0		
FR	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.0	1.0	1.6	1.6	1.6		W
HR																		
IT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
CY																		
LV	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3		
LT	-1.2	-1.2	-0.5	-0.5	-1.2	-1.8	-1.2	-1.2	-1.8	-1.2	-1.8	-1.8	-1.8	-1.8				
LU									2.3	1.6	1.6	2.3	2.3	2.3	2.3	2.3	W	R
HU	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5		
MT	0.6	1.3	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	-0.2	-0.2		
NL	1.2	1.2	1.2	2.1	2.1	2.1	2.2	2.2	1.8	1.8	2.3	2.3					W	R
AT																	W	
PL	-1.0	-1.0	-1.0	-1.0	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3		
PT									2.3	2.3	0.5	0.5	-0.3	-0.3	-0.3	0.5		
RO	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6		
SI	0.0	0.6	0.6	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-0.5	-0.5	-1.5	-1.5	-1.5			
SK	-0.3	-0.3	0.3	0.3	0.3	0.1	-1.1	-1.1	-0.5	-0.5	-1.2	-0.3	-1.9	-2.5	-1.2			
FI	0.6	0.6	0.3	-0.1	-0.1	-0.1	-0.1	0.3	-0.1	-0.1	-0.3	-0.3	-1.0	-1.0	-1.0	-0.3	W	R
SE	1.4	1.4	1.4	1.4	0.7	0.7	0.7	0.7	1.0	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	W	R
GB																		

Notes: Colours reflect verbalised stance assessment as presented in Table 5, i.e. loose in orange, grey zone for loose in yellow, neutral in white, grey zone for tight in light blue and tight in dark blue. Where cells are empty, no stance could be computed due to lack of data. In the right column, "W" stands for warning and "R" for recommendation. In both 2016 and 2019, the ESRB issued warnings and recommendations for a subset of European Economic Area countries which were assessed to exhibit vulnerabilities in the RRE market.

The performance of BBM stance for RRE can be verified against the ESRB assessment of the systemic risk stemming from the RRE markets in individual EU countries, made in 2016 and 2019. The BBM stance indicator might be expected to align with ESRB warnings on medium-term vulnerabilities in the RRE sector – countries with a loose stance receive warnings or recommendations and others, with a neutral or tight stance, do not. The BBM stance performs relatively well in this respect (Chart 18), at least partly validating the information content of the BBM stance and its usefulness for policy discussion. This notwithstanding, it should be underscored that ESRB assessment and BBM stance are unlikely to fully coincide. This is because ESRB assessment, warnings and recommendations encompass not only the policy stance related to BBM, but also risk weights related to RRE, as well as allowing for expert judgement. While this points to the limitations of the BBM stance as a single indicator for RRE, it does also suggest that aggregation of various strands of stance, including BBM, capital and/or liquidity, in the context of expert judgement could alleviate some of the limitations.

Chart 18

BBM stance index, 2019 vs. ESRB RRE warnings or recommendations, 2019



Note: Stance value taken as an average of BBM stance in Q4 2018. Stance above 1.5 is considered loose, while below -1.5 is considered tight. Countries for which no Stance metrics were available have been excluded by the subset of countries for which results are presented.

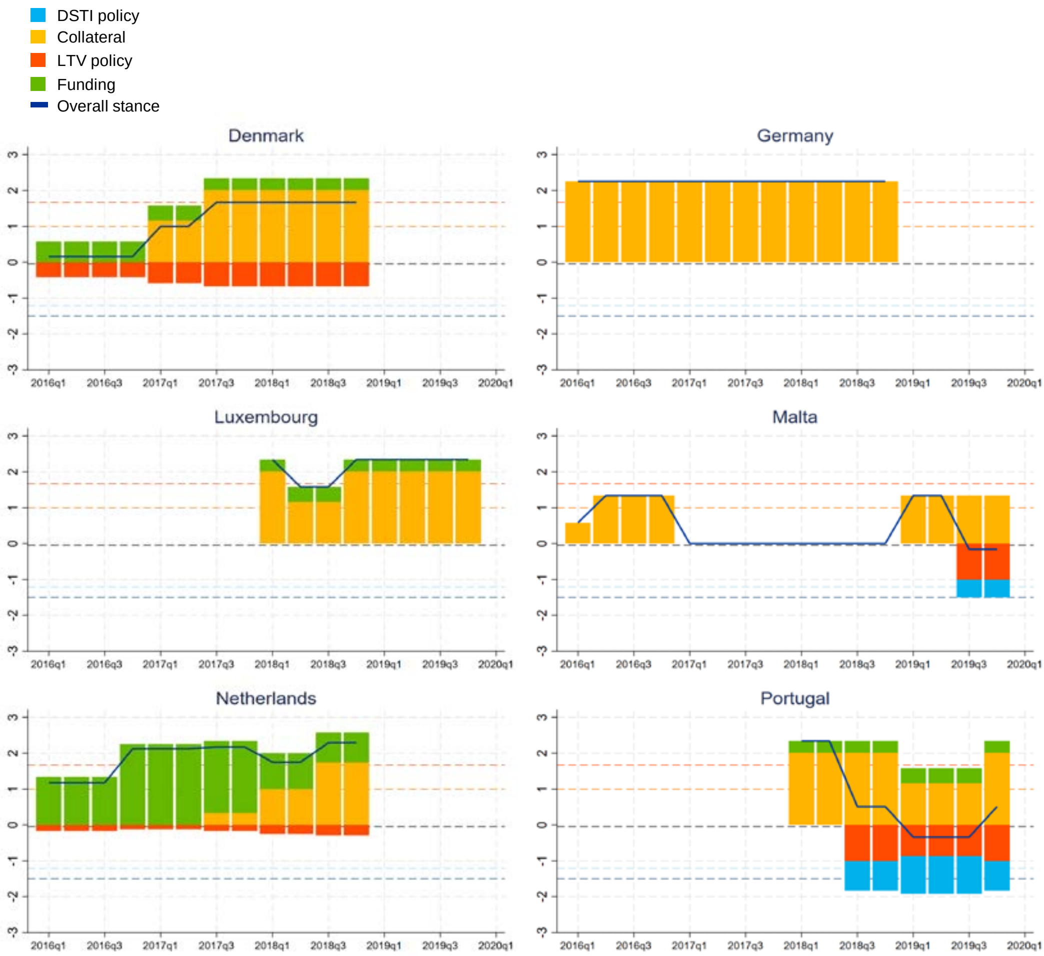
A useful feature of the stance indicator is the ability to decompose it into constituent parts, as it can inform the policy discussion by providing insight into the factors driving the overall index (Chart 19). This breakdown makes it possible to assess how high a particular risk is in any given country relative to others and how effective the measures taken have been. At the same time, the decomposition reveals whether the neutral stance is simply the result of a relatively benign risk environment or high risk that is mitigated by policy measures. Last but not least, decomposition sheds more light on developments in individual countries and allows for more in-depth assessment by national authorities and experts.

To provide more insights into the evolution of overall stance, a graphical decomposition of its high-level components is proposed. At the highest level, overall stance is represented by a continuous line and decomposed in a weighted sum of bucketed LTV and DSTI stances (see Table 8 for the weighting scheme). The bucketed LTV and DSTI stances are determined by the bucketed residual risks for both stretches (collateral and funding) and policy measures (LTV and DSTI). The chart therefore makes it possible to observe the evolution of residual risks and the impact of policy measures against this backdrop. Chart 19 shows a subset of all the countries analysed, illustrating interesting applications of the model discussed (see Annex 2 for all other charts). Denmark, Germany, Luxembourg and the Netherlands received ESRB warnings and recommendations in

September 2019, and are assessed as countries with a loose stance. In a risk environment characterised by vulnerabilities on one or both stretches, Malta and Portugal represent two examples of how introducing policy measures can have a material impact on overall stance and neutralise its level.

Chart 19

Decomposition of BBM stance into LTV and DSTI stance, determined by collateral, LTV policy, funding and DSTI policy



Notes: Higher values denote a looser stance. The solid line shows the overall stance assessment. The dashed lines indicate the 10th, 20th, 50th, 80th and 90th percentiles of overall stance in the entire dataset (all countries, all years). The absence of some elements for some countries means that the respective element has a score of 0 (low risk, low resilience, no policy or very loose policy in place). Additional results, related to other countries not covered in Chart 19, are available in Annex 2, Chart A.2.
Source: ESRB calculation based on STATA model.

The above analysis is an example of how the concept of stance, being the product of risk, resilience and policy, can be operationalised as a relatively narrow measure for a subset of RRE. This has the drawback of being relatively narrow, as some policies related to the RRE sector may not necessarily consist of BBM, and yet affect the very same risk BBM aim to tackle. A natural way to overcome this is to expand the indicator to cover a broader set of risks and policies, potentially beyond RRE. The above method for stance is easily scalable to many dimensions and, from a technical point of view, such an expansion is straightforward to implement. The main challenges are twofold. First, as the analysis of the BBM revealed, data are not always available and even for the relatively well-known BBM tools, their idiosyncratic characteristics make it difficult to map them to standardised, comparable policy measures. Second, as the number of risk areas and policy tools increases, the conceptual challenge concerning the appropriate aggregation and matching of risk and accompanying actions also becomes considerably more demanding.

4.2.3 Reflections on data availability, heterogeneity of BBM and implications for further development

Data availability issues will become less pressing in the coming years. Indicators for monitoring the risks in the domestic RRE sector will be collected[45], as recommended by the ESRB Recommendation on closing real estate data gaps (ESRB/2016/14 as amended by ESRB/2019/03). These indicators relate to some lending standards for the overall RRE sector (i.e. loan-to-value ratio at origination, current loan-to-value ratio, loan-to-income ratio at origination, debt-to-income ratio at origination, loan-service-to-income ratio at origination, debt-service-to-income ratio at origination, number and amount of RRE loans disbursed, maturity of RRE loans at origination), and some additional metrics for the buy-to-let segment, where this segment represents a significant source of risk stemming from the domestic RRE sector (i.e. interest coverage ratio at origination, loan-to-rent ratio at origination). ESRB/2016/14 recommends that both the univariate distribution and some joint distributions of the relevant indicators are monitored.

All European Economic Area (EEA) countries already have a framework in place for monitoring risks related to their domestic RRE sector. This is shown in the assessment of compliance with Recommendation ESRB/2016/14 based on end-2020 reporting by EEA countries. An exception to this is the buy-to-let segment, which was not considered material in 23 out of the 31 EEA countries assessed. The monitoring framework contains the large majority of the indicators mentioned above (except for three EEA countries where only a narrower set of indicators is available).

Thus, the indicators needed for the work on macroprudential stance are already available at EEA country level for their overall domestic RRE sectors. With collection and distribution at EU level, as foreseen by Recommendation ESRB/2016/14, they will allow for a more precise analysis. The assessment findings show that the indicators for the buy-to-let segment are only available in a limited number of countries, making their use for the macroprudential stance work quite challenging.

Differences in implementation of BBM can be subject to future refinements of the methodology. BBM are implemented in diverse ways across EEA countries. Differences are typically found with respect to exemptions or speed limits, where a share of loans can exceed the caps, where different borrower categories such as first-time buyers are treated differently, or where definitions of income differ across countries. These differences are abstracted from in the use of a standardised loan in assessing policy. The assumptions underpinning the standardised loan (Annex 2) may not be fully reflective of the prevailing conditions in a given country (see discussion

[45] According to Recommendation ESRB/2016/14, “the ECB is therefore well-placed to coordinate such a data collection and distribution at Union level” and should work “in consultation with the Eurostat and the national statistical agencies as appropriate.”

in Section 4.2.1 above). Further enhancements of this method could be considered through the practical use in ESRB fora to account for such country specificities.[46]

4.3 Capital-based measures

This section outlines how the capital-based measures (CBM) stance can be calculated. Sections 4.3.1-4.3.3 demonstrate how the methodology outlined in Section 4.2 can be applied to this sector and set out with the results.

While the Expert Group proposes that the ESRB use this methodology, national authorities are encouraged to explore their own data sources and exercise expert judgement to adjust the approach for their own use – as they deem fit. This approach does not result in a quantified version of capital buffers that authorities require in order to achieve a neutral stance, since the risks they face today may not equate to the risks that appear in their forward-looking analyses.

4.3.1 Identification and measurement of risk and resilience

Table 11 outlines a shortlist of key indicators that could be used when communicating in relation to the capital-based measures stance. The list is based on risk indicators used by policymakers when activating capital measures. The main references are the ESRB guidance for the CCyB[47] for cyclical risks, and the framework for the O-SII buffer in the case of structural risks and the systemic risk buffer for both remaining cyclical and structural risks.

Capital-based risks are divided into cyclical risks and structural risks. These two categories of risk are commonly distinguished in policy practice (ESRB, 2019). Distinguishing between the two categories is not always straightforward in practice. Some metrics used to evaluate structural risks are also monitored to detect the emergence of cyclical risks, and some vary over the cycle (such as exposure concentration and asset commonality).[48] In general, structural risks are not expected to abate naturally over the cycle and have the potential to amplify serious negative consequences on the financial system and the economy.

The domestic systemic risk indicator (d-SRI) was selected as the key cyclical risk indicator for measuring stance, as it represents a widely available measure of cyclical risk. The d-SRI measures cyclical systemic risks that originate from a country's domestic non-financial private sector (NFPS). It is defined as a composite indicator given by a weighted average of a set of indicators representative of the main risk categories (as defined in Recommendation C of the ESRB Recommendation on "Guidance for setting countercyclical buffer rates", ESRB/2014/1).[49] This

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[46] In the case of Ireland, for example, first-time buyers account for approximately half of the mortgage market yet have a less stringent LTV requirement (90%) in comparison to second and subsequent buyers (80%), with the latter being the basis for the standardised loan used in this report. In addition, a certain portion of mortgage lending is allowed above the benchmark LTV and LTI ratios in the Ireland BBM. Finally, the LTI limit is defined with respect to gross income in Ireland and not net disposable income. All these factors would have to be considered when interpreting the BBM stance results from this method in coming to a formal stance assessment.

[47] **ESRB Recommendation 2014/1 on guidance for setting countercyclical capital buffer rates**.

[48] When identifying structural systemic risks and applying the systemic risk buffer, the emphasis should mainly be on cross-sectional (cross-bank and cross-country) comparisons. However, the time-series evolution of indicators for the same country could also be of interest since it would facilitate the assessment of potential risks over time (IWG Report).

[49] The weights are chosen to optimise the early warning properties of the composite systemic risk indicators.

indicator also features as a cyclical variable in the empirical GaR model in the stance toolkit (see Section 2.2). For domestic use, however, NDAs are encouraged to complement the d-SRI by indicators that, in their view, improve the identification of cyclical systemic risk.

Structural risk indicators have been selected based on three broad categories of structural risks, identified by the Report of the IWG Expert Group on Structural Buffers.[50] These categories include (i) risk stemming from structural characteristics of the banking sector, (ii) risk stemming from propagation and amplification of shocks within the financial system, and (iii) risk stemming from the real economy.

This list cannot accommodate all possible sources of risk. National authorities are therefore advised to (i) complement this list with additional indicators that take into account relevant national specificities, and (ii) assign higher weights for the structural indicators that describe the predominant risks in the domestic jurisdiction. Also, the challenges of identifying and quantifying the partial overlap remain both for the risk assessment and subsequent policy considerations across the different risk categories. Reconciliation of this potential overlap is left for future research.

Table 11
Risk indicators

Cyclical risk (C)	Structural risk (S)	
C1 Domestic systemic risk indicator (d-SRI)	Structural characteristics of the banking sector	**S1** Total banking sector assets-to-GDP
		S2 Market share of five largest banks (CR5)
		[**S3** NPL ratio][51]
	Risks stemming from the real economy	**S4** Trade openness-to-GDP
		S5 Total NFPS credit-to-GDP
		S6 Sovereign exposure as a share of total exposure
		S7 Foreign exposure as a share of total exposure
	Propagation and amplification of shocks within the financial system	**S8** Intra-financial sector assets as a share of total bank assets
		S9 Herfindahl-Hirschman Index of bank assets

Each indicator (risk, resilience and policy) is discretised in four buckets, from 0 (low risk/resilience or absence of the measure) to 3 (high risk/resilience and high policy intervention). Specifically, we define buckets on the basis of each indicator's distribution over time and across countries, by considering the following percentiles as thresholds: 50th, 80th and 90th (see Table A.11 in Annex 2).

The bucketed versions of the risk metrics are weighted into a single indicator, based on the formula below, yielding a proxy for the level of gross systemic risk.

50 ESRB (2017), *Final report on the use of structural macroprudential instruments in the EU*, December.

51 Dropping NPL ratios might also be considered, due to the high cyclicality of the indicator. Alternatively, a longer-term or lagged definition of the NPL ratio could be used to distinguish it as a structural variable.

$$G = 0.5 \cdot C1 + 0.5 \cdot \frac{1}{3}\left(\frac{S1 + S2 + S3}{3} + \frac{S4 + S5 + S6 + S7}{4} + \frac{S8 + S9}{2}\right)$$

In the case of structural risks, we calculate the average value of the bucketed indicators in each category (second column of Table 11) and then we divide the results for the number of categories (3) in order to give the same relative weight as cyclical risk (C1).

In contrast to risk, it is not necessary to disaggregate resilience into structural and cyclical components. Resilience of banks to shocks is characterised by their overall capital levels. Macroprudential buffers are not the only source of resilience: microprudential capital requirements, and management buffers also provide a source of capital to improve banks' ability to withstand shocks, absorb losses, and continue to lend. Buffers may be released during crises or downturns, but as they are utilised risk also falls, thus netting out the effect on stance.

Total capital net of the CBR in the banking sector scaled by total banking sector assets is suggested as the measure of resilience. This measure encompasses the resilience induced by management decisions and microprudential policy, which are part of the environment and act to offset some of the risk encompassed by the risk metric. The policy-induced level of capital buffers is removed from the measure, in order to prevent double-counting of the buffers across both resilience and policy. The resilience indicator (R) can therefore be calculated as

$$R = \frac{Total\ capital - CBR}{Banking\ sector\ assets}$$

4.3.2 Determining the policy indicator

Macroprudential policy in the banking sector can be summarised by the capital requirements it generates for the banking sector. Reflecting the powers of the macroprudential authority, and consistent with the concept of policy stance being broadly a measure of the use of that power, macroprudential policy is measured by the level of the CBR. The indicator is taken with respect to the banking sector as a whole, in order to allow for variation over banks, while also adjusting for their relative importance.[52]

Given this practice of setting macroprudential buffers with respect to the total risk exposure amount (TREA), this methodology chose to scale the CBR with the TREA.[53] This is in contrast to the resilience indicator, which is scaled by total assets. The policy indicator (P) can therefore be calculated as $P = \frac{CBR}{TREA}$.

Only the latest announced level of the CBR is considered in the policy indicator. Due to phase-in of some buffers, there might be a difference between the actual CBR in place and that

[52] Other policies, such as capital requirements generated by risk-weights are now partly represented in the resilience indicator, insofar as they translate into capital ratios.

[53] This scaling creates some asymmetry with the resilience indicator, which is scaled by total assets. However, scaling with total assets enables changes in the policy indicator to be avoided, due to a change in bank risk weights in the absence of policymaker intervention.

which was announced will apply in future. This methodology uses only the latest announced fully phased-in buffers. This simplifies the analysis and avoids the need to examine the pass-through of the policy decision and its effectiveness. It also acknowledges that the policy decision, and not its implementation, is of primary relevance (as banks might take action before the measure becomes binding) and that some buffers have a legally required minimum phase-in period. The drawback of this choice is that policies with longer and shorter phase-in periods are treated as equally effective, even though longer phase-in makes the policy less binding for a bank.

This approach reduces the spectrum of policy indicators into one variable that is understandable to policymakers. As there is only a single indicator, it is not necessary to weight the indicators, removing an element of complexity from the process.

Data availability might constrain the calculation of the requirement. Precise information on the TREA and capital requirements might require access to supervisory data which might not be available to the ESRB on a frequent basis at the current juncture. In the event of data gaps related to those variables, the proper calculation of resilience and policy indicators may then be impaired.

4.3.3 Combining risk, resilience and policy

Once risk, resilience and policy indicators have been calculated, they are bucketed in order to ensure they are all on a comparable scale. A scale of 0 to 3 is used for each indicator, with 0 indicating low risk/resilience, or policy absence, and 3 indicating high risk/resilience, or considerable policy intervention. Resilience and policy can be subtracted from risk in order to determine stance. The overall stance indicator is then calculated as: $STANCE^{CBM} = G_b - R_b - P_b$, where Gb, Rb and Pb are the bucketed gross risk, resilience and policy indicators respectively.[54] This provides a numerical value for stance which will vary in the range between -6 and +3. Higher values of the overall stance denote situations with higher residual risk or with less stringent policies implemented.

The overall stance indicator can then be mapped to a verbalised stance assessment, based on a simple conversion as shown in Table 12. The cut-off values were selected based on expert judgement, though the knowledge of the distribution of the stance indicator in time and across countries can provide insight into the appropriate thresholds.

[54] Also, in this case, the buckets are defined in terms of the distribution of the indicators by using the median value and the 80th and 90th percentiles as thresholds.

Table 12

Mapping of overall stance values to verbalised stance assessments

Value of the overall stance indicator	Stance assessment
Above 0.75	Loose stance
(0; 0.75]	Grey zone for loose stance
(-2.25; 0]	Neutral stance
(-4; -2.25]	Grey zone for tight stance
-4.0 and below	Tight stance

Table 13

Overall CBM stance index

Numerical score	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019
BE			-1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0
BG																
CZ	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0		-1.0	-1.0	-2.0	-2.0	-2.0	-2.0		
DK																
DE																
EE	1.0	1.0	-1.0	0.0	0.0	0.0	-2.0	-1.0	-1.0	-1.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
IE	-2.0	-2.0	-2.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0	0.0	0.0	-1.0	0.0
GR	0.0	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0
ES								0.0	0.0	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0
FR																
HR	-3.0	-3.0	-3.0	-3.0	-3.0	-5.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0
IT	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	0.0	0.0	0.0	0.0
CY	-2.0	-3.0	-3.0	-3.0	-2.0	-3.0	-2.0	-2.0	-1.0	-1.0	0.0	0.0	1.0	0.0	1.0	1.0
LV	-3.0	-3.0	-3.0	-3.0	-3.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0
LT	0.0	0.0	1.0	0.0	-1.0	-1.0	-1.0	-1.0	-3.0	-1.0	-2.0	-3.0	-2.0	-3.0	-3.0	-3.0
LU	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
HU	1.0	-1.0	-1.0	-1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0
MT		-1.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	-2.0	-2.0	-1.0	-2.0
NL	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	-2.0	-2.0	-2.0	-2.0
AT																
PL	1.0	1.0	1.0	1.0	0.0	1.0	0.0	0.0	-1.0	-1.0	-1.0	-1.0	-2.0	-2.0	-2.0	-2.0
PT									-3.0	-3.0	-3.0	-3.0	-2.0	-2.0	-2.0	-2.0
RO																
SI	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
SK	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	-1.0	1.0	-1.0
FI	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	-1.0	0.0	1.0	1.0	1.0	1.0	0.0	-1.0
SE	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-3.0	-3.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0
GB			-1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0

Note: Colours reflect verbalised stance assessment as presented in Table 10, i.e. loose in orange, grey zone for loose in yellow, neutral in white, grey zone for tight in light blue and tight in dark blue.

4.3.4 Country results for capital-based measures stance

The chart below shows the changes in overall stance over time and the role played by each of the three main components that determine the stance metric: the bucketed components of gross risk (G1), policy (P1) and resilience (R1). For given cyclical and structural risks, a tight stance can result from both a high level of resilience in the banking sector and/or the effect generated by policy actions introduced by national macroprudential authorities. On the other hand, a loose stance may be due to accumulated risks in the banking sector that have not been tackled by policy actions and/or are not reduced by existing resilience in the system.

Chart 20

Decomposition of CBM stance into risk, resilience and policy (selected countries)

Notes: The solid blue line shows the overall stance assessment for capital-based measures, whereas the bars represent the buckets (from 0 to 3) of the gross risk, resilience and capital components (Gb, Rb and Pb respectively). The dashed lines indicate the 10th, 20th, 50th, 80th and 90th percentile of overall stance in the entire dataset (all countries, all years). The overall stance can be calculated only when all the data on risk, resilience and policy are available. The absence of some elements for some countries means that the respective element has a score of 0 (low risk, low resilience, no policy or very loose policy in place). In all cases, the buckets are calculated in terms of the following percentile of each indicator over time and across countries: 50th, 80th and 90th.

4.3.5 Reflections on data availability, aggregation level of credit, and implications for further development

The stance analysis starts in the first quarter of 2016, when macroprudential capital buffers and harmonised reporting were introduced. As the buffers serving as the core capital-based instruments were not available, there is little merit in calculating stance assessments before 2016. A prerequisite for the CBM stance analysis is the availability of harmonised data on things like the CBR. Some reporting gaps would need to be closed by Member States to allow for stance assessments for all countries.

The focus of the CBM dataset (e.g. input for S5) includes domestic banking groups and stand-alone banks, foreign (EU and non-EU) controlled subsidiaries and foreign-controlled branches. The alternative would have been to focus only on domestic banking groups and stand-alone banks, thereby excluding foreign creditors. This would have left out large parts of the domestic banking sector of countries where foreign subsidiaries play a major role. Hence the report proposes the broader aggregation.

5 Policy use and the way forward

5.1 Applying the stance assessment in policymaking

The operational stance framework presented in this report provides a toolkit of complementary methodologies for the quantitative assessment of macroprudential stance. It incorporates three separate approaches which can be used together or separately, depending on the needs of the policymaker. These are:

- **A growth-at-risk** (GaR) framework designed primarily for cyclical risk and cyclical macroprudential policies, given the environment of structural policies (regulation) and structural country conditions;
- **A semi-structural model** better suited to conditional stress scenarios and resilience (not expected to be used by the ESRB Secretariat for the time being);
- **An indicator-based approach** that supports sector-level assessment and can be used as either a qualitative or a quantitative tool.

The GaR framework uses quantile regressions to estimate the contributions of systemic risk, financial stress and macroprudential policy to forecasted GDP growth distribution at different horizons. As underlying financial risks cannot be directly observed and only have a direct impact on growth once they materialise, the macroprudential policy objective underpinning this tool is to manage moments of the forecasted growth distribution. The proposed stance metric relates the mean outlook for economic growth to these downside risks. Periods with large downside risks would indicate that the macroprudential stance is loose (or loosening) as systemic risk is high relative to the deployed macroprudential policy. Nevertheless, given that the MPI behind the forecast is not intensity-based, it cannot advise on optimal policy calibration. This method is fully data-driven with a limited role for expert judgement, thereby providing a relatively "unbiased" guide. In addition to the mean-to-tail distance metric, other metrics may also be considered.

The semi-structural approach, similar to the GaR approach, proposes stance assessment based on changes in the lower parts of the output growth distribution. It encapsulates the intensity of systemic risks, system resilience and macroprudential policies. However, under this approach, a semi-structural model is applied to the data, jointly modelling individual interaction with the macroeconomy, and capturing relevant feedback loops. The semi-structural model used as an example to illustrate this report, is the BEAST model, but the general approach is not limited to it. This method complements the GaR, as its richer structure facilitates a sophisticated description of transmission channels and can shed light on the impact of particular policy calibrations. However, its results may depend on the expert judgement on the macroeconomic scenarios modelled and currently it is limited to considering capital-based measures in the banking sector.

The indicator-based approaches can complement the other aggregate approaches by providing guidance on macroprudential policies applied at sectoral level. The methodology for assessing a sector-level stance draws on work done by previous expert groups such as the WG-REM. It provides weighted aggregate indicators of risk, resilience and policy in each sector.

These indicators can then be quantitatively combined to form an overall stance assessment for the sector. Indicator-based approaches first calculate the level of net systemic risk arising from the sector, based on indicators commonly used by authorities. It then compares the level of net risk to the calibration of policy tools addressing that risk, to determine the residual risk that policymakers are willing to tolerate. The degree of residual risk defines the policymaker's stance. As such, these approaches can be used as a benchmark in decision-making and communication on the calibration of individual classes of macroprudential tools. The approach is sufficiently flexible to be extended to other areas of interest, to account for country specificities or to incorporate expert judgement when coming to a formal stance assessment.

All the tools outlined above provide quantitative measures of stance. These quantitative measures can then be mapped into qualitative measures (e.g. tight, neutral or loose) as necessary. The quantitative modelling approaches, however, ensure a degree of consistency in calculation of stance across decision-makers and through time.

The tools provide policymakers with a guide to structure policy discussion that complements expert judgement. The intention of the stance assessment is to equip macroprudential policy with a framework that facilitates quantitative cross-country and across-time comparison, both on policy set-up and on an ongoing basis. An overlay of expert judgement remains necessary as at this stage, the quantitative guides for the different approaches do not include all relevant country-specific aspects.

All of the tools can account for selected country-specific factors while maintaining cross-country comparability. This means that they can be used effectively by international bodies such as the ESRB, but can also be adjusted by national authorities to better reflect their individual situation and data availability. The Expert Group's calibration of these tools will be shared with national authorities, along with the documentation, to allow them to reproduce the results for their own countries or to alter the calibration.

The tools emphasise specific aspects of macroprudential policies, which might lead to diverging stance assessments across methods. This underlines the importance of using multiple tools at the same time and incorporating additional information and expert judgement to formulate a final verdict on the stance. While this report outlines the respective strengths and weaknesses of each method, the final narrative and policy messages need to be distilled by the policymakers themselves. Analysing the factors that contribute to the overall stance and addressing discrepancies is as important as the final stance verdict. Bringing these methods into active use through the regular ESRB risk and policy assessments will provide the necessary means for their further refinement and holistic interpretation.

In practice, the measures of stance obtained using these tools can assist policymakers when deciding which particular macroprudential actions to take. For example:

- by flagging the build-up of systemic risk and its effects, stance gives policymakers additional insight into the optimal timing of any intervention;
- by providing an indication of the expected costs to the economy of a stress event, stance can help policymakers to evaluate their existing macroprudential policies;

- be ensuring counterfactual policy analysis, stance can help policymakers to establish a “big picture” view of the net effects of any policy;
- by securing separate analysis of risk and resilience, stance can help to identify risk-resilience constellations that could signal a need for policy action.

5.2 Applications of stance assessment at the ESRB

The ESRB intends to use the tools to enhance internal and external communication in the future. Internally, the ESRB aims primarily to use the concept of stance in the regular discussions of the General Board and its sub-committees, as it provides a big picture update of macroprudential policy action in the EU. The ESRB will also use the concept in any relevant risk and policy assessment work. Externally, the ESRB intends to leverage stance to inform stakeholders via its annual Review of Macroprudential Policies in the EU. While internal use is a medium-term objective, external communication using stance is a longer-term goal.

General Board risk discussions could be enriched by summary quantitative assessments of policy stance in Member States. This would provide high-level information about the actual policy set-up and its development over time, with an additional benefit of putting the risk discussion into a policy context. This calculation will most likely be undertaken annually, reflecting the relatively slow developments in risks and policies.

The stance assessment could provide information on whether current policy set-up is commensurate with the cyclical risks set out in the overview of the main systemic risks identified by the ESRB. Stance work could be particularly helpful with respect to cyclical risks, such as those arising from excessive risk-taking, high and increasing indebtedness and debt sustainability concerns. These risks were – and continue to be – prominent in the ESRB risk discussion. In any presentation of such quantitative assessments, however, the limitations of the methods need to be acknowledged.

Stance assessments could also be used for the ESRB’s monitoring of whether the policy measures taken by macroprudential authorities are “sufficient” and “consistent” (Recital 25 of CRD V). As an aggregate approach, the stance assessment could complement assessments of the sufficiency and consistency at the level of individual macroprudential instruments, which have mostly relied on the legal basis of particular instruments instead of their material effectiveness. The stance framework is not a single approach that can shed light on these questions and its methods come with limitations. Nevertheless, the stance framework has the potential to substantially improve the economic analyses conducted by the ESRB in this regard.

Assessments of sectoral policy stance, using the stance toolkit, can complement the ESRB’s work analysing risk and policies in vulnerable sectors. For example, this approach could support the methodological approaches used in 2016 and 2019 when issuing warnings and recommendations to Member States with elevated and persisting RRE risks. It is not intended that the stance tools replace the existing approaches to the analysis of sectoral policies or diminish their role in the assessment. In particular, a formal assessment of country policies must consider all available information and cannot be determined only by simplified and mechanistic tools.

In the long term, stance assessment can provide an overarching narrative for external publications of the ESRB. Once sufficiently mature, analyses of macroprudential stance can feature in the annual **Review of Macroprudential Policy in the EU**. It could show both the trajectory of policy stance and provide a framework for discussing existing risks and actions that is accessible to a wide audience. As the Review is a public document, utmost importance needs to be given to the caveats of the stance toolkit in order to present a view that is consistent with the ESRB's understanding of the situation.

5.3 Areas for further development beyond the Expert Group

The framework presented in this report is contingent on the state of knowledge and experience with the macroprudential toolkit and its implications for broader economic performance. More experience with the tools might allow further advances in the macroprudential stance toolkit. The adequacy of the stance framework will, therefore, be re-examined at regular intervals. The following four areas are among those which can support additional development in the stance toolkit.

- **Experience with implementation:** gaining experience with updates and interpretations in practical policymaking.
- **Refinements for specific macroprudential policies:** Roll-out of the toolkit to specific borrower-based or capital-based measures; expansion to liquidity measures and considerations for macroprudential policy beyond banks.
- **Improved data availability:** New information enabling better measurement of risks, resilience and policies. In particular, wider availability of granular data on lending might advance the work on the assessment of the policy stance with respect to BBM and RRE risks.
- **Academic research:** Increasing evidence on the effects of macroprudential policies can enhance the modelling toolkit and provide insight into important additional interactions that need to be considered in the stance toolkit.

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Annex 1 Additional information on GaR

A.1.1 Risk and stress indicators

Financial conditions indicators (FCIs) are commonly used in growth-at-risk (GaR) frameworks such as the one in Adrian et al. (2019), which uses the National Financial Conditions Index constructed by Brave and Butters (2011) to study GDP vulnerability, or that in Koop and Korobilis (2014), which both the IMF (2017) and Aikman et al. (2019) use to construct FCIs for various countries. An FCI aims to summarise the current state of financial variables that influence economic behaviour and – as a result – the future state of the economy. Typically, higher values of an FCI correspond to tighter financial conditions: higher spreads and volatility, lower asset prices and worsening risk sentiment, which relates to the notion of higher stress in the financial market. Employing these types of variables relies on the assumption that GDP growth responds in a non-linear manner to shocks in the presence of deteriorating financial conditions, which can amplify the impact of shocks on economic activity.

Along with financial conditions indicators, financial stress indicators aim at measuring the materialisation of systemic risk and have also been employed in GaR frameworks, e.g. Alessandri et al. (2019), which uses the Composite Indicator of Systemic Stress in the Financial System (CISS) for the euro area (Holló et al., 2012). The main goal of this indicator is to measure the current state of instability, i.e. the risk that has already materialised. The construction of the CISS index is inspired by the portfolio theory; five market segments are aggregated using their covariance matrix in a quadratic form. It includes data capturing these segments: money markets, bond markets, equity markets, financial intermediaries and foreign exchange markets. A similar indicator to this is the Country-Level Index of Financial Stress (CLIFS) which extends the methodology of the CISS indicator to all EU Member States, meaning it is a market-based measure capable of capturing common turmoil episodes manifested simultaneously on several financial market components within a single jurisdiction. The CLIFS indicator was introduced by Duprey et al. (2015), where the authors use the newly derived measure to identify episodes of high financial stress associated with a substantial negative impact on the real economy. The study concludes that financial stress episodes identified by the model-based approach are mainly consistent with expert-based stress periods and, therefore, the potential exists to limit bias in qualitative assessments related to crisis identification. The main advantages of this approach are in its country-based estimation, which allows for granular approaches and cross-country analysis, and its simple design, which can be applied to all EU countries regardless of their macro-financial development level. Conversely, one potential drawback is the questionable relevance of market-based indicators for economies with banking-centred financial sectors and shallow financial markets.

Some measure of financial vulnerabilities is employed in most GaR-related work with a view to quantifying the impact of systemic risk on future GDP growth, which means this could be useful in guiding macroprudential policy. In order to cover every source of systemic risk, we have considered the composite systemic risk indicator (SRI) constructed for Europe (Lang et al., 2019). This indicator captures cyclical system risk arising from credit, real estate markets, asset prices and external imbalances and has good early warning properties – three to four years ahead of large GDP drops (Lang et al., 2019). The sub-indicators of the SRI were chosen from a large set of individual indicators of each category (credit, real estate markets, asset prices and external imbalances), with the final composite indicator being a weighted average of the six best-performing indicators, with at least one indicator from each category. The indicators included are the two-year change in the bank credit-to-GDP ratio (with a weight of 36%), the current account-to-GDP ratio (20%), the three-year change in the RRE price-to-income ratio (17%), the three-year growth rate of real equity prices (17%), the two-year change in the debt service ratio (5%), and the two-year growth rate of real total credit (5%).[55]

We also considered another composite indicator, the FSRI, that has near-term predictive power for deep recessions. This index incorporates relevant information extracted from a large set of cyclical and cross-sectional vulnerabilities. In particular, it includes measures for valuation pressures/risk appetite, non-financial sector imbalances, financial sector vulnerability and spillovers and contagion, which distinguishes it from the SRI.

Another indicator that could be relevant for this framework and that was considered is the Basel gap, which is commonly used to assess excessive credit growth and can support CCyB decisions. This indicator, which is a deviation of the credit-to-GDP ratio from its long-term trend has been assessed has having good properties as an early warning indicator of systemic banking crises triggered by excessive growth in European countries (Detken et al., 2014).

55 The individual sub-indicators of the SRI were themselves chosen from a large set of individual indicators of the risk categories suggested in Recommendation ESRB/2014/1 to monitor cyclical systemic risk and are considered good early warning indicators.

Indicator selection – estimated coefficients

Table A.1

Key estimation results for eight-quarters ahead

(dependent variable: average annualised real GDP over eight-quarters ahead at 10th percentile and median)

Risk/stress		SRI/ FCI	SRI/ CISS	SRI/ CLIFS	FSRI/ FCI	FSRI/ CISS	FSRI/ CLIFS	Basel gap/ FCI	Basel gap/ CISS	Basel gap/ CLIFS
Risk and stress	Risk	-.0224***	-.0165***	-.0227***	-.0007	.0085	-.0098***	-.0008***	-.0010***	-.0009***
	Stress	-.0122***	-.0482***	-.0543***	-.0100***	-.1231***	-.0669***	-.0071***	-.0556***	-.0362***
	Risk x stress	.0050*	-.0030	.0311*	.0040***	.0269***	.0331**	.00003	.0009**	.0003
Control variables	Real GDP growth rate	-.1502**	-.1417***	-.0978*	-.2094*	-.0010	-.2233***	-.0778	-.1733***	-.0931**
	Lagged real GDP growth rate	-.0616	-.1214***	-.1407***	-.1957***	-.2112***	-.2329***	-.1321***	-.1808***	-.1839***
Number of observations		1,182	1,424	1,515	737	1,265	1,225	1,491	1,754	1,972

Source: ESRB Expert Group on Macroprudential Stance.
*Notes: Bootstrapped standard errors are in parentheses. Significance levels: *10%, **5%, ***1%.*

A.1.2 Macroprudential policy index

The cumulative macroprudential index and its use in the estimation framework.

The MPI is constructed on the basis of individual macroprudential policy decisions. For this reason, it captures the extensive margin of macroprudential policy, but does not capture its specific calibration. If several decisions occur within the same quarter, the associated discrete values are simply added up to arrive at the period-specific policy change indicator $m_{i,t}$ in country i and period t. For example, if in period t four measures were tightened while another two were loosened, then the corresponding policy change indicator becomes $m_{i,t} = 1 + 1 + 1 + 1 - 1 - 1 = 2$. In periods without macroprudential policy changes we have $m_{i,t} = 0$. If the intervention is characterised in MaPPED as "other or with ambiguous impact" it is assigned the value of zero.

The implementation of Basel III regulations has been reported heterogeneously within MaPPED. For example, several national authorities report a single macroprudential tightening on the date of the final calibration of a particular measure following a phase-in period, while other countries explicitly report each of the individual tightening steps during the phase-in period. To address this heterogeneity, macroprudential policy decisions with phase-in are considered as single decisions, through which decisions that merely update legislative texts without tightening or loosening do not alter the value of the MPI.[56] [57]

For capital-based measures, it is possible to assess the implicit size of a decision by regressing the cumulative capital-based policy indicator $MPI_{i,t}^{cb}$ on the combined buffer requirements (CBR). The regression coefficient provides a conversion rate between an average decision and the CBR (available since 2014).[58] Table A.2 shows the results of a regression of CBR on the cumulative $MPI_{i,t}^{cb}$. As can be seen, the relationship with $MPI_{i,t}^{cb}$ is positive and significant. It indicates that a single capital-based macroprudential decision corresponds to 0.87 percentage points of the CET1 ratio within the CBR.

Table A.2

Regression of CBR on the cumulative capital-based MPI

Regression of CBR and on cumulative capital-based MPI

	(1) CBR
mpi_cb (cumulative)	0.866***
Constant	-5.930***
Observations	512
R2	0.24
Number of countries	21

Source: ESRB Expert Group on Macroprudential Stance.
Notes: Regression coefficients. Linear regression of CBR on contemporaneous cumulative capital-based MPI. Unbalanced panel of EU countries.
**** p<0.01, ** p<0.05, * p<0.1*
Sample: 2014-20.

[56] See Basel Committee on Banking Supervision (2011, 2012) and **Basel III transitional arrangements, 2017-2028**. The implementing act of the Basel III agreements in the European Union was the new legislative package comprising Directive 2013/36/EU (CRD IV) and Regulation (EU) No 575/2013 on prudential requirements for credit institutions and investment firms (CRR).

[57] The Basel III Accord prescribes the following regulatory adjustments: the minimum Common Equity Tier 1 capital ratio (CET1) to be set to 3.5% in Q2 2013 and raised to 4.5% in Q1 2015, the minimum Tier 1 capital ratio to be set to 4.5% in Q2 2013 and raised to 6.0% in Q1 2015, the capital conservation buffer (CCoB) to be set at 0.625% in Q1 2016 and raised to 2.5% in Q1 2019, the G-SII and O-SII buffers to be activated in Q1 2016 and increased until Q1 2019 by a constant bucket-specific increment each year.

[58] The data on the CBR are taken from the ECB's Statistical Data Warehouse.

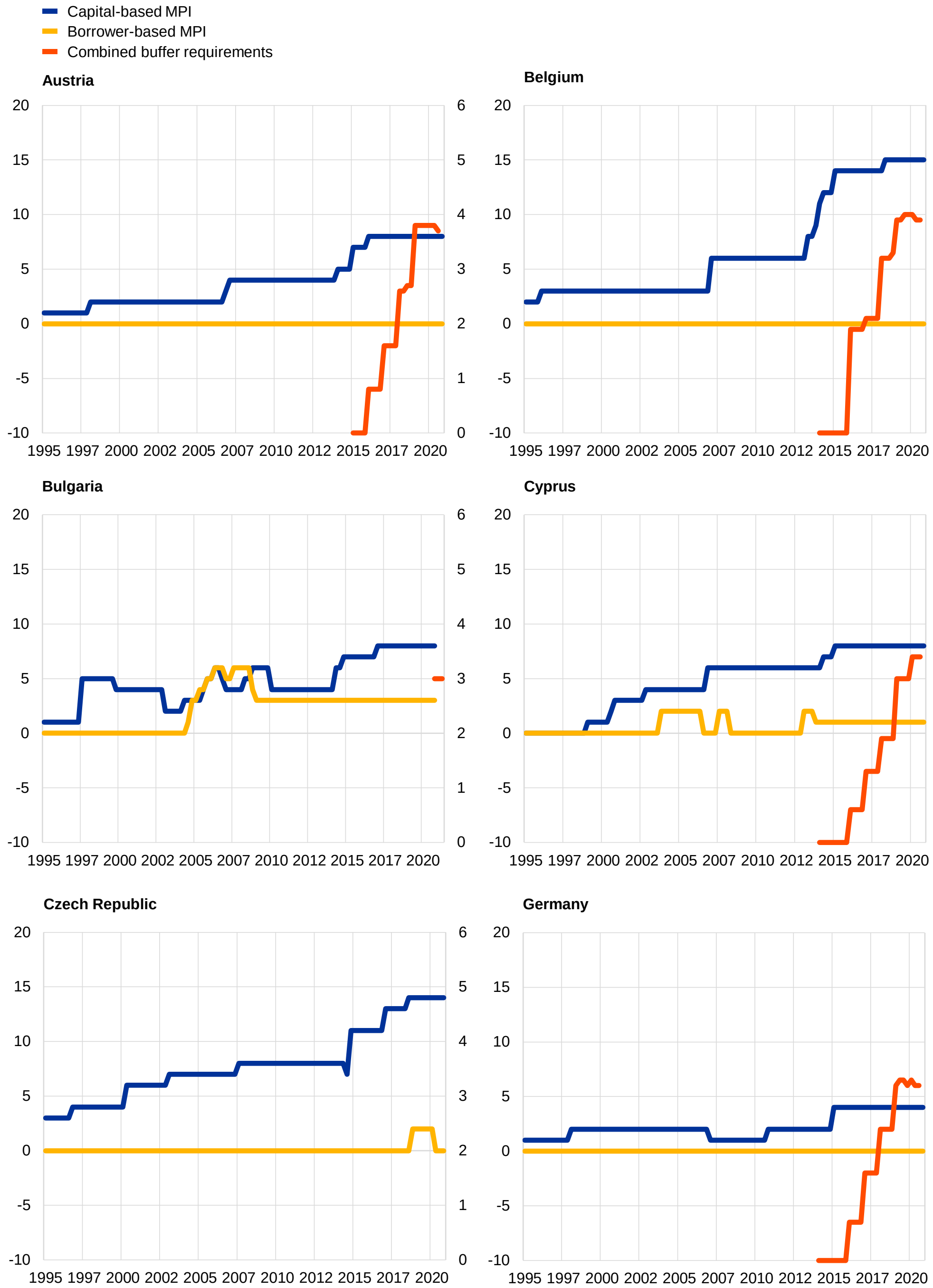
Table A.3

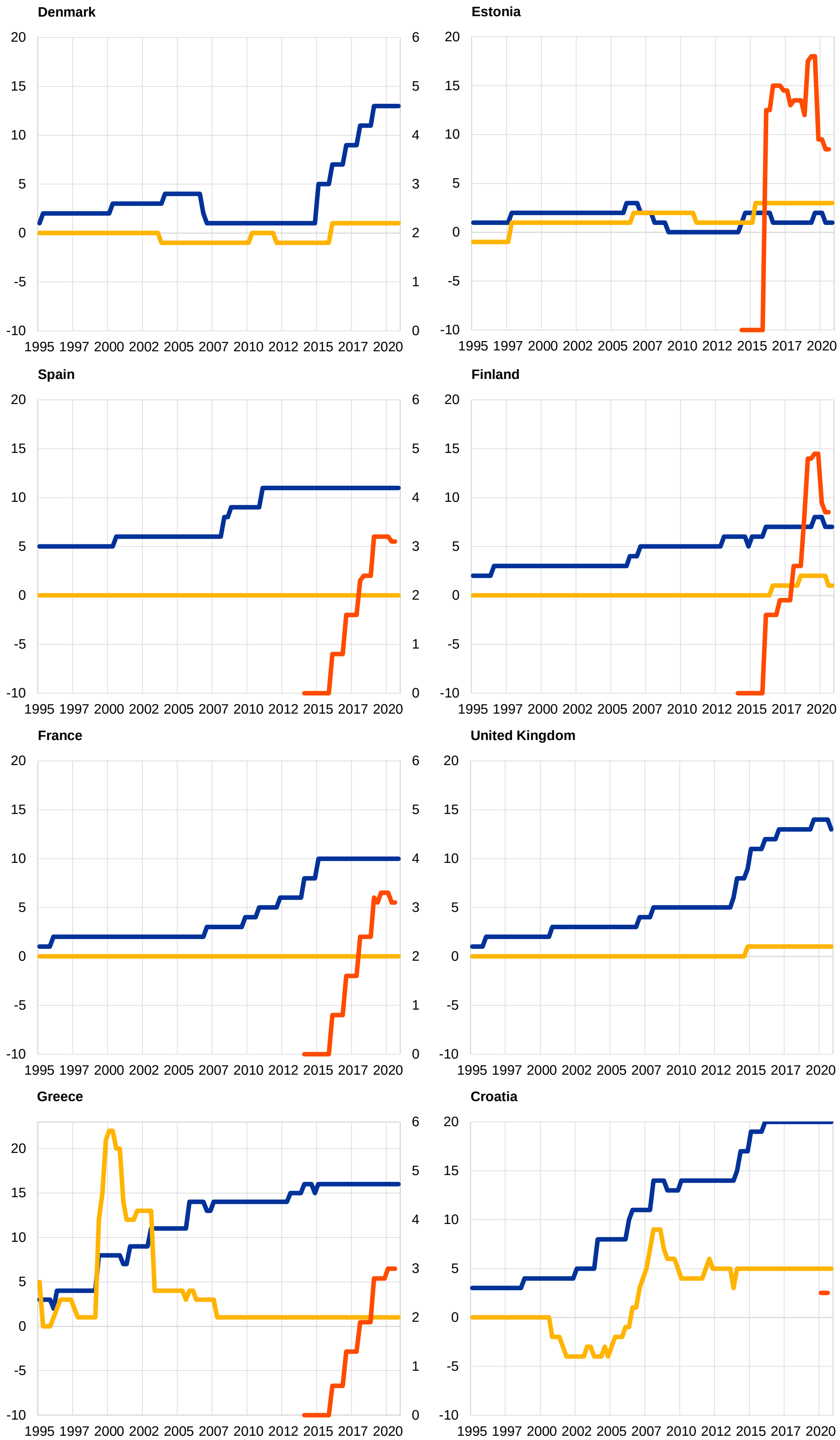
Frequency of legally binding policy changes by type of measure and country

	Capital-based measures				Borrower-based measures			
Country	Total	G-SII/O-SII	CCyB	Other	Total	DSTI limits	LTV limits	Other
AT	9	0	0	9	0	0	0	0
BE	19	0	0	19	0	0	0	0
BG	36	1	1	34	14	0	0	14
CY	16	0	0	16	13	1	12	0
CZ	23	1	3	19	0	0	0	0
DE	12	0	0	12	0	0	0	0
DK	22	0	1	21	7	0	2	5
EE	16	0	0	16	4	0	0	4
ES	18	0	0	18	0	0	0	0
FI	16	1	1	14	1	0	1	0
FR	13	0	0	13	0	0	0	0
GR	34	0	0	34	72	1	3	68
HR	32	0	1	31	35	0	0	35
HU	25	3	1	21	29	5	13	11
IE	17	0	0	17	0	0	0	0
IT	14	4	0	14	1	0	0	1
LT	23	0	1	22	17	1	1	15
LU	15	0	0	15	1	0	0	1
LV	21	0	1	20	18	0	4	14
MT	12	0	0	12	0	0	0	0
NL	19	4	0	15	9	2	6	1
PL	40	0	0	40	0	0	0	0
PT	16	0	0	16	3	0	0	3
RO	39	0	0	39	17	9	6	2
SE	17	0	1	16	3	0	0	3
SI	17	0	0	17	10	0	0	10
SK	20	0	1	19	19	0	2	17
UK	19	1	1	18	1	0	0	1
Total	**580**	**15**	**13**	**557**	**274**	**19**	**50**	**205**

Source: MaPPED database.
Notes: Number of legally binding measures implemented, according to MaPPED database. Time span: 1995-2018. “G-SII” stands for capital buffer for globally systemically important institutions; “O-SII” stands for capital buffer for other systemically important institutions; “CCyB” stands for countercyclical capital buffer; “DSTI” stands for debt-service-to-income ratio; “LTV” stands for loan-to-value ratio. The table shows the policy actions as they are reported in MaPPED, i.e. without any additional adjustments and without extending it by adding the macroprudential measures adopted in 2019 and 2020.

Chart A.1
Development of cumulative MPIs and CBR




Denmark
Estonia
Spain
Finland
France
United Kingdom
Greece
Croatia
20
15
10
5
0
-5
-10
6
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4
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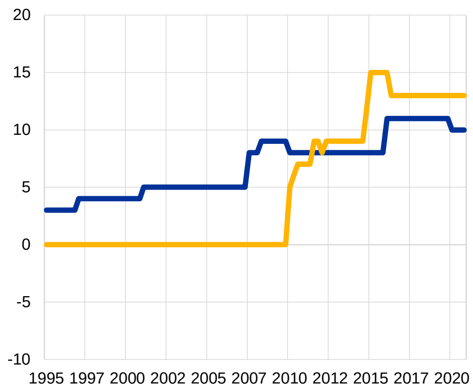
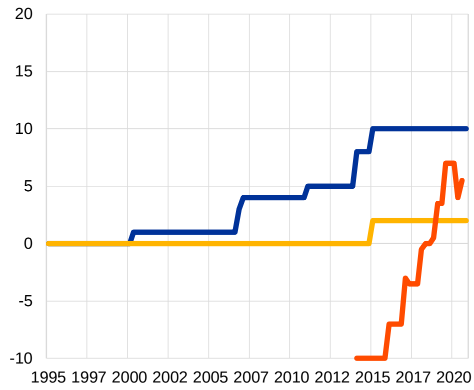
2
1
0
1995 1997 2000 2002 2005 2007 2010 2012 2015 2017 2020

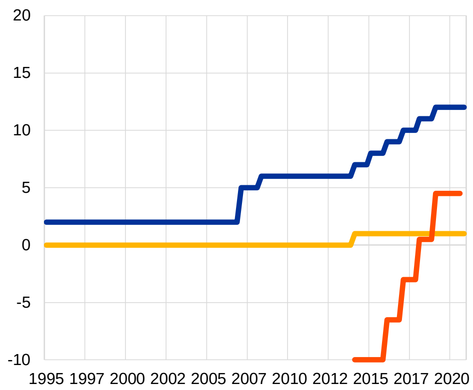
Hungary



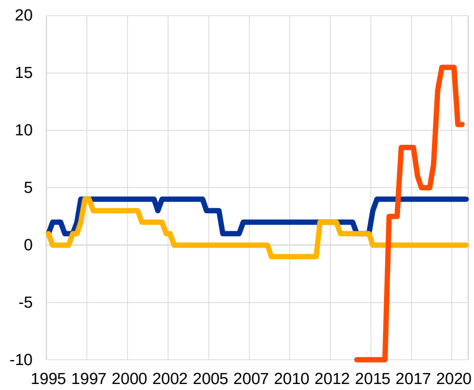
Ireland



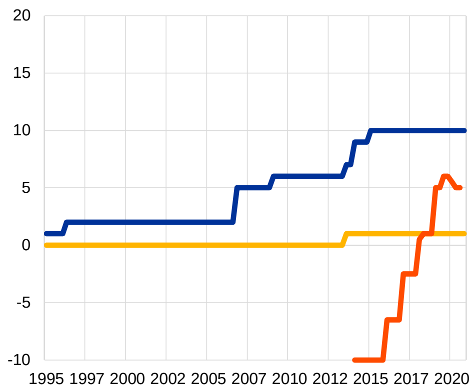
Italy



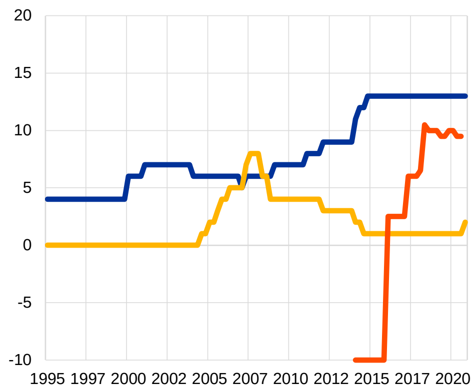
Lithuania



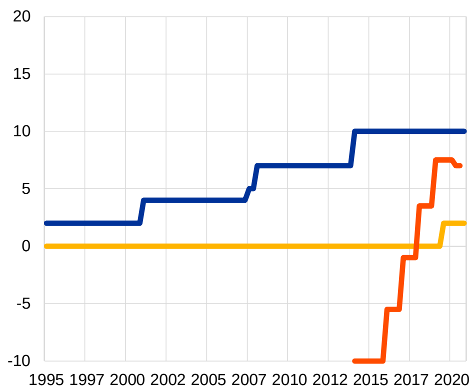
Luxembourg



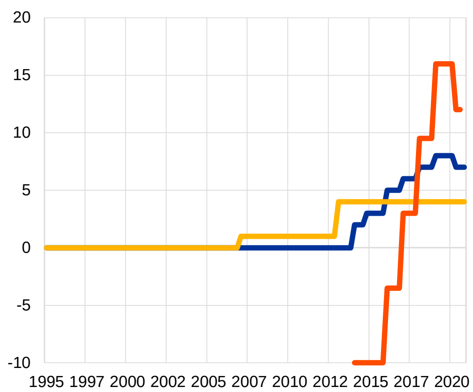
Latvia

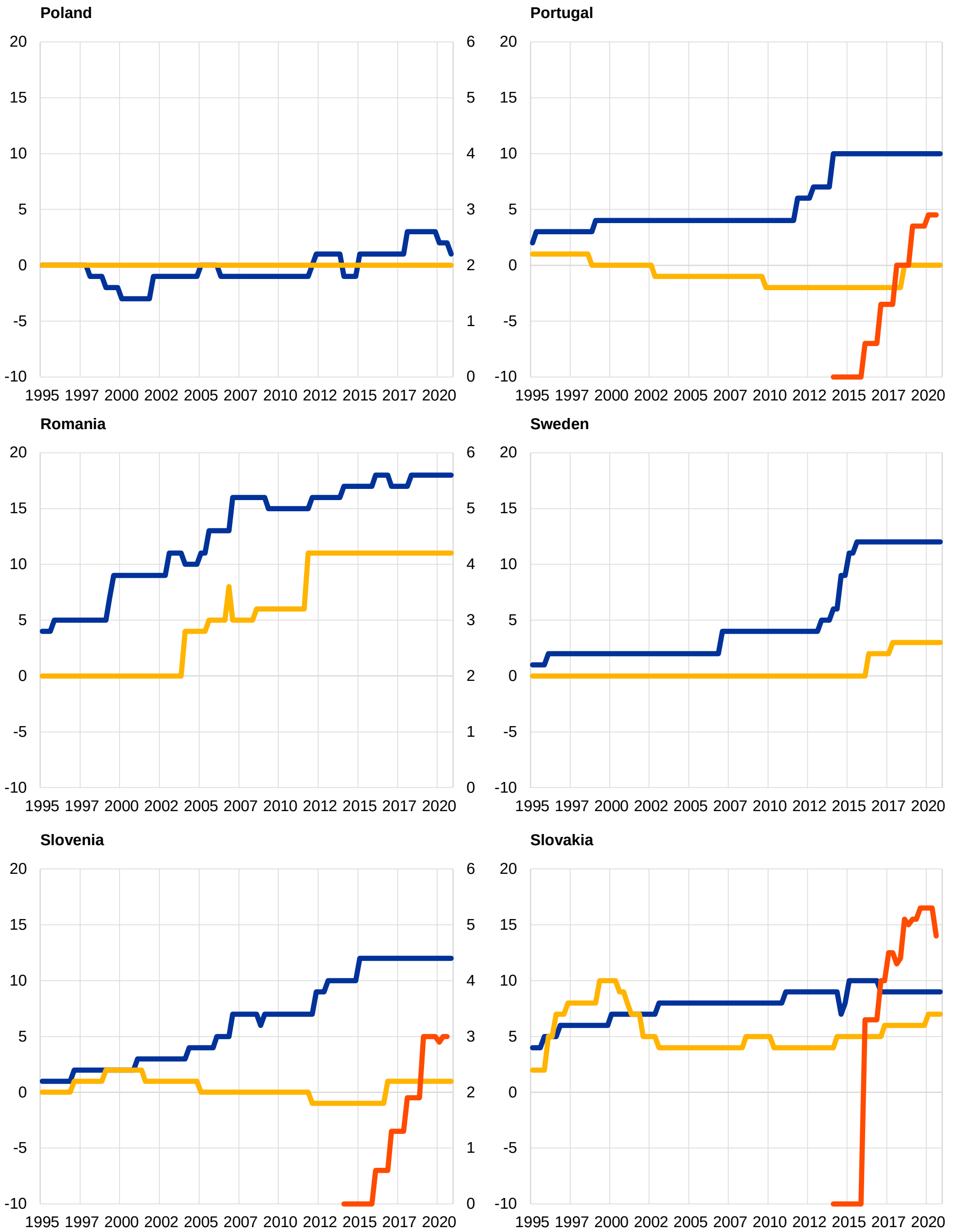


Malta



Netherlands





Notes: Values for the combined buffer requirement are in percent (right-hand scale).
Source: MaPPED-Database (capital-based MPI, borrower-based MPI), SDW (combined buffer requirement).

Empirical GaR results with different MPI transformations

In most countries included in our sample, the cumulative macroprudential indices for capital-based and BBM described in the main text tend to increase over time. The reason is that the number of policy “tightenings” is larger than that of “loosenings”. Since the other variables entering the quantile regressions of our GaR model are (close to) stationary, the upward trending evolution of the MPIs might bias the coefficient estimates. We propose three alternative approaches to deal with this econometric problem and discuss the robustness of the empirical results across these alternatives.

The first approach consists of a simple detrending of the MPIs by removing a country-specific linear trend. The resulting trend deviations for capital-based measures and for BBM then enter the quantile regression. In the second approach, we use the untransformed cumulative MPIs but include a common (non-country-specific) linear trend in the quantile regressions. The third approach consists of transforming the cumulative MPIs in twenty-quarter differences before using them in the GaR model. In particular, we transform them according to

$$MPI_{i,t}^{k,20\,Q} = MPI_{i,t}^{k} - MPI_{i,t-20}^{k}.$$

where $k = cb$ if capital-based measures are considered and $k = bb$ for the case of borrower-based policy interventions. Note that the $MPI_{i,t}^{k,20\,Q}$ corresponds to the cumulative sum of policy changes over the past twenty quarters. All three approaches take into account that past macroprudential policy decisions may affect the predicted GDP growth distribution in the future, as the effects of macroprudential policy might unfold with a substantial delay.

The estimated coefficients of the quantile GaR regressions are shown in Chart 2 (a, b, c and d), for the aforementioned three approaches – i.e. detrended MPIs, global trend in the GaR equation and twenty-quarter-differenced MPI respectively. In particular, these charts show the quantile-regression coefficients for forecast horizons 1 to 16, alongside the corresponding 90% confidence intervals for both, the 10th and the 50th percentile of future GDP growth.

Each of the three empirical approaches indicates that the coefficient of capital-based MPI is significantly positive at short to medium-term horizons for the 10th percentile as well as at medium-to-long horizons for the median (50th percentile) of GDP growth (see Chart 2, panel a). Accordingly, everything else equal, a tightening of capital-based instruments tends to significantly improve both, the tail and the median of future GDP growth. The evidence regarding the analogous effect of borrower-based MPI on GDP as well as on the coefficients of the terms capturing the interactions between the MPIs on the one hand and SRI or CLIFS on the other ($MPI_{i,t}^{k} * SRI_{i,t}$ and $MPI_{i,t}^{k} * CLIFS_{i,t}$) is more mixed and less robust across the three approaches (see Chart 2, panel b).[59] For example, the borrower-based MPI exerts a significantly positive effect on GDP growth only under the specification including a global trend in the GaR model. Otherwise, the corresponding effect is not statistically significant. Chart 2 further indicates that the potential effects of macroprudential policy changes on GDP growth – even when statistically significant – are most likely of small magnitude. A likely explanation for the limited significance and weak magnitude of the effects of macroprudential policy are the imperfections inherent to our policy indicator MPI. Indeed, as emphasised by Akinci and Olmstead-Rumsey (2018), the use of a dummy-type indicator, i.e. not reflecting the intensity of policy changes, potentially creates attenuation bias for the coefficient estimates on the macroprudential policy variables, thus weighing on the significance and magnitude of those coefficients. The attenuation bias is further reinforced, if one does not explicitly account for the bindingness of policy measures (Akinci and Olmstead-Rumsey, 2018). Furthermore, the reference specification of the GaR model only reveals the direct channel of transmission of macroprudential policy to future GDP growth. However, there might be an indirect channel as well, operating through the effects of policy interventions on systemic risk and/or

[59] The interaction terms $MPI_{i,t}^{k} * SRI_{i,t}$ and $MPI_{i,t}^{k} * CLIFS_{i,t}$ capture the potential dependence of the link between macroprudential policy and GDP growth on the state of the financial cycle.

financial stress. In Box 1, we show that the indirect channel, while of small magnitude, is operative and contributes towards making the link between the MPIs and GDP growth stronger and more significant.

Finally, our results – pointing towards the weak and only partly robust effects of macroprudential policy on GDP growth – should not be interpreted as indicating that macroprudential policy is not effective. In particular, even without a strong transmission to GDP, policy interventions might be particularly powerful in reducing private sector indebtedness, systemic risk and financial stress. Moreover, the GaR model considered here is a reduced-form approach which is silent about the nature and strength of the specific channels linking macroprudential policy to GDP growth. To gauge the presence of such underlying transmission channels, we run a series of linear regressions in which a set of country-level vulnerability indicators is regressed on lags of the twenty-quarter-change of the cumulative MPIs for capital-based and BBM. In particular, the vulnerability indicators we consider are the SRI, the CLIFS, the debt-service-to-income ratio of private households (DSR), the households' debt-to-income ratio (HHDI) and the credit-to-GDP gap (Basel gap). The coefficient estimates are shown in Table A.4. As can be seen, tightenings of either capital-based or borrower-based policy measures do indeed contribute significantly – albeit with some delay – to reducing systemic risk (SRI), financial stress (CLIFS), and indebtedness-related vulnerabilities in the private-household sector as proxied by the DSR, the HHDI. The link between the MPIs and the Basel gap is slightly more mixed. Overall, the results presented in Table A.4 suggest that the highly aggregative reduced-form GaR model might indeed mask significant interlinkages between macroprudential policy and important financial stability indicators.

Table A.4

Regressions of vulnerability indicators on MPI

Dependent variables	(1) SRI	(2) CLIFS	(3) DSR	(4) HHDI	(5) Basel gap
mpi_cb *(t-1)*	**-0.0414***	**-0.00521****	0.0902	1.202	-0.200
mpi_cb *(t-2)*	-0.00888	0.000474	-0.0180	0.0176	-0.324
mpi_cb *(t-3)*	-0.00304	0.00328	-0.0135	-0.230	-0.0764
mpi_cb *(t-4)*	-0.00971	0.000507	-0.213*	0.435	-1.259
mpi_bb *(t-1)*	-0.0157	0.000624	0.0315	0.517	-0.185
mpi_bb *(t-2)*	**0.0119*****	0.00161	-0.00235	**-0.884*****	-0.299
mpi_bb *(t-3)*	0.00752	6.59e-05	0.0559	0.0173	0.157*
mpi_bb *(t-4)*	**-0.0198****	-0.00124	-0.128	**-0.603****	-0.593
Constant	0.105*	0.124***	12.66***	92.89***	1.393
Observations	1,899	2,541	2,273	1,556	2,391
R2	0.039	0.003	0.015	0.030	0.046
Number of country_id	28	28	28	28	28

Linear regressions with country fixed effects. The sample includes all EU countries as well as the United Kingdom and covers the period 1995-2020. "mpi_cb" - capital-based MPI; "mpi_bb" - borrower-based MPI. Both cumulative MPIs are transformed into 20-quarter differences. "SRI" - systemic risk indicator; "CLIFS" - composite leading indicator of financial stress; "DSR" - debt-service-to-income ratio of private households; "HHDI" - household-debt-to-income ratio; "Basel gap" - credit-to-GDP gap according to Basel-III definition;
****p<0.01, ** p<0.05, * p<0.1*

Annex 2 Methodological aspects of the indicator-based approach

Table A.5

Calculation of DSTI equivalents

Income-based restriction	Expression in DSTI equivalents	Justification
Debt-service-to-income	Already DSTI	Most commonly used income-based limit in the ESRB database
Loan-service-to-income	DSTI = LSTI	Assumed the lender has no additional debt besides the loan (hard to approximate the size of other debt)
Debt-to-income	DSTI = $\frac{DTI\cdot 12\cdot\frac{i}{12}\cdot\left(1+\frac{i}{12}\right)^{N\cdot 12}}{\left(1+\frac{i}{12}\right)^{N\cdot 12}-1}$ Where i is the current interest rate on new mortgages at the prevailing fixation in the previous period and N is maximum maturity of the loan – term limit or 40 years in the absence of a term limit	DSTI of a loan with maximum DSTI and maximum maturity limit at the current interest rates prevailing in the market Assumption of 40 years as maximum length
Loan-to-income	DSTI = $\frac{LTI\cdot 12\cdot\frac{i}{12}\cdot\left(1+\frac{i}{12}\right)^{N\cdot 12}}{\left(1+\frac{i}{12}\right)^{N\cdot 12}-1}$ Where i is the current interest rate on new mortgages at the prevailing fixation in the previous period and N is maximum maturity of the loan – term limit or 40 years in the absence of a term limit	Assumed the lender has no additional debt besides the loan (hard to approximate the size of other debt and interest rate on the other debt)
Amortisation requirement	Ignored	All loans assumed to be amortised
Term limit	Enters calculations of DSTI equivalents for DTI and LTI	Term limits effective only in conjunction with other debt servicing limits
Household interest rate stress testing	DSTI=$sDSTI\cdot\frac{i}{i+\Delta}\cdot\frac{\left(1+\frac{i}{12}\right)^{N\cdot 12}}{\left(1+\frac{i+\Delta}{12}\right)^{N\cdot 12}}\cdot\frac{\left(1+\frac{i+\Delta}{12}\right)^{N\cdot 12}-1}{\left(1+\frac{i}{12}\right)^{N\cdot 12}-1}$ where: sDSTI is the maximum stressed DSTI or LSTI prescribed, i is the current interest rate on new mortgages at the prevailing fixation, Δ is the size of the interest rate shock in the stress test, and N is maximum maturity of the loan – term limit or 40 years in case of term limit	DSTI of a maximum loan permissible under the stressed DSTI Assumption of 40 years as maximum length

Table A.6

Standardised loan definition

	Definition	Justification
Loan characteristics		
Collateral	Mortgage collateralised by RRE	Excluding consumer loans, for which more stringent rules often apply
Amortisation	Amortised	Most typical case in EU countries
Currency	Domestic currency	Most typical case in EU countries
Fixation	Most common fixation for new lending in the given county in the previous period	
Real estate characteristics		
Location	Metropolitan area of that country (this distinction does not currently play any role, as all measures that entered the stance assessment set limits for the entire country)	BBM are deployed in some cases in response to rising risk in metropolitan areas
Purpose	Primary residence of the borrower	Excluding buy-to-let segment and secondary housing, for which more stringent rules often apply
Price	Median price in that area for a flat sized 70m2	Standardised definition for cases where rules depend on the purchase price
Borrower characteristics		
Income	Median net disposable income in the country	To approximate the income of the borrower and co-signers in the loan transaction
Age	Not qualifying for exemptions granted to young applicant, if available in the given country	Young applicants face different policy criteria in some instances
Transaction history	Not a first-time buyer	First-time buyers face different policy criteria in some instances

Table A.7

Indicator bucketing thresholds (risk and resilience variables)

Bucket score	C1 RRE prices, three-year growth	C2 RRE price gap	C3 House price-to-income ratio	C4 Price-to-rent ratio	C5 LTV in the market (new loans)	F1 Mortgage credit, three-year growth	F2 Mortgage credit-to-GDP ratio	F3 HH credit-to-GDP gap
0	(-Inf, 2.5)	(-Inf, 1)	(-Inf, 4)	(-Inf, 0)	[74.852, Inf)	(-Inf, 3)	(-Inf, 0.218)	(-Inf, -0.122)
1	[2.5, 5)	[1, 1.04)	[4, 10)	[0, 13)	[66.05, 74.852)	[3, 6)	[0.218, 0.416)	[-0.122, 2.77)
2	[5, 7.5)	[1.04, 1.08)	[10, 16)	[13, 21)	[57.804, 66.05)	[6, 9)	[0.416, 0.576)	[2.77, 5.341)
3	[7.5, Inf)	[1.08, Inf)	[16, Inf)	[21, Inf)	(-Inf, 57.804)	[9, Inf)	[0.576, Inf)	[5.341, Inf)
Basis	WG-REM	WG-REM	WG-REM	Based on pctles over entire distrib. (50, 80, 90)	Based on pctles over entire distrib. (50, 80, 90)	WG-REM	Based on pctles over entire distrib. (50, 80, 90)	Based on pctles over entire distrib. (50, 80, 90)

Bucket score	H1 HH sector DTI	H2 HH sector DSR	S1 Housing investment-to-GDP	S2 Bank exposure to RRE in relation to capital	S3 Bank exposure to construction in relation to capital
-1	[95;Inf)	[14;Inf)			
0			(-Inf, 4.098)	(-Inf, 222.967)	(-Inf, 82.294)
1	[85;95)	[12;14)	[4.098, 6.116)	[222.967, 426.895)	[82.294, 130.078)
2	[75;85)	[[10;12)	[6.116, 7.277)	[426.895, 588.482)	[130.078, 186.308)
3	(0;75)	[0;10)	[7.277, Inf)	[588.482, Inf)	[186.308, Inf)
Basis	WG-REM – modified	WG-REM – modified	Based on pctles over entire distribution (50, 80, 90)	Based on pctles over entire distribution (50, 80, 90)	Based on pctles over entire distribution (50, 80, 90)

Table A.8

Indicator bucketing thresholds (policy variables)

Bucket score	P1 LTV benchmark	P2 DSTI benchmark
0	None in place	None in place
0.5	[1, Inf)	[0.5, Inf)
1	[0.95, 1)	[0.45, 0.5)
1.5	[0.9, 0.95)	[0.4, 0.45)
2	[0.85, 0.9)	[0.35, 0.4]
2.5	[0,8, 0.85)	[0.3,0.35)
3	(-Inf,0.8)	[0, 0.3)
Basis	Based on expert judgement	Based on expert judgement

Table A.9

Residual risk bucketing threshold

Bucket score	R1 Residual risk for value-based segment	R2 Residual risk for income-based segment
0	(-Inf, 0375)	(-Inf, -0.208)
1	[0.375, 0.75)	[-0.208, 1.666)
2	[0.75, 1.25)	[1.666, 2.666)
3	[1.25, Inf)	[2.666, Inf)
Basis	Based on percentiles over the entire distribution (50, 80 and 90)	Based on percentiles over the entire distribution (50, 80 and 90)

Table A.10

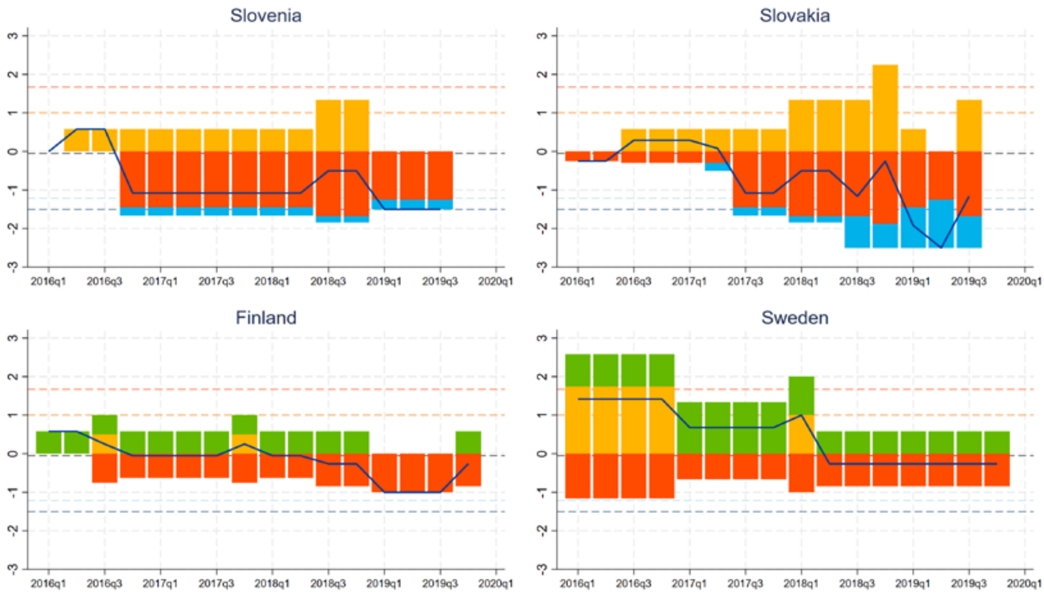
Weights attributed to the value-based and income-based segments stances for calculating overall stance

Difference in bucket scores for residual risk for value-based segment and income-based segment (R1-R2)	Weight attributed to the value-based segment (a)	Weight attributed to the income-based segment (b)
-3	0.25	0.75
-2	0.33	0.67
-1	0.42	0.58
0	0.50	0.50
+1	0.58	0.42
+2	0.67	0.33
+3	0.75	0.25

Chart A.2

Decomposition of BBM stance into LTV and DSTI stance, determined by DSTI policy, LTV policy, funding and DSTI policy

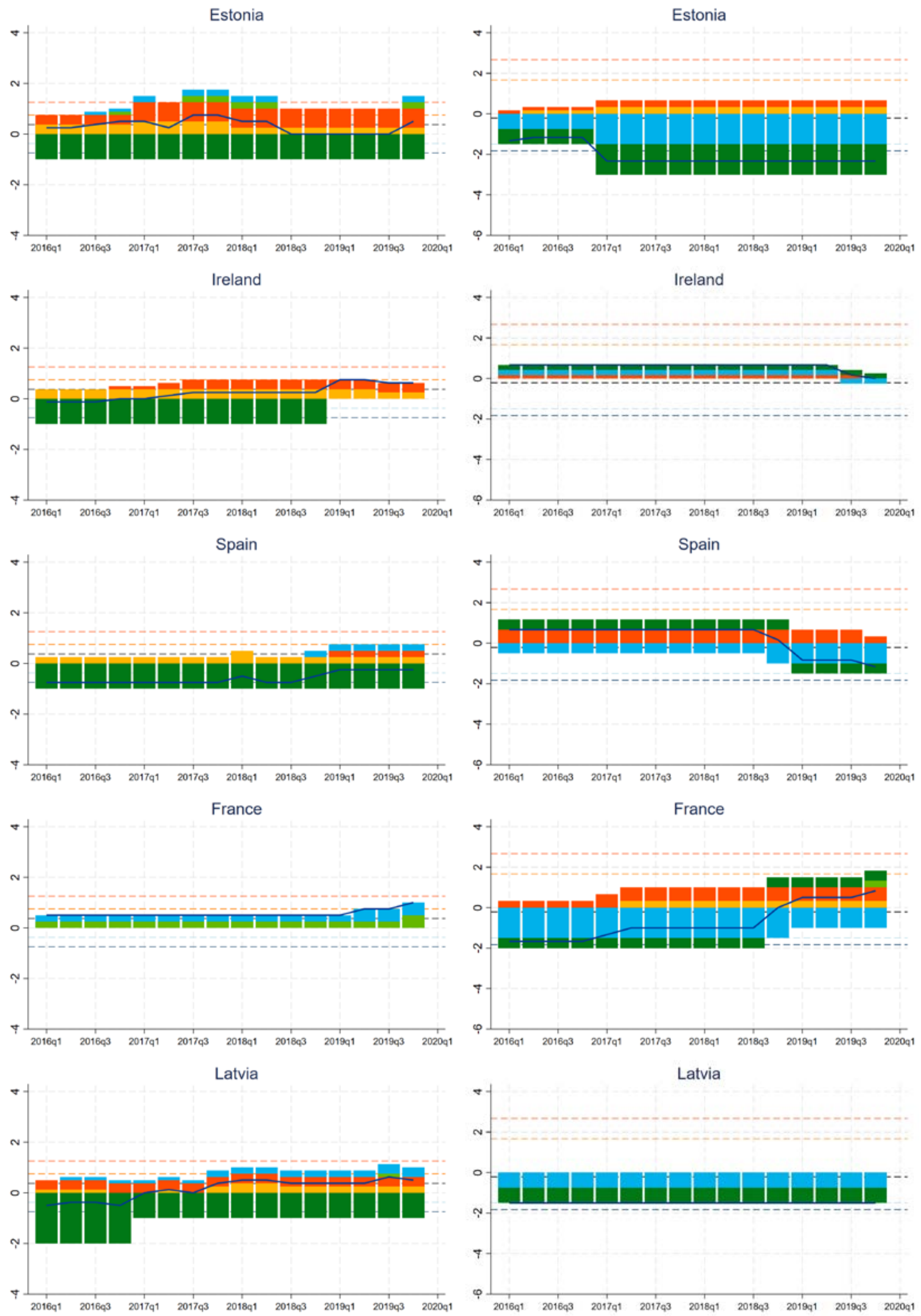

Italy
Latvia
Lithuania
Luxembourg
Hungary
Malta
Netherlands
Poland
Portugal
Romania
2016q1
2016q3
2017q1
2017q3
2018q1
2018q3
2019q1
2019q3
2020q1



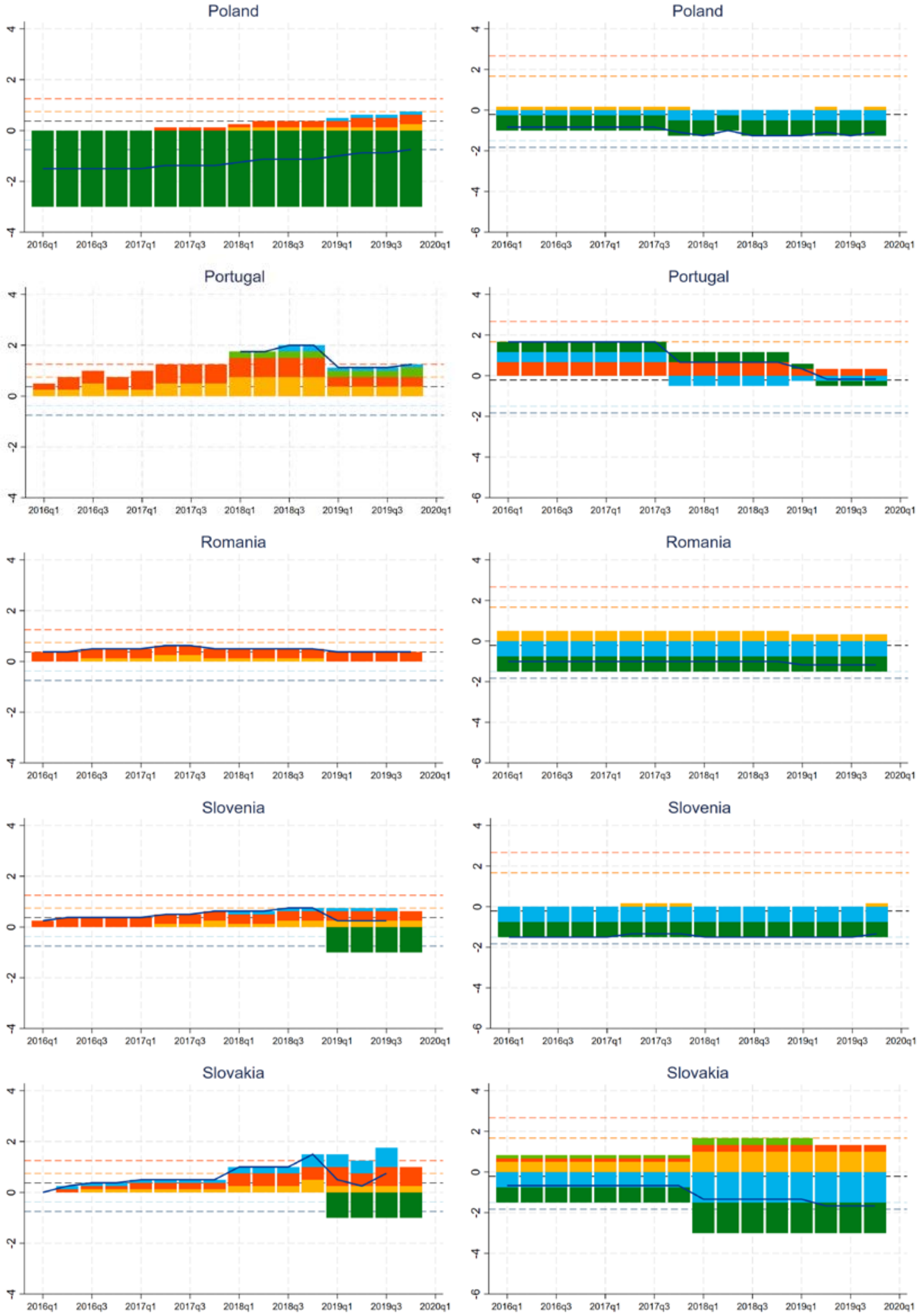
Notes: The solid line shows the overall stance assessment. The dashed lines indicate 10th, 20th, 50th, 80th and 90th percentile of overall stance in the entire dataset (all countries for which data were available, 2016-19 coverage). The absence of some elements for some countries means that the respective element has a score of 0 (low risk, low resilience, no policy or very loose policy in place). LTV and DSTI policy segments do not discriminate between legally binding and non-legally binding measures. For the sake of completeness, the following list summarises whether countries had legally binding or non-legally binding measures in place. Legally binding: Estonia, Ireland, Latvia, Lithuania, Hungary, Malta, the Netherlands, Slovenia, Slovakia and Sweden. Non-legally binding: Czech Republic, Denmark, Poland, Portugal and Romania.

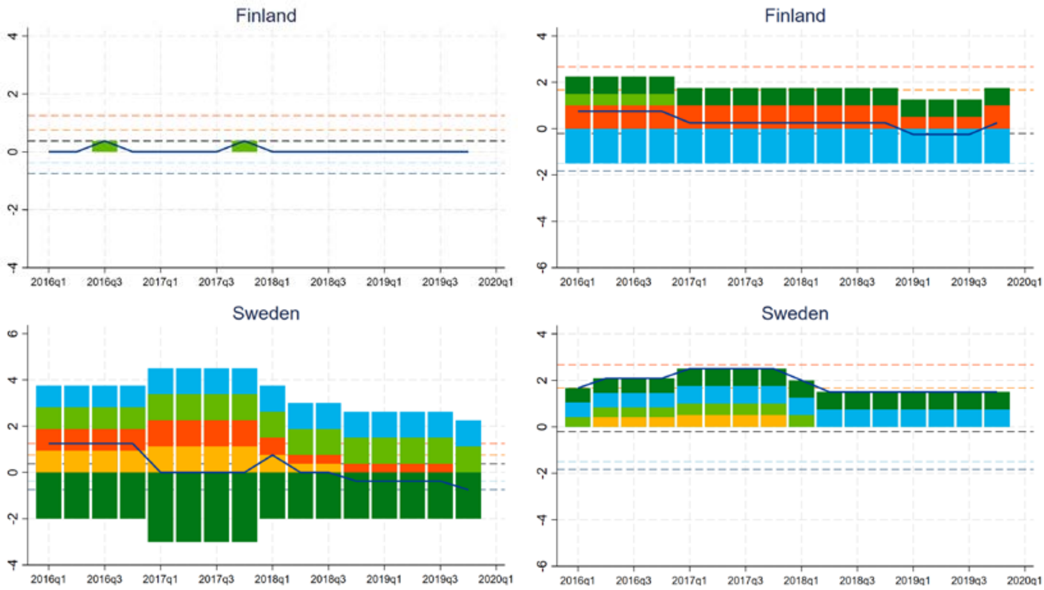
Chart A.3

Decomposition of collateral and funding stretches into their bucketed components.


Estonia
Estonia
Ireland
Ireland
Spain
Spain
France
France
Latvia
Latvia
4
2
0
-2
-4
-6
2016q1
2016q3
2017q1
2017q3
2018q1
2018q3
2019q1
2019q3
2020q1


Lithuania
Lithuania
Luxembourg
Luxembourg
Hungary
Hungary
Malta
Malta
Netherlands
Netherlands
2016q1 2016q3 2017q1 2017q3 2018q1 2018q3 2019q1 2019q3 2020q1


Poland
Poland
Portugal
Portugal
Romania
Romania
Slovenia
Slovenia
Slovakia
Slovakia
-4
-2
0
2
4
-6
2016q1
2016q3
2017q1
2017q3
2018q1
2018q3
2019q1
2019q3
2020q1



Notes: The solid line shows the overall stance assessment. The dashed lines indicate the 10th, 20th, 50th, 80th and 90th percentile of overall stance in the entire dataset (all countries for which data were available, 2016-19 coverage). The absence of some elements for some countries means that the respective element has a score of 0. In these representations, collateral and funding are not weighted according to Table 8. These charts show the relative contributions of each individual component in determining risk and resilience for the two stretches.

Table A.11

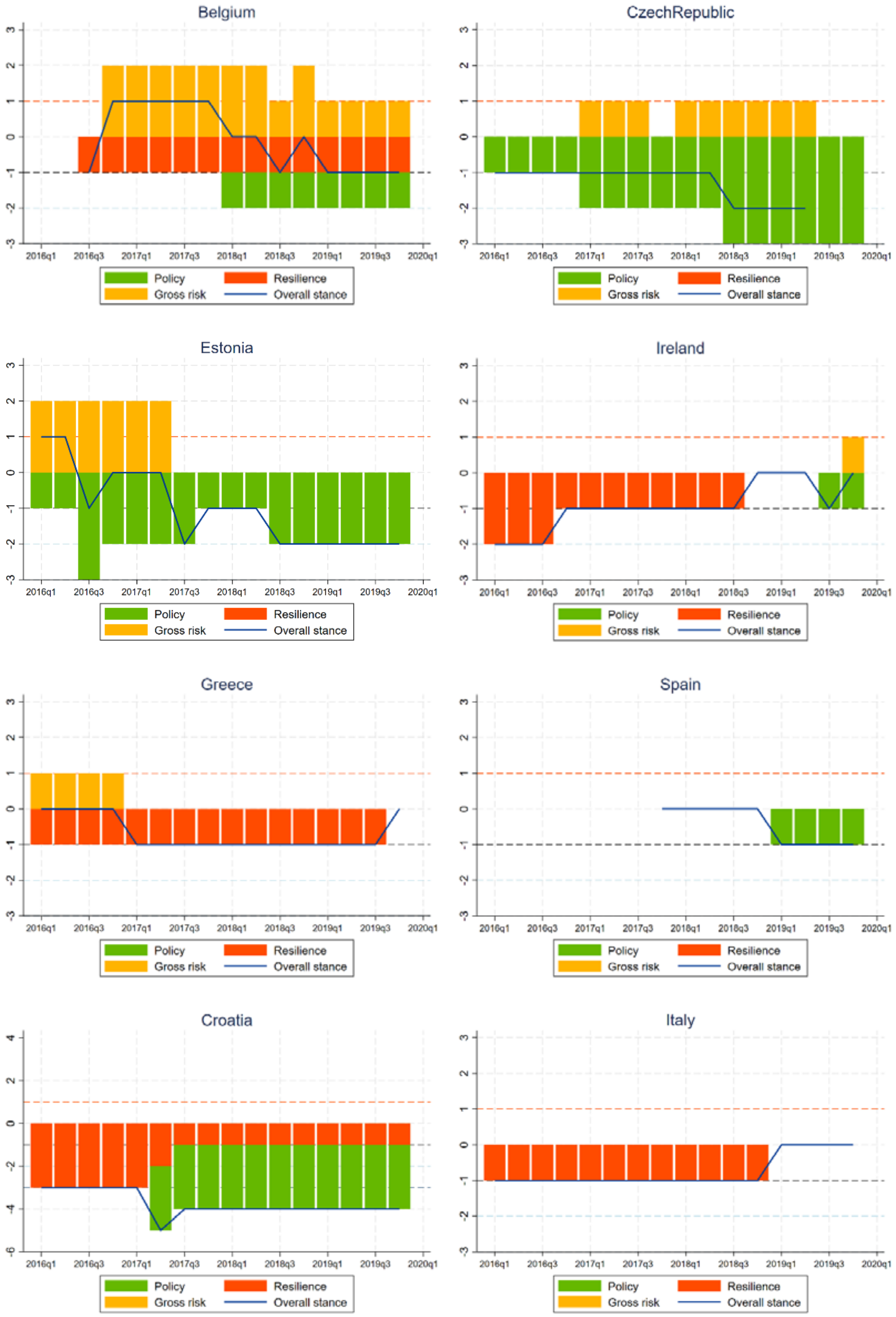
Indicator bucketing thresholds

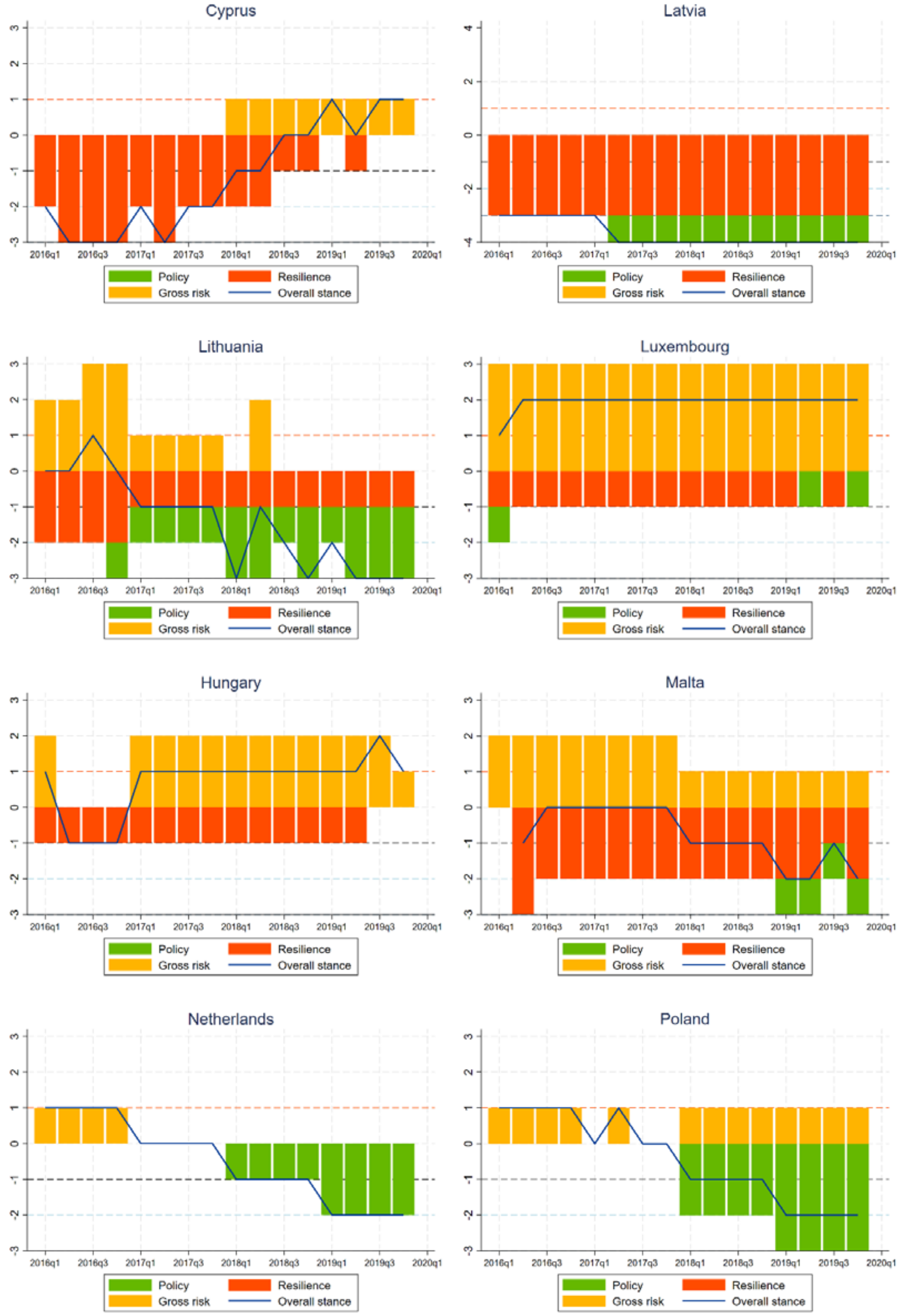
Bucket score	C1 Cyclical risk	S1 Total banking sector assets-to-GDP	S2 Market share of five largest banks	S3 NPL ratio	S4 Trade openness-to-GDP	S5 Total NFPS credit-to-GDP
0	(-Inf; -9.2)	[0; 206.1)	[0; 62.1)	[0; 4.1)	[0; 26.7)	[0; 86.2)
1	[-9.2; 18.1)	[206.1; 351.4)	[62.0; 79.5)	[4.1; 11.2)	[26.7; 40.2)	[86.2; 154.3)
2	[18.1; 53.5)	[351.4; 437.2)	[79.5; 86.7)	[11.2; 16.9)	[40.2; 47.2)	[154.3; 187.0)
3	[53.5; Inf)	[437.2; Inf)	[86.7;100)	[16.9; Inf)	[47.2; Inf)	[187.0; Inf)

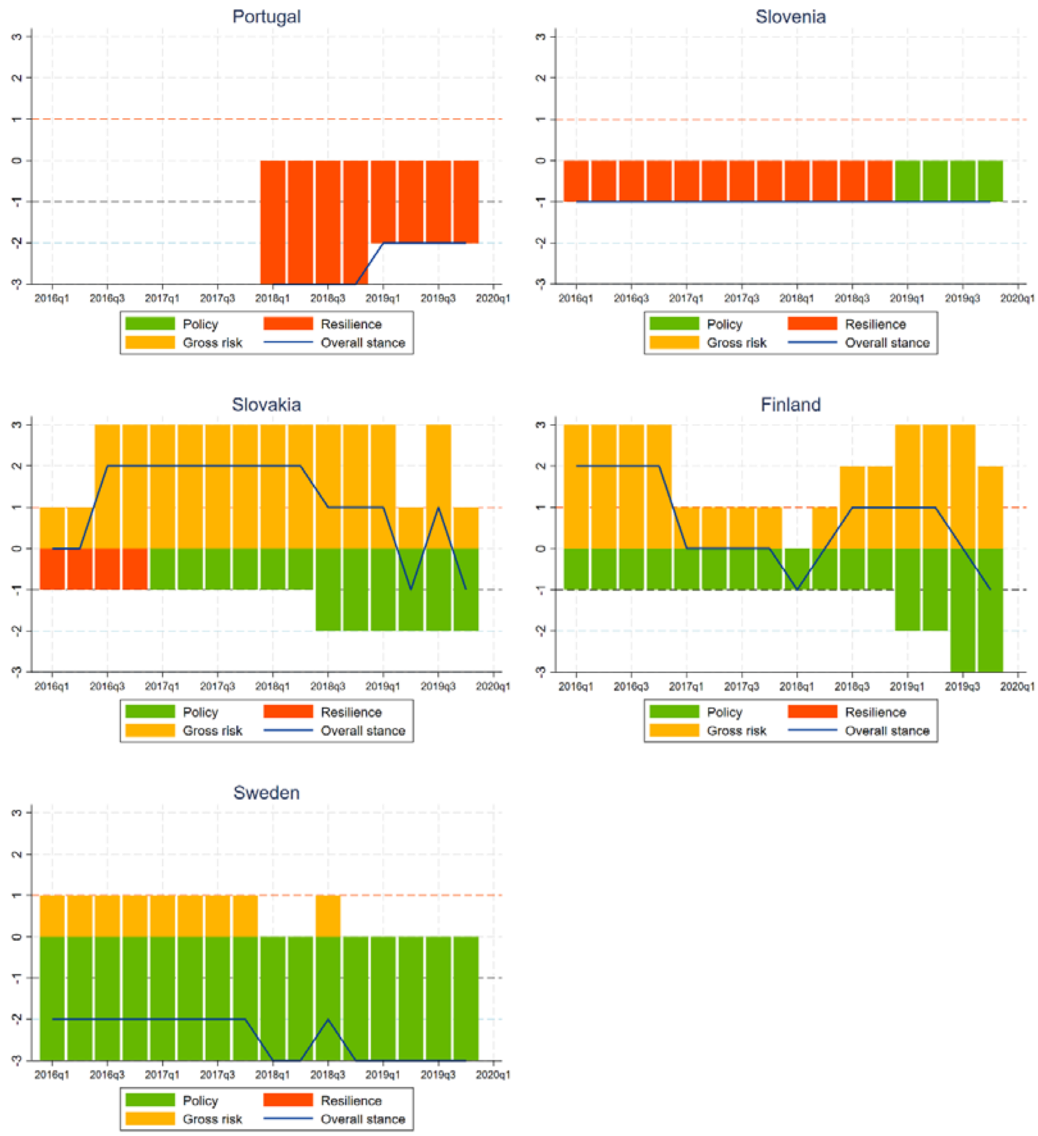
Bucket score	S6 Sovereign exposure as a share of total exposure	S7 Foreign exposure as a share of total exposure	S8 Intra-financial sector assets as a share of total bank assets	S9 Herfindahl-Hirschman Index of bank assets	R1 Resilience	P1 Policy	G1 Gross risk
0	[0; 8.1)	[0; 23.9)	[0; 20.1)	[0; 10.2)	[0; 1.1)	[0; 2.9)	[0; 0.7)
1	[8.1; 18.7)	[23.9; 44.2)	[20.1; 25.6)	[10.2; 15.8)	[1.3; 2.8)	[2.9; 4.8)	[0.7; 0.9]
2	[18.7; 24.2)	[44.2; 68.6)	[25.6; 29.9)	[15.8; 21.9)	[2.8; 3.9)	[4.8; 5.3)	(0.9; 1.1]
3	[24.2; Inf)	[68.6; Inf)	[29.9; Inf)	[21.9; Inf)	[3.9; Inf)	[5.3; Inf)	(1.1; Inf)

Chart A.4

Decomposition of CBM stance into risk, resilience and policy (for all countries with available data)



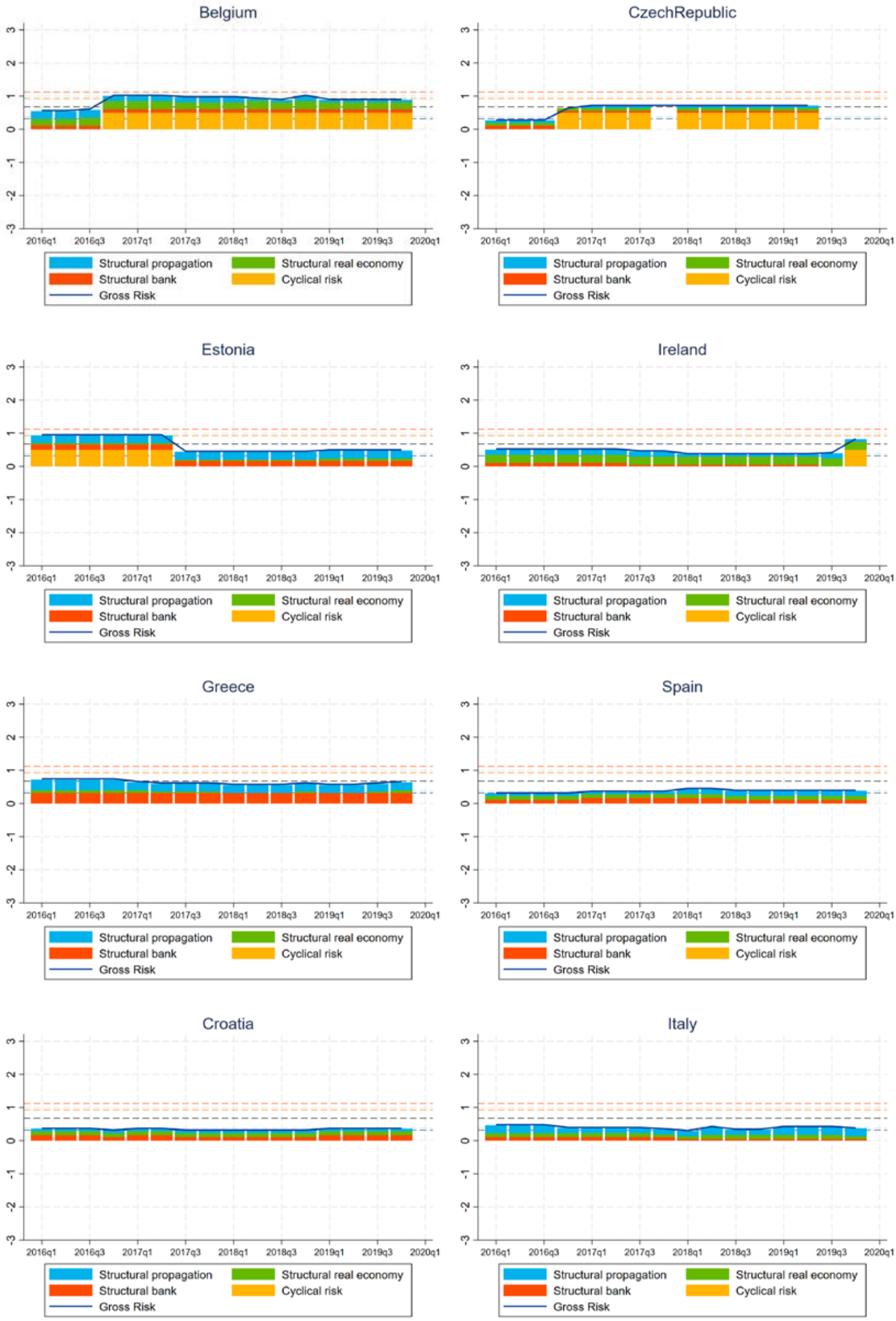

Cyprus
Latvia
Lithuania
Luxembourg
Hungary
Malta
Netherlands
Poland
2016q1
2016q3
2017q1
2017q3
2018q1
2018q3
2019q1
2019q3
2020q1
Policy
Resilience
Gross risk
Overall stance

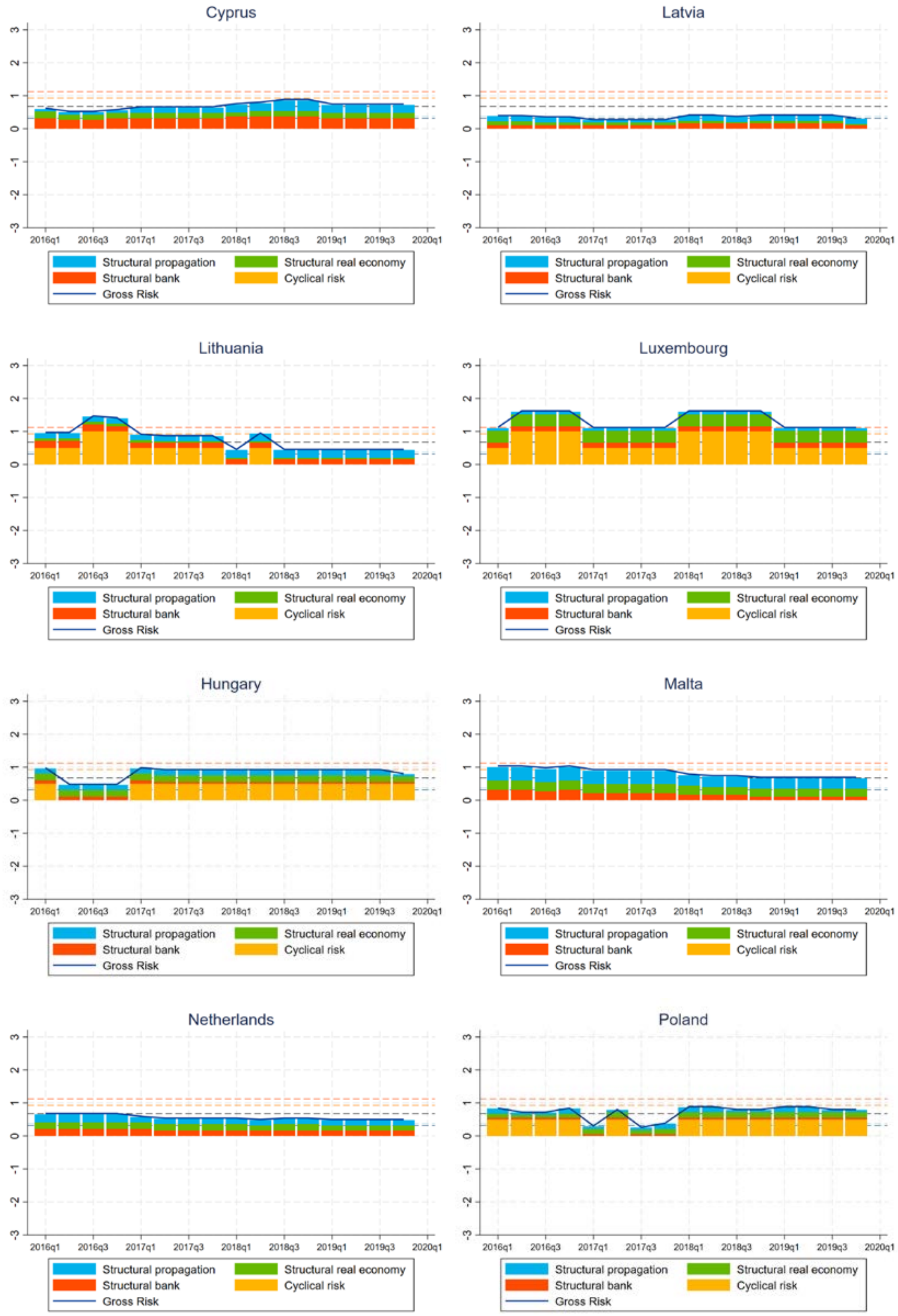


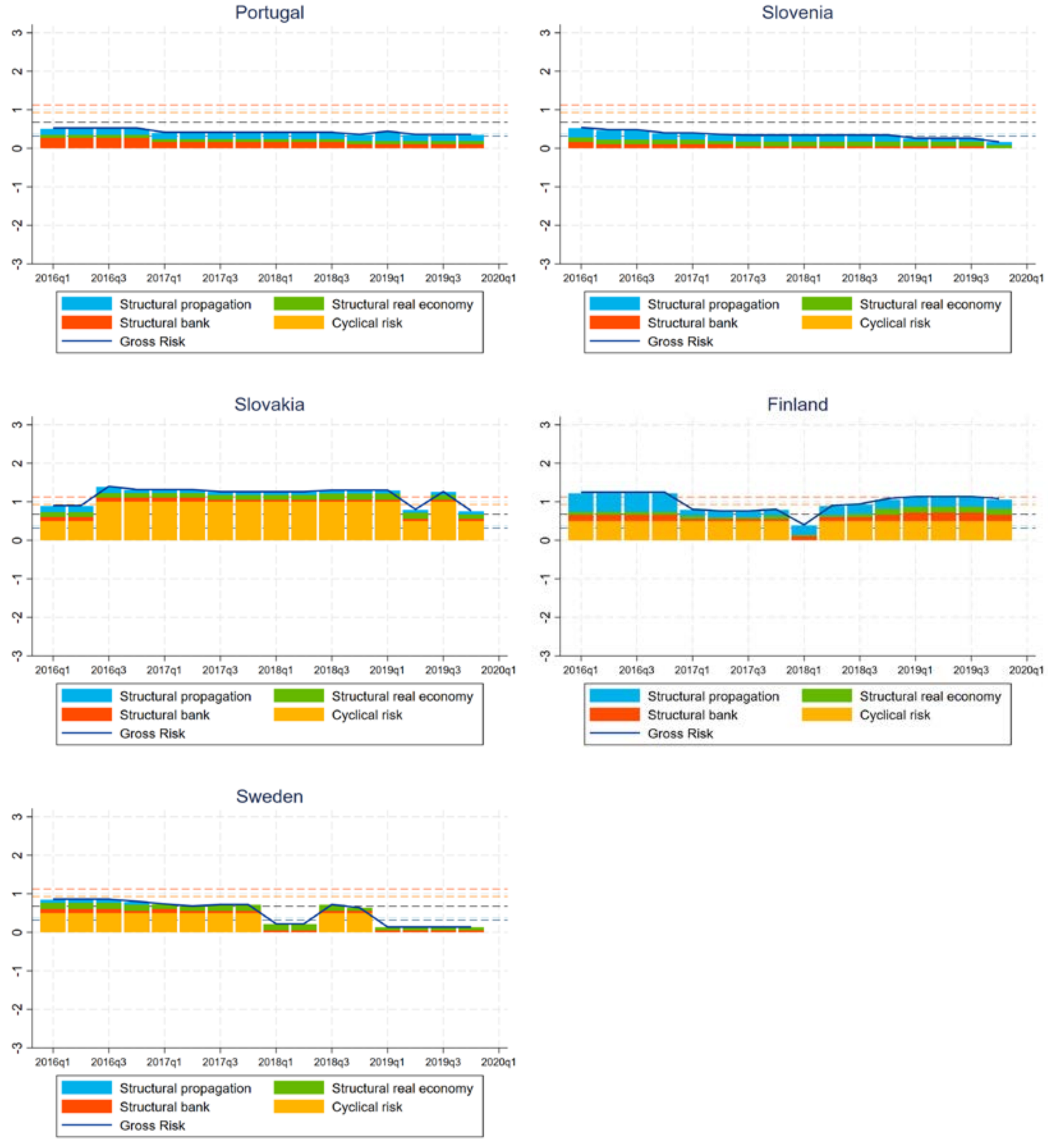
Notes: The solid blue line shows the overall stance assessment for capital-based measures, whereas the bars represent the buckets (from 0 to 3) of the gross risk, resilience and capital components (G1, R1 and P1 respectively). The dashed lines indicate the 10th, 20th, 50th, 80th and 90th percentile of overall stance in the entire dataset (all countries, all years). The overall stance can be calculated only when all the data on risk, resilience and policy are available. The absence of some elements for some countries means that the respective element has a score of 0 (low risk, low resilience, no policy or very loose policy in place). In all cases, the buckets are calculated in terms of the following percentile of each indicator over time and across countries: 50th, 80th and 90th.

Chart A.5

Decomposition of gross risk into bucketed cyclical risk and three categories of structural risk components (Table 11)




Cyprus
Latvia
Lithuania
Luxembourg
Hungary
Malta
Netherlands
Poland
3
2
1
0
-1
-2
-3
2016q1
2016q3
2017q1
2017q3
2018q1
2018q3
2019q1
2019q3
2020q1
Structural propagation
Structural real economy
Structural bank
Cyclical risk
Gross Risk



Note: The solid blue line shows the gross risk assessment for capital-based measures, whereas the bars represent the buckets (from 0 to 3) of cyclical risk and three categories of structural risks. The dashed lines indicate the 10th, 20th, 50th, 80th and 90th percentile of gross risk in the entire dataset (all countries, all years). The absence of some elements for some countries means that the respective element has a score of 0 (low risk, low resilience, no policy or very loose policy in place). In all cases, the buckets are calculated in terms of the following percentile of each indicator over time and across countries: 50th, 80th and 90th.

Imprint and acknowledgements

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The cut-off date for the data included in this report was December 2019.

For specific terminology please refer to the **ESRB glossary** (available in English only).

PDF ISBN 978-92-9472-248-5, doi: 10.2849/61297, DT-06-21-176-EN-N