

# Function and application of the new macroprudential tools available to the Banco de España

Christian Castro and Ángel Estrada

BANCO DE ESPAÑA

Ángel Estrada is the Director General Financial Stability, Regulation and Resolution of the Banco de España. Christian Castro belonged to the Directorate General Financial Stability, Regulation and Resolution of the Banco de España when this article was drafted. The authors would like to thank Jorge Galán, Javier Mencía, Carlos Pérez, Rafael Repullo, Carlos Trucharte and an anonymous referee for their contributions and comments, and the staff of the Financial Stability and Macroprudential Policy Department for their assistance in preparing the graphics. Email address for comments: [aestrada\(at\)bde\(dot\)es](mailto:aestrada(at)bde(dot)es).

This article is the exclusive responsibility of the authors and does not necessarily reflect the opinion of the Banco de España or of the Eurosystem.



### Abstract

Following the global financial crisis, banking regulation incorporated macroprudential policy into the authorities' toolkit with the aim of mitigating so-called "systemic risk". This is namely the risk of financial instability becoming so widespread that it hampers the functioning of the financial system, to such an extent that economic growth and citizens' well-being are adversely affected. One of the distinctive characteristics of this risk is that it is multi-dimensional; accordingly, a broad range of specific tools is needed to be able to tackle each of these dimensions. Up to a year ago Spanish regulations, deriving from European regulations, basically provided for macroprudential tools that could bear on banks' solvency requirements. Since then it has added other tools, some of which are common to other jurisdictions, that allow action to be taken on specific credit portfolios or on specific characteristics of the loans granted by banks. This article sets out these new tools, discussing their main properties and their potential scope for operating in practice. It also reviews some of the challenges that future revisions or future extensions of the macroprudential toolbox may pose.

### 1 Introduction

The global financial crisis late in the first decade of this century highlighted the fact that ensuring the solvency and liquidity of each financial institution individually is not sufficient to guarantee financial stability; rather, it is necessary to supervise the system as a whole. Indeed, one of the key lessons of that crisis was that the authorities should include an additional objective in their macroeconomic policies: the mitigation of systemic risk. In this respect, a fundamental principle that should be followed in designing economic policies is that each of the authorities' objectives should have differentiated tools to prevent policy clashes (Tinbergen (1956)). Given that a new objective requires a new policy, regulation incorporated the macroprudential policy, initially in the form of instruments resting above all on new capital and liquidity requirements for credit institutions.

There is no standardised definition of systemic risk. One of those most commonly accepted is that of the ECB (European Central Bank (2009)), which defines it as the risk of financial instability becoming so widespread that it hampers the functioning of the financial system, to such an extent that economic growth and citizens' well-being suffer. This definition underscores the multi-dimensional nature of this risk. It is thus essential that the authority responsible for the application of macroprudential policy should have a wide range of tools, allowing each of these dimensions to be tackled as efficiently as possible.

The theoretical and empirical literature appear to concur that there are at least two dimensions to systemic risk: a time/cyclical dimension (relating to the systemic risks that evolve over the course of the credit cycle) and a cross-sectional/structural dimension (relating to the impact on the systemic risk arising, for example, from the size, complexity and interconnectedness of banks). The dynamic characteristic of systemic risk means that, as in the case of economic cycles, there are different stages or phases in the gestation of a possible systemic crisis. These stages usually occur one after another, although they do not always have the same duration. Both the succession of stages and their duration will depend, among other things, on the measures adopted to mitigate them. Precisely for this reason, it would be desirable to have macroprudential instruments adapted to each stage that can be activated sequentially if they do not manage to mitigate the systemic risk in a prior stage.

It is generally considered that, in the initial stages of systemic risk build-up (or in the gestation of a systemic crisis), it would suffice for macroprudential instruments to mitigate the effects of such risk by requiring banks to accumulate additional resources (in the form of capital) with which to counter the consequences of the risk materialising. Some papers have shown that this type of instrument could also contribute to tempering the build-up of systemic risk. Firstly, because, by requiring more capital for each loan granted, banks would have fewer incentives to assume greater risks since they would have more skin in the game (see, for instance, Taleb and Sandis (2014)). Secondly, because in certain circumstances they could lead banks to raise the interest rate on loans, thereby reducing the demand for lending (Estrada and Mencía (2021)). The most emblematic instrument of this type is the countercyclical capital buffer (CCyB), which was introduced into banking regulations under the Basel III reforms after the global financial crisis. These are in fact the types of instruments envisaged in the main by current legislation following the transposition of the European capital requirements Directive and Regulation (CRD/CRR) (see Table 1).

However, at later stages in the development of systemic risk, it may be necessary to act directly on lending standards and, thereby, exert a more decisive impact on the volume of credit in specific or in all portfolios. Here, there are other instruments whose effectiveness may be deferred over time or be more immediate, meaning their use will once more depend on how urgent it is to act. First, there are relatively proportionate options for banks that involve restricting the flow of new lending by, for example, setting more restrictive lending conditions. The empirical evidence available shows, moreover, that this reduces the risk of borrower default, since looser lending conditions at the time of loans being granted are associated with a greater probability of subsequent default. Second, much more drastic and, therefore, last-resort instruments might also be envisaged, bearing directly on the total volume of lending admissible, e.g. limiting banks' lending-to-capital ratios. These are two of the instruments now available to the Banco de España, following Spanish Parliamentary authorisation, given that they do not exist in the attendant European regulations (although they do in many euro area countries).

Table 1

**MACROPRUDENTIAL TOOLS PROVIDED FOR IN THE CRD/CRR**

Tool	Legal basis	Description
Countercyclical capital buffer (CCyB)	CRD: 130, 135-140	Additional capital buffer, built up during upswings and released during downswings to smooth the credit cycle and absorb losses
Buffer for systemically important institutions	CRD: 131	Additional capital buffers to internalise the externalities created by systemic institutions, both global (G-SII) and national (O-SII)
Systemic risk buffer (SRB)	CRD: 133, 134	Capital buffer to prevent and mitigate non-cyclical systemic risks not covered by the CRR
Flexibility package	CRR: 458	Stricter requirements for capital, conservation buffer, liquidity, large exposures, information and risk weightings
Higher risk weightings for real estate exposures (standard approach)	CRR: 124	Tools for the real estate sector available to the competent authority
Higher Loss Given Defaults (LGDs) for real estate exposures (internal models)	CRR: 164	

**SOURCE:** Banco de España.

Logically, this new range of instruments will enhance the likelihood of macroprudential policy being successful in its preventive action against macrofinancial imbalances building up. But we must also consider the possibility that none of these preventive instruments will suffice and that systemic risk may ultimately materialise. Or that the financial system is disrupted as a result of an exogenous shock not preceded by an accumulation of systemic risk, as has been the case with the COVID-19 pandemic. To contend with this type of situation, macroprudential instruments also have to be palliative in nature, enabling banks to continue performing their function of providing financing for both firms' and households' solvent projects. But in this connection, it must be possible to release (or use) the built-up capital buffers when the risk materialises. Given the experience of COVID-19 and the lessons that may be drawn from it, it would be desirable to consider the need for possible adjustments to the current design of buffers so as to address systemic shocks exogenous to the financial system; these shocks are not preceded by an accumulation of systemic risks and, consequently, under current operating arrangements, releasable buffers are not built up. The instruments that restrict specific characteristics of the loans granted by banks reinforce, above all, borrower solvency (and, indirectly, that of the banks, which will experience fewer defaults), meaning that their deactivation will be less effective as a palliative measure, since they do not release funds that can be used by banks when a crisis breaks.

Concerning the second, cross-sectional/structural dimension of systemic risk, the strong financial interconnectedness of banks and financial sector sub-sectors (via markets, common positions and cross-positions) involves major efficiency gains for

the economy as a whole. This is because it allows risks to be distributed among more agents and enables each risk to be managed by the institution best prepared to do so. But it is also a source of vulnerabilities, which macroprudential policy must take into account and seek to mitigate. This interrelatedness means that the actions or problems of one financial institution can affect all the others. Moreover, there will be shocks that affect all of them in unison, jeopardising the system in a way that shocks only bearing down on one bank in isolation would not.

Included within this dimension, in particular, would be the risks arising from the presence of systemically important institutions. These types of institutions have far more capacity to affect the system's stability than smaller or less interconnected banks. Indeed, in many circumstances the authorities have not let such institutions go to the wall to prevent the entire system from falling into difficulties (the "too-big-to-fail" doctrine). These potentially higher costs for society would warrant an extra layer of protection against shocks being demanded of these banks. Some researchers have also stressed that a potential bailout by the authorities may lead these banks to enjoy preferential treatment by the markets and depositors in their funding, which would give such banks a competitive edge over others. Therefore, current legislation envisages the possibility of establishing additional capital buffers for these types of institution (global or domestic systemically important bank (G-SIB or D-SIB) buffers), and other types of buffers for more specific cross-sectional risks (systemic risk buffer (SyRB)).

The cyclical and structural dimensions of systemic risk are not isolated but interact with each other (Freixas, Laeven and Peydró (2015)). A good example of this interaction is the potential existence of a sectoral component of systemic risk. In fact, past experience shows that there have been situations in which systemic risk has originated in a specific sector and that, indeed, that sector has drained financial resources from the other sectors. This is why it must be possible to apply macroprudential instruments sectorally. Logically, the sectors considered should be materially significant for there to be any possibility of them deriving in a systemic risk. However, it should be borne in mind that these sectoral risks also have a dynamic component. Accordingly, it appears that sectoral instruments also need to be able to address systemic risk in the different stages of its development over time. First, by acting on banks' capital; this is why the third macroprudential instrument the Banco de España now has is the sectoral countercyclical capital buffer (SCCyB). Second, by exerting an impact on the amount, conditions and composition of the flow of lending. Thus, the instruments that set conditions on loans may also be applied with a degree of sectoral granularity and, ultimately, on the volume of lending to specific portfolios, as is the case with the limits on sectoral concentration.

As has been shown, the macroprudential instruments available up to a year ago under the regulations did not allow some of the situations described to be tackled, and did not therefore provide sufficient flexibility. In particular, the systemic risk

buffer alone provides for use on sectors or sub-sectors of banks' credit portfolios. However, this buffer cannot be applied in the case of cyclical risks that are already covered by the general CCyB, and nor do the regulations provide for how they may interact. Moreover, nor is the sectoral SyRB governed by the CCyB's principle of "guided (or bounded) discretion". This principle is especially useful for mitigating the time dimension of systemic risk, since it provides greater transparency and communication, allowing agents to anticipate to some extent its future changes and to incorporate it into their decision-making. Articles 124 and 164 of the CRR do enable sectoral imbalances to be tackled, although only when real estate exposures are involved. Nor does Article 458 of the CRR, known as the "flexibility package", offer clear alternatives to the measures envisaged in the proposal. This article is conceived for use under exceptional conditions, once the use of the other macroprudential instruments in the CRD/CRR has been shown to be inappropriate or insufficient. In fact, among the wide range of measures this article authorises, in no case does it allow strict limits to be set on lending standards or on concentration. Another alternative to introducing new instruments is the use of non-binding recommendations made by the macroprudential supervisor to banks. In this connection, several European countries have opted to introduce recommendations on lending standards rather than binding measures. Yet the evidence available shows that legally binding macroprudential measures are far more effective than non-binding recommendations for checking the growth of house prices and of lending in expansionary phases (see Poghosyan (2019)).

The rest of this article analyses these three new macroprudential instruments in greater detail. The second section describes their objectives and general workings, and the third section presents the empirical evidence available on their effectiveness, compared with that of the instruments already available. However, given the interrelatedness between dimensions and the degree of development of systemic risk, it may so occur that both the new instruments and those already available have to be combined under certain circumstances. The limited experience in their use and the modest (but rapidly growing) empirical evidence are naturally a significant limitation, which the passage of time will progressively mitigate. Nevertheless, section 4 of the article offers some considerations on this matter, assessing specific situations that might occur in practice. Lastly, section 5 sets out some of the challenges that future revisions or extensions of the macroprudential toolbox available to the authorities may pose.

## 2 The new macroprudential instruments

Pursuant to Article 2 of Royal Decree-Law 22/2018, a series of amendments were made to Law 10/2014 of 26 June 2014 on the regulation, supervision and solvency of credit institutions to include the new macroprudential instruments. Article 15(1) of Royal Decree 102/2019 provides for the use by the Banco de España of these

instruments in systemic risk situations, adding to those instruments already available for application through their inclusion in the CRD/CRR.

The three new instruments available are:

- a) **CCyB applicable to exposures to a specific sector (i.e. SCCyB):** as provided for in Articles 43 to 49 of Law 10/2014. Specifically, four sectors are considered: lending to individuals under mortgage guarantee, without a mortgage guarantee, for productive construction and development activities and for other productive activities.
- b) **Limits on the conditions governing lending and other operations by credit institutions (i.e. borrower-based instruments (BBI)):** considered by virtue of Article 69 ter of Law 10/2014.
- c) **Limits on the concentration by credit institutions in a specific sector of economic activity (i.e. sectoral concentration limits (SCL)):** set in accordance with Article 69 bis of Law 10/2014. Two further sectors are added to the list envisaged in the SCCyB: credit institutions and other financial institutions.

A newly drafted Banco de España circular is scheduled to cover the development and implementation of these tools, and compliance therewith.

## 2.1 Sectoral countercyclical capital buffer

As discussed in the introduction, it has occasionally been the exposures to specific sectors that have concentrated most systemic risk. In such a situation (excessive credit growth in a particular sector, but whose magnitude does not significantly affect total credit initially), activating aggregate macroprudential instruments might not be an effective measure and, in fact, could be counter-productive.

In this case, while the activation of the CCyB could help build up a buffer capable of absorbing the future losses that credit exposures in general (including those in this sector) were to bring about, it might not be useful for actually deterring the excessive growth of credit to the sector with imbalances. Indeed, although the CCyB would increase the cost for banks of continuing to expand total credit, the relative price of extending credit to the sector identified would remain unchanged compared with the price of lending to other sectors. Accordingly, insofar as loans to the sector identified were to provide a higher return (a greater risk) than other types of loans, the incentives to continue increasing credit and its concentration would persist, even at the cost of reducing credit to other less risky sectors. Also, nor would introducing the CCyB be able to ensure that the terms under which these loans were granted were excessively loose in relation to those of the other sectors. Conversely, if the measure were to



affect one or a specific group of sectors, the relative cost of lending to the sectors would increase, altering the relative returns on the various portfolios to the detriment of the sector, or sectors, that are generating the systemic risk.

In any event, the application of a sectoral instrument should be accompanied by the strict monitoring of its potential spillover effects to the other sectors. The aim here would be to prevent, for example, the problem of excessive credit growth from shifting across sectors. Moreover, the sectors considered should have a systemic dimension, to prevent the instrument from being microprudential in nature. For example, there should be evidence that developments in these sectors, if not duly controlled, may contribute in the future to increasing risks in other sectors or at the aggregate level.

### 2.1.1 General description of the functioning of the sectoral countercyclical capital buffer

From a technical standpoint, the SCCyB can be seen as an extension of the design of the CCyB, by allowing its application both to overall exposures and to certain sectors, or even to both simultaneously.<sup>1</sup> Hence, the main purpose of the SCCyB is to tackle systemic risk stemming from the imbalances potentially generated in a specific sector of economic activity, and to endow institutions with sufficient capital resources to withstand the potential losses that might arise should there be a disorderly spread of the sectoral cyclical imbalances created.

Following the guidelines laid down in the principles published by the Basel Committee on Banking Supervision (BCBS) (Basel Committee on Banking Supervision (2019a)) and the pertinent literature, as with the CCyB, the activation, accumulation and deactivation of the SCCyB will be guided by different categories of indicators, including: i) sectoral lending volumes / measures of credit growth, intensity and gaps; ii) asset prices / changes and measures of disequilibrium, specialised for each sector, and iii) sectoral macrofinancial imbalances / debt, net wealth, net borrowing or lending, saving rate and investment, inter alia.

Any rule guiding the use of the SCCyB in practice should comply with certain protocols allowing its correct interaction with the CCyB:

- a) When there is an increase in credit risk, total required capital, whether through the general CCyB or through the sectoral component, should be increased.
- b) As the level of the CCyB increases, the absolute cost of granting credit to the sector identified as the source of systemic risk should increase.

---

<sup>1</sup> See Castro, Estrada and Martínez (2014 and 2016) for an explanation of the general functioning of the CCyB and its operationalisation in Spain.

## 2.2 Borrower-based instruments

In situations in which there is an excessive and widespread easing in lending conditions without regard to its systemic consequences, borrower-based instruments (BBI) allow, for macroprudential reasons, limits to be set on these conditions at the time the loans are granted (e.g. limits on collateral coverage ratios, borrower ability-to-pay ratios, loan maturity terms, etc.). Accordingly, the aim of BBI is to attempt to influence lending standards, which directly affect the flow of new lending and the subsequent probability of default.

By setting limits on new lending conditions, BBI could be applied when, for example: house price overvaluation reaches such a level that potential future corrections would lower the collateral value to below that of the loan made; borrowers not in a sufficiently sound financial situation can gain access to credit; or lending indicators for a significant percentage of the credit portfolio reach worrying levels from a solvency standpoint.

### 2.2.1 General description of the functioning of borrower-based instruments

Royal Decree-Law 22/2018 states that the Banco de España may, among other measures, set limits or conditions on:

- i) the maximum debt allowed to a borrower based on the value of the collateral provided (i.e. using the loan-to-value ratio (LTV) or loan-to-price ratio (LTP), depending on whether the appraisal value of the property or the transaction value is used);
- ii) the proportion of a borrower's income that a specific loan (loan-to-income ratio, LTI) or all of their loans (debt-to-income ratio, DTI) represents;
- iii) the share of the borrower's disposable income dedicated to paying down a specific loan (loan-service-to-income ratio, LSTI) or all of their loans (debt-service-to-income ratio, DSTI);
- iv) the maturity of the loan.

BBI can be applied to various loan characteristics. The decision to impose conditions on certain characteristics and not on others will therefore depend on the specific situation that needs to be addressed, i.e. the nature of the systemic risk and the most effective characteristic for its mitigation. However, setting conditions on one characteristic might prompt excesses in others. Accordingly, it may be necessary to

act on several characteristics simultaneously. In other words, several limits may sometimes have to be activated simultaneously, and limits may need to be combined with other existing macroprudential tools.

There could also be spillover effects to other credit portfolios not subject to the limits introduced, e.g. from mortgage to non-mortgage loans, which could lead to the measures being extended to those segments. Regulation of this instrument should also provide for the possibility of adjusting the conditions according to the characteristics of the borrower and the lender, thus ensuring their efficacy and preventing the disproportionate concentration of their effects on certain groups of potential borrowers.

## 2.3 Sectoral concentration limits

Like the SCCyB, this tool focuses on overall exposures to a specific sector. Concentration is defined in terms of the ratio of sectoral exposure to common equity tier 1 capital (CET1). Therefore, it does not place an absolute quantitative cap on exposure (i.e. the limit is activated when the ratio between exposure and capital exceeds a certain threshold). It is also a sectoral instrument, meaning its objectives are aligned with those of the SCCyB (in particular, limiting excessive credit growth). The potential effects of spillovers to other sectors must also be carefully analysed. Further, the sectors must have a systemic dimension and be consistent, as far as possible, with those envisaged for the SCCyB.

The fundamental difference between this tool and the SCCyB is that its activation would inhibit the growth of sectoral concentration more directly (via the “quantity” effect), while the SCCyB only provides a disincentive, making it more expensive, in relative capital terms, to increase credit exposure to the targeted sector or sectors. As a result, there are benefits and challenges to its use. For one thing, it is implemented through a quantitative reference as to concentration, meaning this tool more directly limits the banks’ – and consequently the system’s – degree of exposure to a specific sector. However, such a quantitative reference poses challenges in terms of its correct calibration and practical use, if distortions and unintended consequences on the system’s and banks’ normal functioning are to be avoided. Lastly, unlike the SCCyB, the exposures to which SCL refer are not risk weighted.

### 2.3.1 General description of the functioning of sectoral concentration limits

Given their ties with the SCCyB, there should be some consistency and continuity when defining the sector or sectors to which SCL would be applied. Further, as with the SCCyB, periodic monitoring and analysis is required to consider the potential need for their activation. The indicators already envisaged for the SCCyB are useful

in this respect, along with certain additional indicators that can also serve to determine the temporary thresholds which banks cannot exceed. Possible indicators include changes in the aggregate exposure to each sector, its historical share of total exposures and recent changes, its relevance in GDP and in sectoral value-added, and, naturally, its weight in aggregate CET1.

SCL may be imposed on a specific sector or on several sectors simultaneously if exposure concentration occurs across various sectors at once. They may also be applied simultaneously with other macroprudential tools if deemed necessary to increase their effectiveness.

As regards the sequencing of the above-mentioned instruments, SCL are considered a tool of last resort. Although the evidence suggests that activating BBI tends to have a swift impact on credit growth, it is important to bear in mind that they only affect the flow of new lending and not the volume of existing loans. This is further reason to consider activating SCL in exceptional circumstances.

### 3 Empirical evidence on the effectiveness of the new macroprudential tools

Broadly speaking, analysis of the effectiveness of macroprudential tools seeks to measure or assess – both conceptually and empirically – how effective macroprudential instruments are in staving off systemic risks (ex ante resilience) or in mitigating them should they materialise (ex post resilience). In other words, it aims to assess, first, their ability to reduce the probability of systemic risks materialising (which would entail losses for banks and the system) and, second, their ability to lessen the impact should they materialise (if they have sufficient resources to absorb the losses and allow banks and the system to continue their financial intermediation activity).

#### 3.1 Sectoral countercyclical capital buffer

Although only a handful of countries have activated the aggregate CCyB, and in most cases it has only been recently deactivated as part of the response to the COVID-19 crisis, the empirical literature on this tool is growing. By contrast, literature on the SCCyB is far sparser (see, for example, BCBS (2019b)), since very few countries provide for it in their legislation. This section therefore sets out evidence based on studies of the CCyB or of the observed effects in other instances of increased capital requirements in specific sectors.<sup>2</sup>

The literature review conducted by the BCBS (2018a) mentions a series of instances in which specific capital requirements were applied to sectors such as residential

---

<sup>2</sup> For example, Ferrari et al. (2017) analyse the increase in risk weights, which can be regarded as equivalent to raising capital requirements.

and commercial real estate, consumer loans and foreign currency loans. However, few papers have conducted an empirical assessment of their effectiveness. In fact, thus far only Switzerland has introduced a SCCyB, targeted at the real estate sector. Based on that experience, Basten and Koch (2017) find that while its activation in 2013 did not affect the loan approval rate, it did have an impact on the lending interest rates offered by the more capital-constrained banks and mortgage-specialised banks. For mortgage-specialised banks, they also found that annual mortgage loan growth decreased after the measure was introduced. In respect of measures raising capital requirements for certain sectors, Ferrari et al. (2017) find that the increase in risk weights for mortgage exposures in Belgium has had a limited effect on mortgage loan interest rates and on their growth. By contrast, Martins and Schechtman (2014) and Afanasieff et al. (2015), who study the effects of an increase in risk weights for auto loans in Brazil, find a material impact on the volumes of targeted loans. It appears, therefore, that there is mixed evidence regarding the impact generated by such sectoral measures on loan volumes, both in terms of quantity and price (BCBS (2019b)).

However, there is greater consensus on the positive effect of sectoral capital tools such as the SCCyB on ex post resilience; i.e. as a means to help absorb losses and sustain the flow of credit to the economy, thereby avoiding credit crunches. The recent evidence emerging from certain jurisdictions which have deactivated any of their existing capital buffers (generally the CCyB) in response to the COVID-19 crisis seems to suggest that deactivating such instruments has made the buffers more readily available to banks to be used to maintain the flow of credit to the real economy (see Castro and Estrada (2021)).

Despite the scant direct evidence on the effectiveness of the SCCyB, the studies conducted on the general CCyB are potentially relevant to understanding the impact on aggregate credit and other variables. In keeping with the results generally observed internationally, the empirical evidence available in Spain, for the period of systemic risk build-up preceding its materialisation during the global financial crisis, suggests that the CCyB is able to slightly temper credit growth (Jiménez et al. (2017)),<sup>3</sup> but that its strongest effect comes upon its release in response to the materialisation of systemic risk, easing credit supply constraints. These findings are borne out when broader historical periods are considered (see Bedayo et al. (2020)). The study of credit cycles over the past 150 years indicates that a 1% increase in the capital ratio of banks during upturns would moderate credit growth by close to 0.8 percentage points (pp), while the GDP growth rate would be reduced by around 0.4 pp. These effects appear to be concentrated in the period one to two years after activation. However, the benefits of releasing the

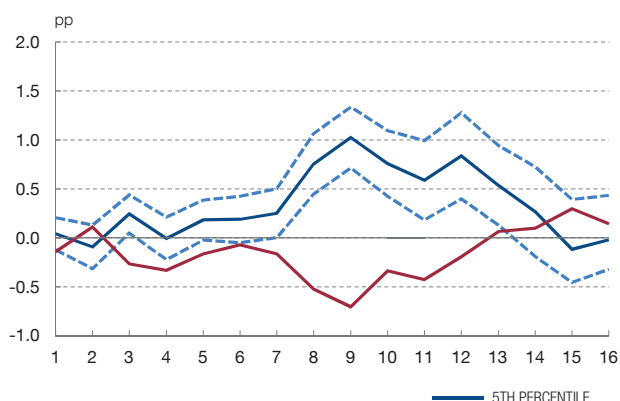
---

3 The study by Jiménez et al. (2017) is based on Spain's experience of dynamic provisioning. Provisions do not form part of banks' capital, but the workings of dynamic provisioning and its economic interpretation make them distinctly similar to the CCyB.

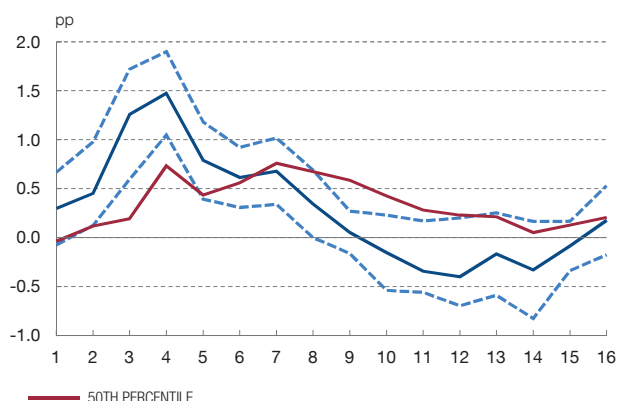
Chart 1

**IMPACT OF THE ACTIVATION AND RELEASE OF THE CCyB ON THE 5TH AND 50TH PERCENTILES OF THE GDP GROWTH DISTRIBUTION OVER TIME HORIZONS OF BETWEEN 1 AND 16 QUARTERS (a)**

1 ACTIVATION OF THE CCyB DURING UPSWINGS



2 RELEASE OF THE CCyB DURING PERIODS OF FINANCIAL CRISIS



SOURCE: Galán (2020).

a The solid blue and red lines represent the estimated impact on the 5th and 50th percentile of the conditional distribution of GDP growth, respectively. The dotted blue lines represent the confidence band at 95% obtained through bootstrapping.

CCyB in economic downturns would clearly outweigh these costs, since the credit fall-off during downswings could be mitigated by as much as 4.5 pp and the decline in GDP by 2 pp.

Further, applying a methodology that makes it possible to estimate the impact of the macroprudential instruments on the entire GDP growth distribution function (Galán (2020)) suggests differential effects not only in terms of the time horizon but also in the distribution.<sup>4</sup> In particular, it would significantly lessen the extreme falls in GDP that would occur in a severe crisis two years after its activation, but would also prompt a modest decline in expected growth. This would suggest that, although the expected average impact could be negative (in line with the results of the above-described methods), there would be a favourable effect in return: a smaller GDP contraction in the event of a severe recession. Also, the effects of releasing a CCyB during periods of financial crisis would be positive across the entire GDP growth distribution and would be felt more immediately, in just one year.<sup>5</sup> This exercise confirms that the benefits of increasing the CCyB would clearly outweigh the costs, and that the benefits are most evident when the buffer is released during crisis periods (see Chart 1).

4 These estimates are based on a growth-at-risk approach, using quantile regression models in which the dependent variable is future GDP growth over time horizons of between one and 16 quarters. The sample for the estimates comprises a panel of advanced and emerging economies with quarterly data.

5 Trucharte (2021) conducts a counterfactual exercise estimating the size of the buffers that Spanish banks would have built up in the run-up to the global financial crisis had these tools been available and activated mechanically pursuant to the recommendations established for the CCyB.

### 3.2 Instruments based on the borrower's ability to pay

Past experience shows that, in general, the most severe systemic financial crises have been associated with imbalances, boom and bust cycles and weaknesses in the real estate sector (see, for example, Reinhart and Rogoff (2008 and 2009), Crowe et al. (2013) and Hartman (2015)). Accordingly, the monitoring of real estate sector risks and the analysis of potential instruments and measures for prevention or mitigation of these risks have been central to the development of macroprudential policy since the outset.

Indeed, the rationale for using BBI is based on the empirical observation that mortgage loans extended under stricter standards in terms of their leverage, repayment schedule and maturity (i.e. with shorter maturities) subsequently present significantly lower default rates. Further, loan contracts in which several of these credit standards are looser tend to show appreciably higher probabilities of default than loans in which only one of them is looser.

Credit standards are key to ensuring the safety and soundness of banks, since they bolster borrowers' creditworthiness and, therefore, reduce potential subsequent losses for lenders. Accordingly, assessing banks' lending policies is crucial for diminishing the impact of future shocks. And this should not be limited to mortgage loans; rather, it should extend to all other credit portfolios, including corporate portfolios, as is the case under Spanish legislation. Unfortunately, analysis of this tool's effectiveness is necessarily limited to mortgages, as these are the only portfolios to which such tools are applicable in most of the countries that have them. Here, Spanish regulation is quite unique, since it extends their use to other credit portfolios.

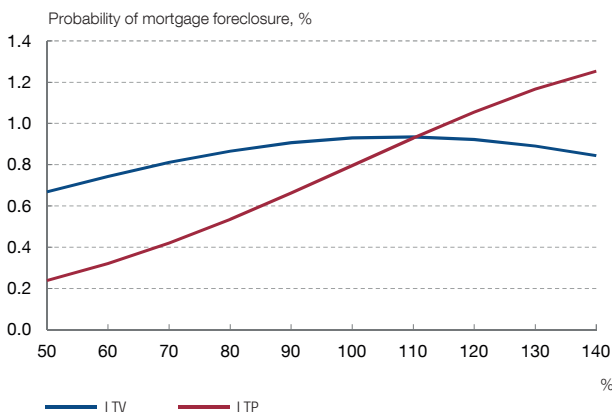
Specifically, various empirical studies identify positive effects of borrower-based measures in terms of moderating credit and house prices (Claessens et al. (2013) and Cerutti et al. (2017)) and reducing mortgage risk (Campbell and Cocco (2015) and Aron and Muellbauer (2016)). For their part, studies analysing the impact on economic growth of activating such measures have found adverse effects (see Richter et al. (2019)). These findings may owe to the above papers focusing on models that exclusively identify the near-term impact on average GDP, where the immediate costs of tighter macroprudential policy are evident. Moreover, the handful of studies that analyse the effects of deactivating these tools in crisis periods find negligible impacts on credit or GDP (Galán (2020)). However, banks' losses in crisis periods would probably also be reduced, given the lower ex ante build-up of risk on their balance sheets.

More specifically, in the case of Spain, Galán and Lamas (2019) find empirical evidence suggesting that the variables pertaining to credit standards at origination, such as the LTV, LTP and LSTI ratios or loan maturity, are key indicators of ex ante

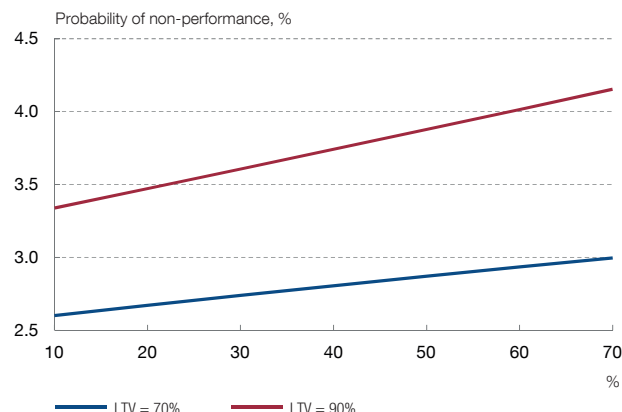
Chart 2

**PROBABILITY OF MORTGAGE DEFAULT EVENTS AND RELATIONSHIP TO CREDIT STANDARDS (a)**

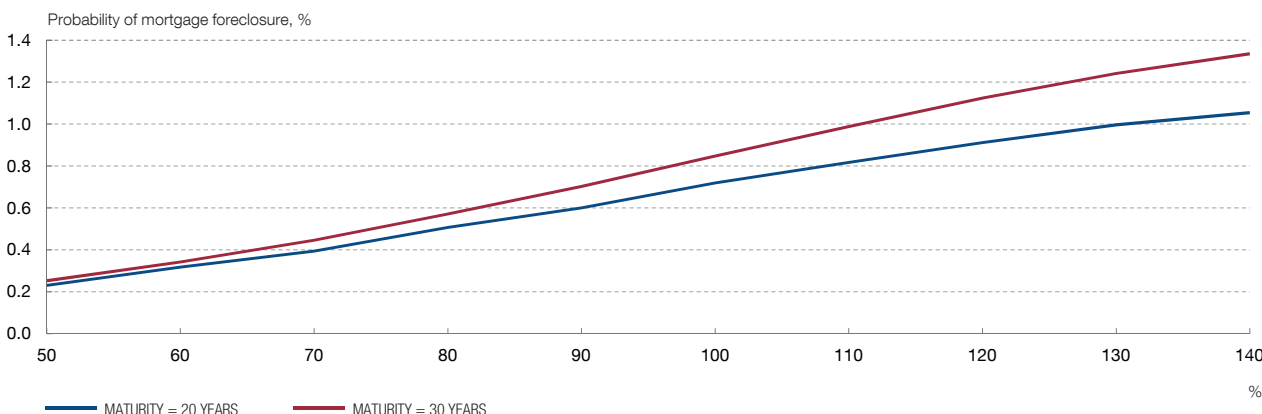
1 LEVERAGE RATIOS AND PROBABILITY OF MORTGAGE FORECLOSURE



2 INTERACTION BETWEEN LSTI AND LTV AND PROBABILITY OF MORTGAGE NON-PERFORMANCE (b)



3 INTERACTION BETWEEN MATURITY AND LTP AND PROBABILITY OF MORTGAGE FORECLOSURE (c)



SOURCE: Galán and Lamas (2019).

- a The probability of a stress event occurring (mortgage foreclosure or non-performance) is estimated for loans with identical characteristics, in which the LTV, LTP, maturity or LST value varies, depending on the chart. Except where the LTV ratio is over 80%, the confidence intervals of these estimates are narrow, and therefore the changes in probability are statistically significant.
- b The LSTI ratio is plotted on the horizontal axis.
- c The LTP ratio is plotted on the horizontal axis.

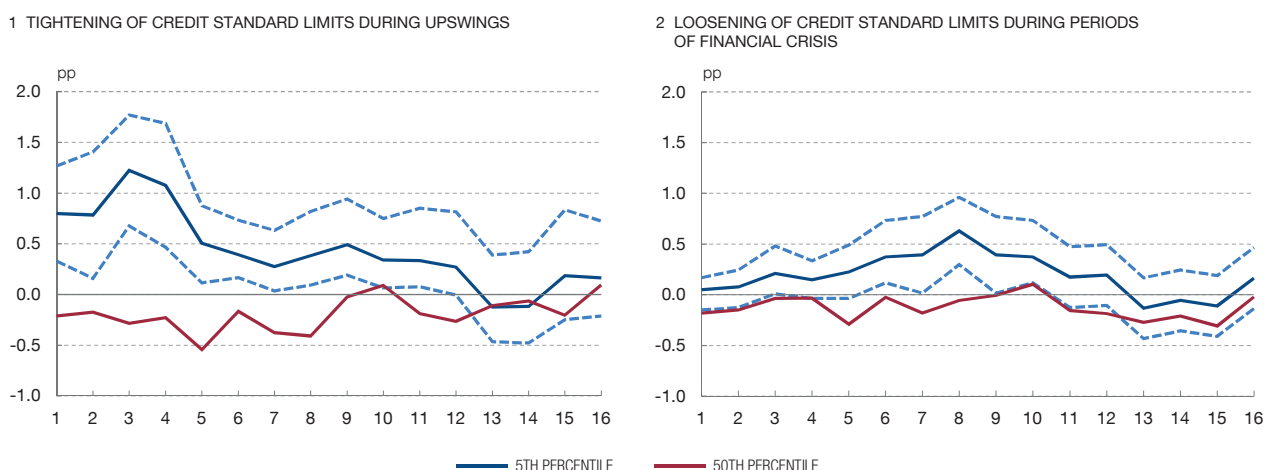
risks in the real estate sector. In particular, they find that loans are riskier when all of these ratios are higher and the maturity is longer. Moreover, the analysis of the interactions between these loan characteristics indicates non-linear effects on risk. This suggests the need to combine the various metrics indicated, and to consider the effects in different phases of the financial cycle, for a more consistent analysis of real estate sector risks (see Chart 2).

The estimated effects of setting limits on credit standards in terms of the future GDP growth distribution function (Galán (2020)) likewise suggest that their activation or tightening during normal or expansionary periods would have positive effects for the GDP decline that would arise in the event of a downturn (5th percentile) that exceed



Chart 3

**IMPACT OF CREDIT STANDARD LIMITS ON THE 5TH AND 50TH PERCENTILES OF THE GDP GROWTH DISTRIBUTION OVER TIME HORIZONS OF BETWEEN 1 AND 16 QUARTERS (a)**



SOURCE: Galán (2020).

a The solid blue and red lines represent the estimated impact on the 5th and 50th percentile of the conditional distribution of GDP growth, respectively. The dotted blue lines represent the confidence band at 95% obtained through bootstrapping.

the estimated adverse impact under normal economic conditions (50th percentile). Unlike in the case of capital tools, the positive impact is identified almost immediately following implementation of the measures and their effects are longer lasting. Also, the effects of deactivating or easing these limits during periods of financial crisis are virtually non-existent (see Chart 3).

### 3.3 Sectoral concentration limits

There is very little empirical evidence on the impact of sectoral concentration limits, given their scant use in a macroprudential setting and the difficulty in distinguishing the various effects. However, as a sectoral instrument, it seems logical to expect similarities between these effects and those indicated for the SCCyB, but the potential spillover effects to other sectors need to be analysed carefully. Given that concentration is defined as a ratio relative to CET1, it could be equated to a far more demanding capital tool.<sup>6</sup>

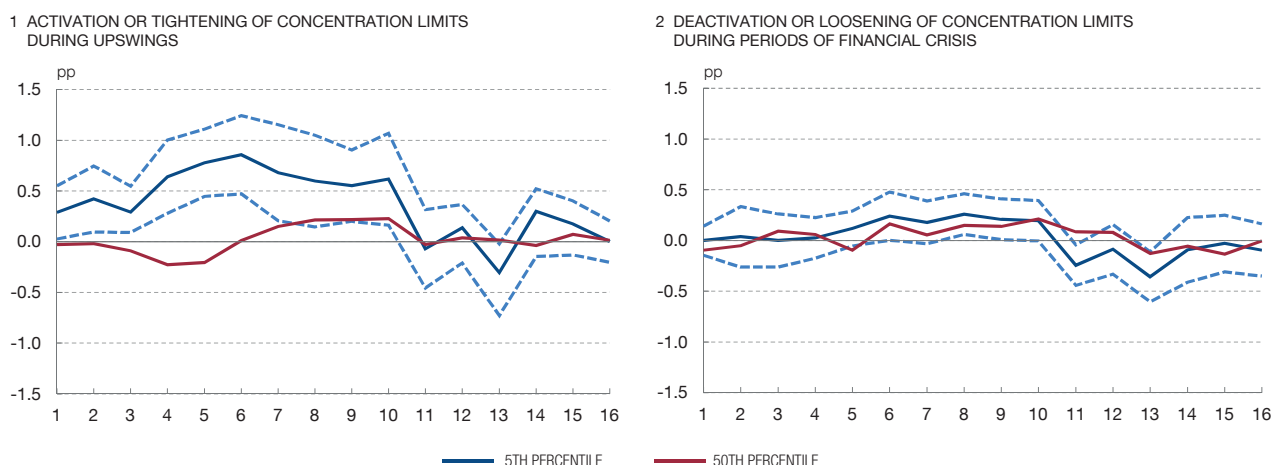
The quantile regression methodology, mentioned in previous sub-sections, can be used to quantify the impact of implementing sectoral concentration tools<sup>7</sup> on

6 Trucharte (2021) also conducts a counterfactual backward-looking exercise based on the last financial crisis to calculate the capital increase that would have been required of banks had the concentration limit been set at average historical levels.

7 These instruments were activated on microprudential rather than macroprudential grounds, and therefore this evidence should be interpreted with caution.

Chart 4

**IMPACT OF THE TIGHTENING AND LOOSENING OF CONCENTRATION LIMITS ON THE 5TH AND 50TH PERCENTILES OF THE GDP GROWTH DISTRIBUTION OVER TIME HORIZONS OF BETWEEN 1 AND 16 QUARTERS (a)**



SOURCE: Galán (2020).

a The solid blue and red lines represent the estimated impact on the 5th and 50th percentile of the conditional distribution of GDP growth, respectively. The dotted blue lines represent the confidence band at 95% obtained through bootstrapping.

the GDP growth distribution (Galán 2020). As with the CCyB, the results show the activation or tightening of these limits having positive effects on the left-hand tail of the GDP growth distribution (a smaller GDP decline in the event of severe recessions), which outweighs the negative effects on the median distribution (a slight decline in growth in normal times). These effects would be significant immediately after activation and would show strong persistence between one and two years thereafter. Deactivating or loosening the limits on concentration during periods of systemic crisis would have no significant effect on the GDP growth distribution (see Chart 4).

## 4 A proposal for the practical functioning of macroprudential instruments

As discussed above, designing a framework for macroprudential decision-making is an enormously complex task. In addition to the difficulty of defining and quantifying their objective, the instruments available interact with each other, with other microprudential regulatory requirements and with other macroeconomic and microeconomic policies. Further, little experience has yet been obtained on their functioning and effectiveness, either by those responsible for their application<sup>8</sup> or by theoretical and empirical researchers.

<sup>8</sup> European legislation has provided for the application of macroprudential measures since 2014 or 2016 (depending on the tool).

The ideal approach would consist of a process with two distinct phases. In the first phase, the causes (frictions) underlying the emergence and development of systemic risk would be identified. In the second stage, the most appropriate instrument for each case would be selected, using duly calibrated and estimated theoretical and empirical models. Given that this is a very new field, this approach can only be developed over a medium-term horizon. Nonetheless, the experience obtained to date allows for some preliminary reflections, based on a compilation of potential systemic risk situations. Specifically, analysing how these situations would affect banks and determining the channels through which the effects of macroprudential tools are transmitted can provide an indication of the best strategy in each case. Evidently, this exercise must take into account both the spillover effects of activating each specific instrument<sup>9</sup> and the possible leakages that may diminish their effectiveness.<sup>10</sup> The potential distributional effects of each of the tools must also be factored into decisions, since it is very important that the cost of the measures is not borne exclusively by one group or segment.<sup>11</sup> Naturally, this list of situations will never be exhaustive, but it provides a good starting point for drawing up an operational framework. It should also be borne in mind that the situations actually arising may differ considerably from those described here. Therefore, it must be ensured that supervisory authorities are able to make flexible use of the tools available.

#### 4.1 Possible practical application and sequencing of the tools

As commented above, the credit cycle is a central element of the time dimension of systemic risk. High and sustained credit risk growth increases the probability of subsequent systemic financial crises arising (see Martínez-Miera and Suárez (2012)). Consequently, most of the financial system vulnerabilities analysed here are associated with credit developments. However, situations may arise that heighten or mitigate the risks. For instance, if credit growth runs in step with asset revaluation (particularly for real estate property), both the probability of a systemic financial crisis and its effective cost rise significantly.

Conversely, as Dell’Ariccia et al. (2016) show, not all credit expansions lead to financial crises, particularly when those expansions are prompted by improved economic fundamentals (demand conditions). Accordingly, developments in credit standards will have to be assessed, since this is a key part of obtaining information

---

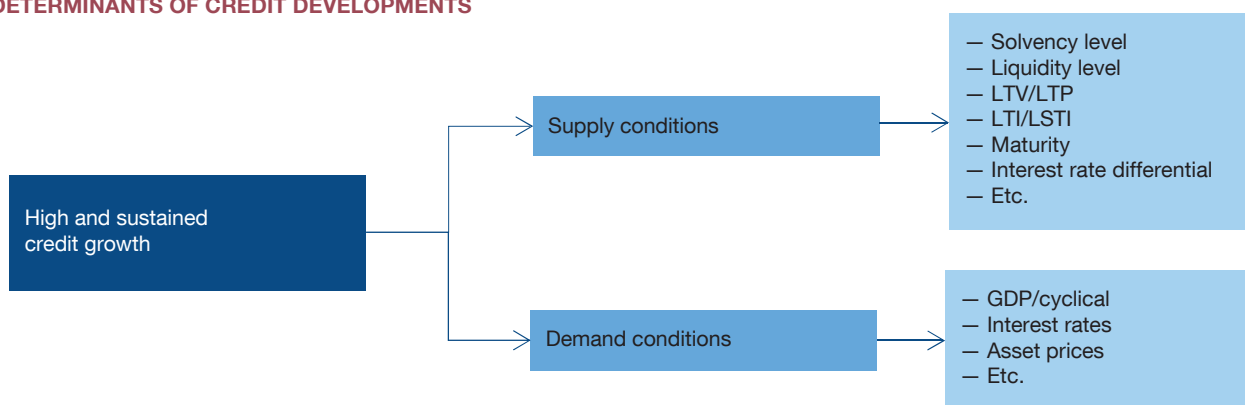
9 For example, Tzur-Ilan (2017) shows that limits imposed on some characteristics of mortgage loans can drive up unsecured consumer lending.

10 Aiyar et al. (2014) found that the Bank of England’s heightened capital requirements for supervised institutions in the United Kingdom lowered the credit supply from these banks; however, unsupervised institutions, which were not subject to the increased capital requirements, expanded their supply of credit, offsetting nearly a third of the initial reduction.

11 For further information on banks’ capacity to differentially pass-through to customers measures that affect them as a whole, see Jiménez et al. (2020).

Figure 1

**DETERMINANTS OF CREDIT DEVELOPMENTS**



SOURCE: Banco de España.

on loan supply conditions and borrowers’ creditworthiness and ability to pay. Consequently, any high and sustained credit growth that is detected as part of financial cycle analysis should prompt careful study of whether this has been accompanied by an easing of lending standards, since this could determine whether the credit expansion is driven by supply-side or demand-side developments (see Figure 1).

**4.1.1 Credit expansion with easing of credit standards**

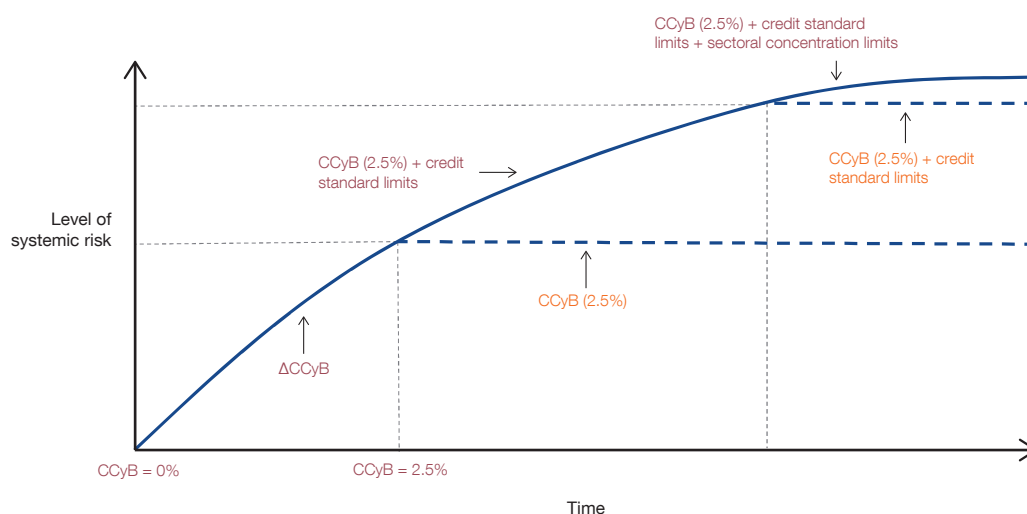
In a situation of easing credit standards, banks or the financial system as a whole endogenously generate an expansionary financial cycle or amplify an existing one. According to the evidence presented in the foregoing section, capital-based macroprudential tools should be applied in the early stages of credit expansion. Further, since this is a cyclical risk, the most suitable tool would be the CCyB<sup>12</sup> (see Figure 2). It should be phased in, at a pace adapted to developments in the financial sector, as envisaged in prudential legislation. Should the cycle stabilise, no additional measures would be required. However, the empirical evidence available also shows that this buffer tempers credit growth only very slightly and therefore, in all probability, the excessive credit growth will persist.<sup>13</sup>

Consequently, if systemic risk build-up continues, borrower-based macroprudential instruments (BBI) would have to be activated. In principle, the decision to restrict one characteristic or another, and how to calibrate the degree of restriction, will depend

12 Assuming credit growth is widespread across portfolios. As discussed below, if the growth were in one or several specific portfolios, the SCCyB would be the more appropriate macroprudential tool.  
 13 As has been emphasised, part of this tool’s effectiveness comes into play when the systemic risk materialises; hence, it must be activated in good time.

Figure 2

**SEQUENCE OF ACTIVATION OF MACROPRUDENTIAL TOOLS IN RESPONSE TO A BUILD-UP OF SYSTEMIC RISK ASSOCIATED WITH AN EASING OF CREDIT STANDARDS**



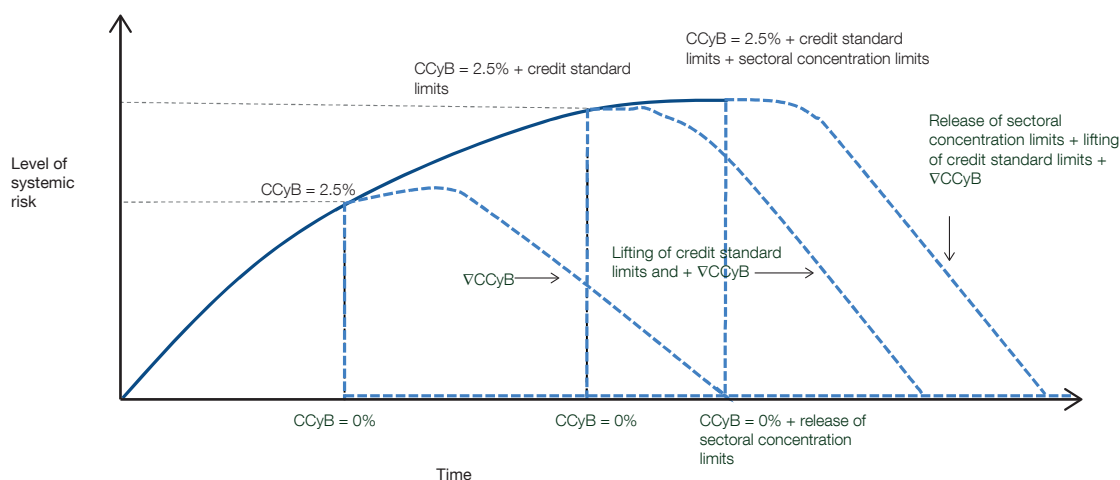
SOURCE: Banco de España.

on which dimension of lending is easing. However, experience appears to show that when just one dimension is limited, others fill the space; therefore, several dimensions will typically have to be acted on simultaneously. Further, there is also some evidence that credit can be transferred from some portfolios to others; for instance, from secured to unsecured credit. Consequently, transaction-side limits may have to be followed up with borrower-based limits. The empirical evidence suggests that, when activated, these tools have a fairly immediate effect on the growth of new lending. However, depending on the average maturity of the portfolios, they may take time to affect the volume of existing credit, which is the magnitude that represents the system's true vulnerability. Therefore, in more exceptional circumstances, particularly when banks are highly leveraged, introducing limits on the sectoral concentration of exposures should also be considered. Logically, in practice this sequencing will depend on the specific analysis of the situation and the course of the systemic risk, which may advise changes both in the order of use and the intensity of the limits.

As Figure 3 shows, the deactivation of these instruments will depend on how the systemic risk develops: it may dissipate progressively or it may materialise and prompt a financial crisis. If the risk dissipates, it seems reasonable to think that the tools should be deactivated in reverse order of their activation. Thus, in the initial phase, if activating the CCyB suffices to control the credit cycle, the additional tools will not have been activated and the buffer may be progressively released. Similarly, if the situation is brought under control after limits have been imposed on lending standards or concentration, these would be deactivated first, followed by gradual

Figure 3

**SEQUENCE OF DEACTIVATION OF MACROPRUDENTIAL TOOLS IN RESPONSE TO THE MITIGATION OR MATERIALISATION OF SYSTEMIC RISK ASSOCIATED WITH AN EASING OF CREDIT STANDARDS**



SOURCE: Banco de España.

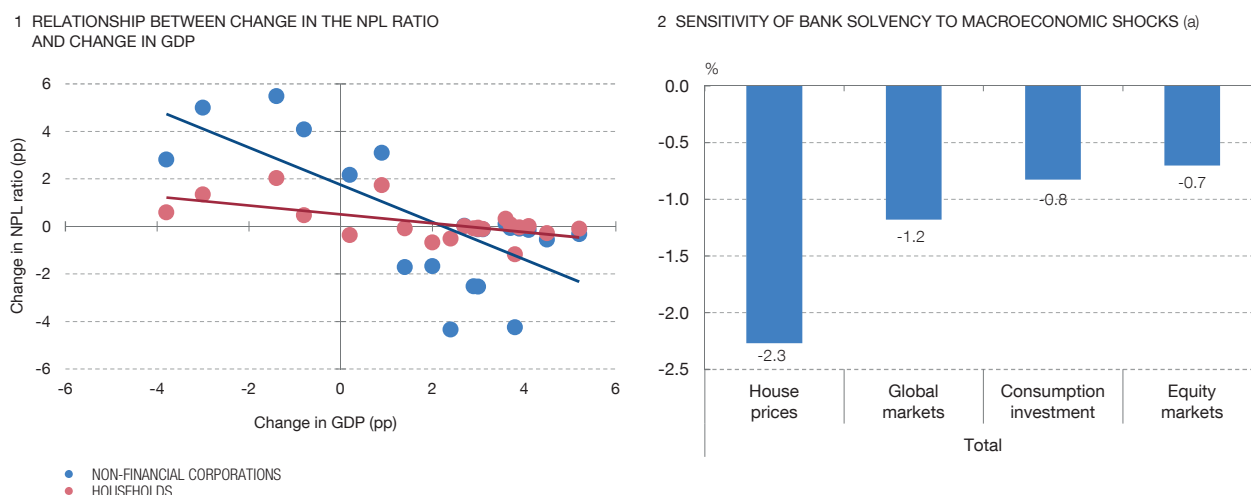
release of the CCyB. If the systemic risk materialises, however, the CCyB should be released immediately and in full, since, on the empirical evidence, this would ease the credit supply constraints and, therefore, the potential decline in GDP. The sectoral concentration limits should also be deactivated immediately. Note that, since concentration is defined in terms of credit volume as a percentage of CET1, this ratio could rise abruptly if the systemic risk materialises. This is because CET1, the denominator of the ratio, will decline as banks absorb losses, forcing them to deleverage if the limit is not deactivated. By contrast, as explained in the previous section, eliminating the limits on loan terms and conditions has little effect on credit or GDP, since banks tend to tighten credit standards in such situations.

**4.1.2 Credit expansion without easing of credit standards**

One might be tempted to think that if lending standards remain unchanged, macroprudential tools do not need to be activated. However, deeper analysis can help temper that conclusion. In the event, for example, of an upswing (positive output gap) and agents are accordingly increasing their debt, macroprudential policy could play an important role during the subsequent economic downturn in preventing credit constraints. Indeed, the empirical evidence shows that both households (see, for example, Casado and Villanueva (2018)) and firms (see, for example, Jiménez et al. (2014)) fall into arrears when their income declines significantly and, in the case of individuals, when they become unemployed. This is precisely what happens to a relatively broad set of agents when the economy moves into recession (see Chart 5.1).

Chart 5

**RELATIONSHIP BETWEEN MACROECONOMIC PERFORMANCE, CREDIT QUALITY AND BANKING SECTOR SOLVENCY**



**SOURCE:** Banco de España.

**a** The results are presented in terms of the difference in the CET1 capital ratio (FL) at the end of the analysis horizon in each of the adverse scenarios compared with the level attained under the baseline scenario (coinciding with that designed for the 2018 EU-wide stress tests coordinated by the EBA). Only the scenarios associated with the 1st percentile of the distribution of these four sets of shocks are included. The shocks considered include: (i) impact on international trade; (ii) declining confidence of national economic agents in Spain, with reduced consumption and business investment; (iii) downward adjustments in equity prices, and (iv) house price adjustments. For each of these, shocks are applied in line with historical periods of very high stress (1st percentile of the distribution). The endogenous response of the other Spanish macroeconomic variables is calculated based on the Banco de España’s macroeconomic models. For a full analysis of these shocks, see Chapter 2 of Banco de España (2019).

If, when faced with the type of shock that can lead to recession, credit institutions lack a sufficient capital buffer to absorb those losses (see Chart 5.2), they may react by reducing the supply of credit. If several banks are affected, a credit crunch could ensue which would exacerbate the economic recession (see Bentolila, Jansen and Jiménez (2018)).

The optimal macroprudential tool in this circumstance would be countercyclical and be aimed at shoring up the banks’ loss-absorbing capacity. The CCyB has precisely these characteristics. On the evidence presented in the foregoing section, building up the buffer during business cycle upturns would have little near-term impact on the credit cycle or GDP. However, its deactivation during economic downturns could help to fend off credit constraints in the economy. If the recession did not ultimately materialise, the buffer could be gradually deactivated. Evidently this strategy is not without risk, since activating the instrument prematurely could slow the post-recession economic recovery, while tardy activation could exacerbate the slowdown. However, on the empirical evidence presented in the above section, it appears preferable to act too early rather than too late.

Note that a similar case could be made in the event of an upswing with a positive output gap but no credit growth. Given that the course of the economic cycle would

lead to a recession down the line, losses would materialise on banks' accounts, although they would be smaller. The recommendation would only differ in that the CCyB activation percentages should be lower. Moreover, in this (and the previous) case, it would seem logical that these percentages should be determined depending on the voluntary buffers that banks have built up, since these buffers, if they are high, could play the same role. Activating the CCyB has the advantage of ensuring that banks retain these resources until the systemic risk materialises and that they are put to macroprudential use, regardless of each bank's individual circumstances and constraints, thus preventing, for example, any stigmatisation effects if just one bank uses them.

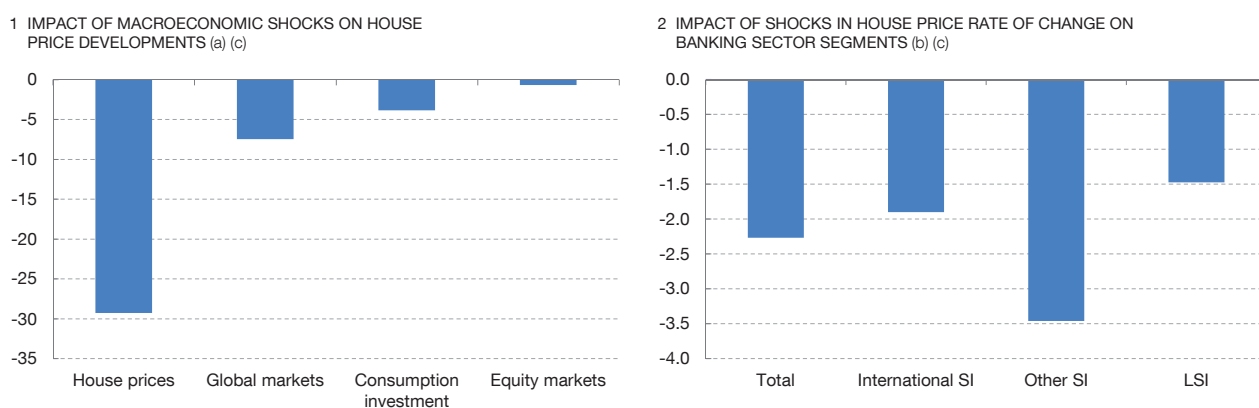
Higher credit growth may also have resulted from interest rates standing at very low levels for an extended period of time. Evidently, the lower the interest rates, the greater the demand for credit; however, the so-called credit channel of monetary policy suggests that banks will also expand their balance sheets and, therefore, the supply of credit (Bernanke and Gertler (1995)). There is also empirical and theoretical evidence that banks may react to such situations by taking greater risks (risk-taking channel) (see for example, Jiménez et al. (2014) and Martínez-Miera and Repullo (2017)) Any, not necessarily cyclical, materialisation of these risks could entail losses for the banks. In consequence, an instrument that shores up banks' capital would again be the optimal macroprudential instrument. However, this reduction in nominal interest rates may be more persistent if, for example, it results from a reduction in equilibrium real interest rates. In this case, the systemic risk buffer could be more appropriate. It stands to reason that this instrument should be progressively deactivated when banks' risk-taking begins to moderate, or deactivated entirely if the risks materialise.

#### 4.1.3 Credit expansion in certain sectors

Credit expansion may also stem from significant increases in collateral valuations (specifically of real estate assets), possibly outstripping their long-run equilibrium value. Indeed, house prices have on occasions been used as an indicator of the financial cycle as an alternative to credit developments (Claessens, Kose and Terrones (2011)). To assess whether macroprudential policy action is needed in this situation, it must be borne in mind that, first, such credit expansions normally run in step with an easing of some lending standards (particularly conditions relating to agents' ability to pay). And second, the empirical evidence shows that the greater the house price overvaluation, the larger the eventual correction in situations of stress (see, for example, Galán and Rodríguez-Moreno (2020)) and, therefore, the greater the potential future losses for banks (see Chart 6). These losses can materialise at banks through both direct and indirect channels. Of the direct channels, probably the most important is when reductions in collateral value force banks to scale up residential mortgage loan provisions; in addition, the value of the foreclosed



Chart 6

**RELATIONSHIP BETWEEN HOUSE PRICES WITH MACROECONOMIC SHOCKS AND BANKING SECTOR SOLVENCY**

**SOURCE:** Banco de España.

- a** For house prices, the impact of applying additional shocks to the variables indicated in the horizontal axis are presented, with respect to the level reached by these under the baseline scenario of the 2018 EBA stress test. For instance, if the shock is applied directly to house prices, their cumulative growth in 2018-2020 is nearly 30 pp less than under the baseline scenario, while a shock to global trade would lead to an adjustment in that same growth of approximately 7 pp. The shocks are calibrated at the 1st percentile of the historical distribution of shocks in house prices, global trade, consumption and investment in Spain and equity prices in Spain.
- b** For a very severe house price shock (1st percentile of the distribution), the endogenous response of the other Spanish macroeconomic variables is calculated based on the Banco de España's macroeconomic models. For this stressed macroeconomic scenario, the difference is calculated between the CET1 capital ratio (FL) at the end of the 2018-2020 analysis horizon and the level that this ratio would attain under the baseline scenario of the 2018 EU-wide stress tests coordinated by the EBA. The results are shown both for the overall banking sector and for each type of institution: significant institutions (SI), with and without material international activity, and less significant institutions.
- c** For a full analysis of these shocks, see Chapter 2 of Banco de España (2019).

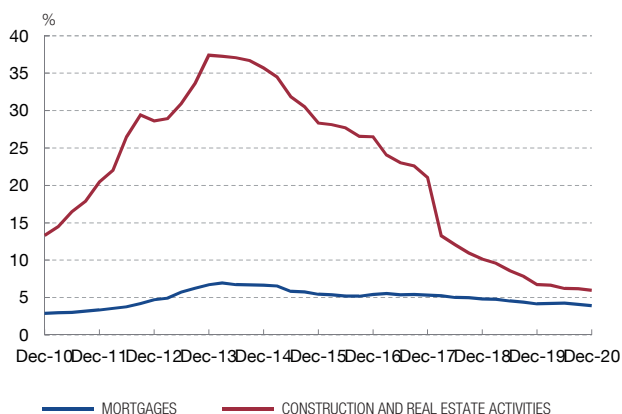
properties arising from defaulted mortgage loans will also decline. Among the indirect channels, falling house prices will erode household wealth, which will naturally depress consumption and investment. Likewise, activity in the residential construction sector will decline, having an impact on employment. Further, firms and sole proprietors that obtain financing using housing as collateral could see their credit flow reduced. All of which will have a negative impact on banks' income statements.

Accordingly, it seems advisable for banks to have sufficient capital to absorb these potential losses without affecting the flow of financing to the rest of the economy. This recommendation would stand even if credit were not expanding, although in all likelihood the capital required to absorb the losses would be lower. It seems reasonable to think that the optimal macroprudential instrument in this case would be the CCyB. However, some important caveats, set out below, mean specific analysis of each situation is warranted. Admittedly, this vulnerability is clearly cyclical, does not necessarily affect a specific credit portfolio and can generate losses in credit institutions' business lines. Yet if the credit growth is confined to the mortgage portfolio, the SCCyB for that specific portfolio could be activated prior to activating the general CCyB, with a view to prompting a change in their relative cost prices without affecting the other sectors. If this fails to mitigate the systemic risk,

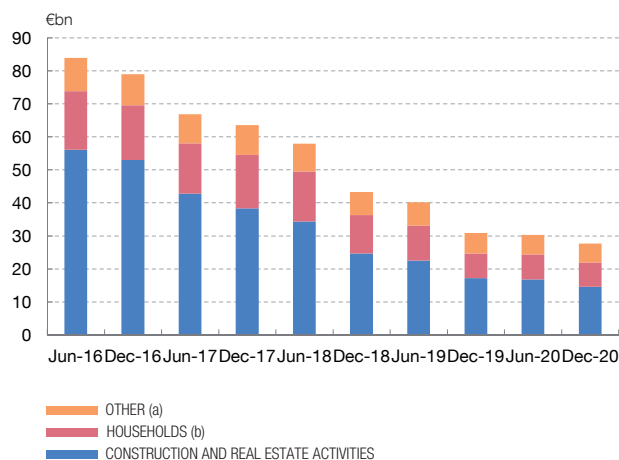
Chart 7

**BANKING SECTOR TROUBLED ASSETS LINKED TO REAL ESTATE EXPOSURES**

1 NPL RATIO: MORTGAGES AND CONSTRUCTION AND REAL ESTATE ACTIVITIES FIRMS. DEPOSIT INSTITUTIONS (DI)  
Individual data



2 FORECLOSED ASSETS. DI  
Consolidated data



SOURCE: Banco de España.

a Includes, primarily, capital instruments, financing for holding entities and other real estate assets foreclosed or received in lieu of payment of debts.  
b Arising from loans for house purchase.

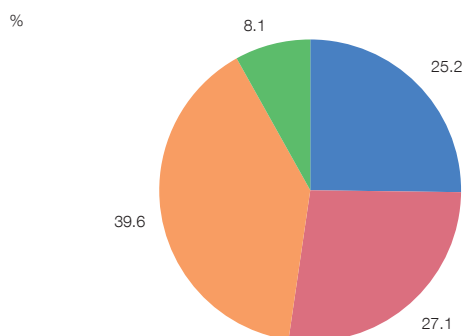
consideration should be given to activating the borrower-based macroprudential tools, such as LTV or LTP limits. This would reduce the losses for banks in the event of default. The difficulty with LTV or LTP limits is that they would have to be tightened as the estimated house price overvaluation intensified. This could shift credit towards other portfolios, such as consumer loans, which, besides, tend not to be secured. As a result, other types of instruments, such as LTI/LSTI or DTI/DSTI limits, should be activated to ensure that borrowers have sufficient resources to meet their financial obligations. If this also proves insufficient, limits on the sectoral concentration of exposures would have to be introduced to act directly on the mortgage loan portfolio.

In the particular case of risk concentration in real estate sector portfolios, it is also very important to consider whether this concentration is running in step with activity growth in the sector itself. If so, the activation of macroprudential tools must take into account the housing production processes. It seems reasonable that limits on credit terms and conditions or sectoral concentration should be activated for builders and property developers prior to being activated for households (house purchasers). This would make for more preventive action and would avoid a truncation of the housing production and sale chain that could lead to homes being left unfinished. It should not be forgotten that firms, unlike households, have limited liability and, consequently, their probability of default is far higher (see Chart 7). Moreover, the value of an unfinished home is much lower than that of a finished one.

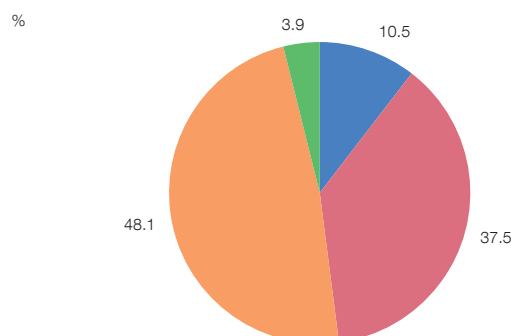
Chart 8

**BANK CREDIT IN SPAIN BY SEGMENT OF THE NON-FINANCIAL PRIVATE SECTOR**

1 CREDIT TO THE RESIDENT PRIVATE SECTOR. DI  
Individual data. December 2010



2 CREDIT TO THE RESIDENT PRIVATE SECTOR. DI  
Individual data. December 2020



■ NON-FINANCIAL CORPORATIONS (NFCs) AND SOLE PROPRIETORS, CONSTRUCTION AND REAL ESTATE ACTIVITIES ■ NFCs AND SOLE PROPRIETORS, OTHER ■ HOUSEHOLDS, HOUSING ■ HOUSEHOLDS, OTHER

SOURCE: Banco de España.

In any event, we must bear in mind that house prices can outstrip their fundamentals for reasons far removed from the macroprudential sphere, such as supply-side constraints or tax aspects, which these tools will not correct. In this connection, He (2014) shows that tax measures can be particularly suitable for modulating house price developments.

Still on the subject of sectoral issues, as with the mortgage portfolio, when one or more credit portfolios begin to present far stronger growth than is warranted by their fundamentals, several distinct elements are worth considering, particularly if restraint is evident in other portfolios (see Chart 8). In these circumstances, it may not be appropriate to use aggregate macroprudential instruments. Indeed, if the portfolio in excessive growth also offers the highest short-term returns (disregarding the risks it is generating), imposing higher costs or restrictions at the aggregate level could divert even more financing towards that portfolio, thus building up greater systemic risk. Accordingly, it would appear far more effective to use sectoral instruments that are able to alter the relative costs of each of the portfolios or to limit those exposures, which would consequently help financing flow towards other credit portfolios (BCBS (2019b)).

However, this crowding-out effect can go too far and the other portfolios must therefore be continuously monitored. Here, the question may arise of how many sectors need to show exuberance for aggregate instruments – which seem the most natural from the macroprudential standpoint – to be introduced. This decision will, of course, depend on the weight of the affected portfolios. In any event, the step from sectoral instruments to aggregate instruments should never entail reducing the intensity of the use of sectoral instruments in the portfolios concerned. Assuming

that the portfolio exuberance is wholly cyclical, i.e. there have been no structural changes in the economy warranting permanent portfolio rebalancing, the sequencing of macroprudential instruments would be the same as when the credit exuberance is aggregate, both in their activation and their deactivation. Put differently, in Figure 3 an initial phase could be envisaged in which the aggregate systemic risk is very low, but in which there is a build-up of risks in one or more sectors for which the SCCyB would be activated prior to the general CCyB. According to the circular pending approval in Spain, the combination of both instruments would allow a capital buffer to be amassed of up to 5 pp if the systemic risk continues to build up.

#### 4.1.4 Credit expansion and overindebtedness

So far, we have analysed situations of high and sustained growth in credit to the non-financial private sector when agents start out with sustainable levels of debt. However, the credit growth cycle may begin when agents are already overindebted. The policy recommendations in this case will necessarily differ. If it is households or non-financial corporations that are overindebted, the priority would be to prevent them from increasing their debt. To this end, the most effective measures would be limits on credit terms and conditions; specifically, establishing LTI/LSTI limits or shortening loan maturities. However, to avoid harming households and firms that are not excessively leveraged, these would need to be combined with limits on DTI/DSTI ratios. This would not obviate the need to activate instruments to shore up banks' capital, since indebtedness and debt burden are two important determinants of financial defaults in general, both for households and firms. However, they could always be activated secondarily. Further, it would have to be determined whether this overindebtedness is persistent, in which case the most appropriate tool would be the systemic risk buffer. The advantage of this buffer is that it can be applied in a sufficiently granular manner so as to act directly on the main source of risk.

When banks themselves present excessive leverage, the general recommendation is more straightforward: their solvency levels need to be increased. Different instruments could be used, depending on whether the situation is considered cyclical or more persistent. Another aspect that would have to be taken into consideration is which banks are affected: all banks, many small banks, or just a few large banks. If the problem is cyclical, the best option is the CCyB. If the problem is more permanent, the systemic risk buffer should be selected.

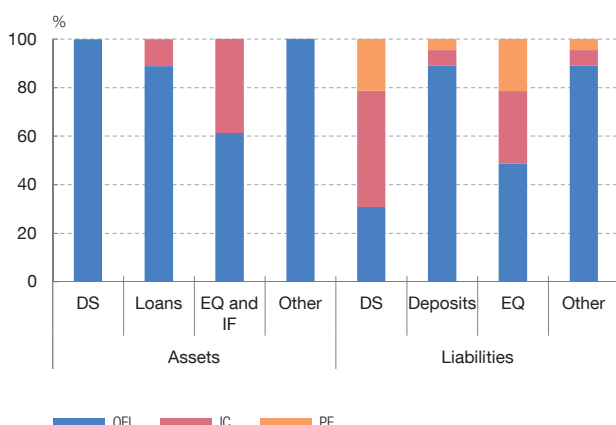
## 4.2 Some further considerations on the cross-sectional dimension of systemic risks

Systemic risk may arise without an increase necessarily occurring in the overall debt of the economy and, in particular, that of the non-financial private sector. As set out

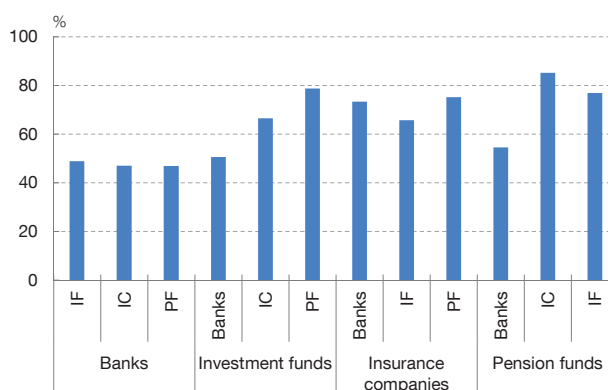
Chart 9

**INTERCONNECTIONS BETWEEN TYPES OF INTERMEDIARIES IN THE SPANISH FINANCIAL SYSTEM**

1 DIRECT INTERCONNECTIONS. BANKS – OTHER NON-BANKING FINANCIAL SECTORS (a)  
Individual data



2 INDIRECT INTERCONNECTIONS. COMMON HOLDINGS (b)  
Individual data



**SOURCES:** Banco de España (Chart 9.1) and Securities Holdings Statistics by Sector (Chart 9.2).

- a The stacked bars indicate the share of each instrument relative to the banking sector's total exposure to the corresponding non-banking financial sector. The abbreviations DS, EQ and IF denote debt securities, equity instruments and investment fund units. The other financial institutions (OFI) category includes investment funds, special lending institutions and other financial intermediaries (broker-dealers, securitisation special purpose vehicles, venture capital firms, central counterparties and asset management companies, including Sareb, and other entities). The abbreviations IC and PF denote insurance companies and pension funds.
- b The share of common holdings in the marketable securities portfolio of each sector is shown. "Common holdings" means ownership of identical securities issued by the same issuer. The abbreviations IF, IC and PF denote investment funds, insurance companies and pension funds. For example, the common holdings between banks and investment funds represent 49% of the banks' overall securities holdings (first column in the chart) and 51% of the investment funds' overall holdings (fourth column). The market value (or fair value) of the holdings is used.

in the introduction, systemic risk also has a cross-sectional dimension, whose presence, accumulation and development should be mitigated with the appropriate macroprudential instruments.

One such situation may be the outcome of certain banks being systemic in nature, or of their systemicity becoming a fact or increasing. Indeed, difficulties at systemic banks may entail disruptions for the entire financial system and can also be key to bringing about contagion situations (Bluhma and Krahen (2014)), which have to be mitigated. As previously discussed, there is one regulatory macroprudential instrument that does in fact address this risk: the (global or national) systemically important institution buffer. Accordingly, an appropriate calibration of the buffer reflecting banks' degree of systemicity would be the first line of defence against this risk.<sup>14</sup>

The cross-sectional dimension of systemic risk also comes about when interconnections between institutions go beyond what the framework for systemic banks encompasses. Such interrelatedness can be direct or indirect (see Chart 9)

<sup>14</sup> A description of the calculation of these scores can be found in Banco de España (2017).

and, depending on its nature, certain macroprudential instruments may be preferable to others. Aggregate capital instruments may be used (such as the systemic risk buffer) or, in extreme situations, the banking sector's exposure to the rest of the financial system may be quantitatively constrained by the activation of the instrument setting limits on concentration. Logically, the analysis of risks in the rest of the financial system will determine the intensity with which these instruments have to be activated.

To conclude the analysis of the cross-sectional dimension of systemic risk, we should review – albeit briefly – the problems surrounding international interconnections. In a financially globalised world, as at present, the risks or spillover effects of decisions taken by other countries may impact the national economy most significantly, in particular the financial sector. This is all the more important when global banks intermediate a sizeable portion of credit on national territory or, as in Spain's case, when national banks locate a significant portion of their operations in other countries.<sup>15</sup> This is why regular monitoring of these risk factors must continue as part of the ongoing assessment of the micro- and macroprudential measures in place, in order to analyse whether they are proving effective in terms of risk prevention and mitigation.

## 5 The future challenges for macroprudential policy

The new macroprudential instruments available to the Banco de España complement those already in place, allowing it to address a broad range of financial stability risks that have proven significant in view of past international experience and that of Spain. Despite their different specific objectives, the ultimate aim of all these instruments continues to be to help preserve financial stability, which provides for a positive and sustainable contribution of the financial system to the real economy.

Adding to the challenges proper to the operationalisation of the new instruments, fresh risks and areas of attention for macroprudential policy continue constantly to arise. These must be duly addressed, given their implications for financial stability.

### 5.1 Lessons on the effective functioning of the instruments during the COVID-19 crisis

The economic crisis triggered by the COVID-19 pandemic is affecting most of the world's financial systems. As a result, it is testing the effectiveness of the regulatory reforms introduced in response to the last financial crisis, including macroprudential

---

15 The empirical evidence prior to the COVID-19 crisis suggests that the internationalisation model that has characterised Spanish banks, based on the independent management of these subsidiaries, especially in terms of funding and risk analysis, has contributed to restricting the transmission to the rest of the world of the financial conditions of the international banks in the country (Argimón et al. (2018)).

policy. The specific characteristics of this crisis (it is exogenous to the global financial system and, in principle, temporary) have required a swift and forceful response by national and international authorities (including those in the banking regulation area), whose effects should also be analysed.

Admittedly, the full effects and consequences of the COVID-19 crisis have still to be seen and may prove persistent. But some initial and preliminary lessons may be drawn for banking regulation on the basis of the experience to date (Castro and Estrada (2021)). Some of these lessons are particularly relevant for macroprudential policy and may be analysed in due course as part of the assessment exercises covering the effects of the reforms implemented by the pertinent agencies and authorities, bearing in mind the empirical evidence.

As regards macroprudential capital buffers, the COVID-19 crisis has accentuated the advantages of releasable buffers, such as the CCyB, with a view to making them more readily usable by banks at times of stress to absorb losses when these materialise, maintaining the flow of credit to the economy. Further, the crisis has signalled the need for buffers to stand ready to respond to risks, both endogenous and exogenous. Another notable aspect is the importance of the regulatory authorities maintaining regular, active and coordinated communication.

Depending on the empirical evidence gathered, we might also assess whether it is necessary to address some other aspect of the current design of capital buffers. In particular, taking a medium-term view, we might analyse the balance between structural and releasable capital buffers, and whether the latter need be set up even without systemic risk associated with excessive credit growth developing (e.g. in Figure 3 a positive level for releasable buffers might be taken as a starting point). And there is also the possibility of introducing mechanisms that allow the cyclical adjustment of liquidity buffers and that respond to different risk situations.

## 5.2 The non-bank financial sector: interrelations and regulatory perimeter

Under certain scenarios, an expansionary financial cycle might arise owing to the activity of non-bank financial institutions, or the activation of macroprudential instruments for banks might shift activity towards them, limiting the effectiveness of the measures. If these institutions are directly and significantly interconnected with banks (cross-positions on institutions' balance sheets, either via loans, fixed-income securities, equities or derivatives), tensions may pass through and be amplified via the banking system. Another possibility is the existence of indirect interconnections with non-bank financial institutions (e.g. owing to the similarity between the balance sheets of non-bank financial institutions and those of banks). In that case, the main risk arises from a potential price correction of assets in which there are common positions if events were to materialise triggering discount sales.

In these situations, the first step sees the regulators and supervisors of non-bank financial institutions use the micro- and macroprudential mechanisms and instruments available to them to prevent and mitigate risks at their source. It might moreover be necessary to jointly assess the need for other types of macroprudential measures not geared to specific sectors or institutions, but rather to address systemic risks arising in financial markets and operations (normally associated with procyclical interconnections and effects) in which different types of bank and non-bank financial agents interact.<sup>16</sup> Finally, there might be an assessment of the suitability of the current buffers available to the banking sector, such as the systemic risk buffer, in order to cater for potential residual risks caused by direct and indirect interconnections with the non-bank financial sector, in the event sufficiently material risks were identified that were not already covered by current regulatory requirements.

In any event, the emergence of new actors in financial markets – some motivated by the far-reaching technological changes under way in the sector, as is the case with so-called Bigtech – calls for systematic monitoring and analysis of the effects of the regulatory measures on different sectors and their interrelations (interdependencies, interconnections and possible spillovers), and of the regulatory perimeter of the entire financial system. For the proper functioning of the system, having regard to the different types of activity performed by financial services providers, it is essential to ensure that market participants operate under the principle of regulatory neutrality when they are assuming identical risks.

### 5.3 New risks with macroprudential implications: new technologies and climate change

In addition to the emergence of new actors in financial markets, the application of new technologies to financial activity is also giving rise to new risks and vulnerabilities. These include those derived from cyber-attacks and from dependence on technological services concentrated in third parties. The pandemic, for its part, has accelerated the digitalisation of certain financial activities and has seen an increase in remote working. That further increases the significance of these risks and the need for appropriate mechanisms to prevent and mitigate them.

Of particular importance for macroprudential policy is the potential of these risks to cause events with a systemic impact, should they materialise (Bank of England (2018) and European Systemic Risk Board (2020b)). That would affect core functions of financial systems, depending, for instance, on amplifying factors (system complexity) or mitigating factors (contingency plans).<sup>17</sup> Given their significance,

---

<sup>16</sup> See, for example, the report by the European Systemic Risk Board (2020a) on the macroprudential use of margins and haircuts in derivatives markets and securities financing transactions.

<sup>17</sup> See, for example, Ros (2020).



these factors are already receiving due attention from the pertinent authorities and agencies (see, for example, Basel Committee on Banking Supervision (2018b) and European Banking Authority (2019)). Monitoring of the cross-sectoral transmission of these risks will in any case be necessary here, bearing in mind that many of the connections and possibilities of contagion that are generated may go beyond the banking regulatory perimeter.

Other risks of clear macroprudential significance are those arising from climate change, since by their nature they affect the economy and the financial system as a whole. In this case, the main risk factors are well-known and include: the physical risks that the rise in temperature or extreme weather conditions may cause; the so-called “transition risks”, linked to the regulatory and technological changes geared to preventing or mitigating climate change, with a view to creating a more sustainable economy; and the changes in demand (changes in bank customers’ behaviour and preferences), prompted by greater environmental awareness.

Given, first, the potential systemic impact of climate change-related risks and, second, the possible contribution of the banking sector to smoothing the transition to a more sustainable economy, in this area macroprudential supervision has a clear role. One specific task involves assessing and quantifying the risks arising from this transition, both for individual banks and for the entire financial system. It will be necessary here to have appropriate data and methodologies, such as the stress tests required of the financial system, which allow the impact of different scenarios to be evaluated. Various initiatives are also under way with regard to climate change and its impact in respect of financial stability. Examples include the Network for Greening the Financial System (NGFS) and the G20 Sustainable Finance Study Group.<sup>18</sup> The BCBS, meantime, has published a report compiling the regulatory and supervisory initiatives adopted by its members in relation to the risks associated with climate change (Basel Committee on Banking Supervision (2020)) and continues to pursue the matter through a high-level group. At the European level, the European Commission, the European Banking Authority and the ECB have set various initiatives in train within their fields of competence.

In short, the Banco de España, as the designated authority for macroprudential policy decision-making in relation to credit institutions, has broadened the range of instruments available to it to fulfil its remit to prevent and mitigate systemic risk. This is a complex task. And a major analytical and research drive will be required in the coming years, given that the subject matter is new to the world stage, if it is to be comprehensively and reliably addressed. Indeed, significant challenges most likely requiring new developments continue to emerge. For the time being, certain scenarios are being considered which, on the basis of the experience at hand, may prove useful for steering discussions.

---

18 G20 Sustainable Finance Study Group (2018).

## REFERENCES

- Afanasiyeff, T. S., F. L. C. A. Carvalho, E. C. de Castro, R. L. P. Coelho and J. Gregório (2015). *Implementing loan-to-value ratios: The case of auto loans in Brazil (2010-11)*, Working Papers, no 380, Banco Central do Brasil.
- Aiyar, S., C. W. Calomiris and T. Wieladek (2014). "Does Macro-Prudential Regulation Leak? Evidence from a UK Policy Experiment", *Journal of Money, Credit and Banking*, Supplement to vol. 46(1), pp. 181-214.
- Aizenman, J., and Y. Jinjarak (2009). "Current account patterns and national real estate markets", *Journal of Urban Economics*, vol. 66(2), pp. 75-89.
- Akinci, O., and A. Queralto (2014). *Banks, Capital Flows and Financial Crises*, Board of Governors of the Federal Reserve System, International Finance Discussion Papers no 1121.
- Argimón, I., C. Bonner, R. Correa, P. Duijm, J. Frost, J. de Haan, L. de Haan and V. Stevunovs (2018). "Financial Institutions' Business Models and the Global Transmission of Monetary Policy", *Journal of International Money and Finance*, vol. 90(C), pp. 99-117.
- Aron, J., and J. Muellbauer (2016). "Modelling and forecasting mortgage delinquency and foreclosure in the UK", *Journal of Urban Economics*, 94, 32-53.
- Banco de España (2017). "Identification of Systemic Institutions", Box 3.1, *Financial Stability Report*, May, pp. 65-66.
- Banco de España (2019). *Financial Stability Report*, Spring.
- Bank of England (2018). "Could a cyber attack cause a systemic impact in the financial sector?", *Quarterly Bulletin*, Topical article, Q4.
- Basel Committee on Banking Supervision (2018a). *Towards a sectoral application of the countercyclical capital buffer: A literature review*, Working Paper, 32, March.
- Basel Committee on Banking Supervision (2018b). *Implications of fintech developments for banks and bank supervisors*, Sound Practices, February.
- Basel Committee on Banking Supervision (2019a). *Guiding principles for the operationalisation of a sectoral countercyclical capital buffer*, November.
- Basel Committee on Banking Supervision (2019b). *Towards a sectoral application of the countercyclical capital buffer*, Working Paper, 36, April.
- Basel Committee on Banking Supervision (2020). *Climate-related financial risks: a survey on current initiatives*, April.
- Basten, C., and C. Koch (2017). *The countercyclical capital buffer*, mimeo.
- Bedayo, M., Á. Estrada and J. Saurina (2020). "Bank capital, lending booms, and busts: Evidence from Spain over the last 150 years", *Latin American Journal of Central Banking*, 1.
- Bentolila, S., M. Jansen and G. Jiménez (2018). "When credit dries up: Job losses in the great recession", *Journal of the European Economic Association*, vol. 16(3), June, pp. 650-695.
- Bernanke, B., and M. Gertler (1995). "Inside the black box: The credit channel of monetary policy transmission", *Journal of Economic Perspectives*, vol. 9, no 4, Fall.
- Bluhma, M., and J. P. Krahen (2014). "Systemic risk in an interconnected banking system with endogenous asset markets", *Journal of Financial Stability*, vol. 13, August, pp. 75-94.
- Campbell, J. Y., and J. F. Cocco (2015). "A Model of mortgage default", *The Journal of Finance*, 70, pp. 1495-1554.
- Casado, J. M., and E. Villanueva (2018). "Spanish household debt defaults: results of the Spanish Survey of Household Finances (2002-2014)", *Financial Stability Review*, no 35, November, Banco de España.
- Castro, C., and Á. Estrada (2021). "Financial stability and banking regulation in the context of the Covid-19: some early policy reflections", *The Euro in 2021 - A Yearbook on the European Monetary Union*, Fundación de Estudios Financieros and Fundación ICO.
- Castro, C., Á. Estrada and J. Martínez (2014). "The countercyclical capital buffer in Spain: an exploratory analysis of key guiding indicators", *Financial Stability Review*, November, Banco de España.

- Castro C., Á. Estrada and J. Martínez (2016). *The countercyclical capital buffer in Spain: an analysis of key guiding indicators*, Working Papers, no 1601, Banco de España.
- Cerutti, E., S. Claessens and L. Laeven (2017). "The use and effectiveness of macroprudential policies: New evidence", *Journal of Financial Stability*, 28, pp. 203-224.
- Claessens, S., S. Ghosh and R. Mihet (2013). "Macro-prudential policies to mitigate financial system vulnerabilities", *Journal of International Money and Finance*, 39, pp. 153-185.
- Claessens, S., M. A. Kose and M. E. Terrones (2011). *How do business and financial cycles interact?*, IMF Working Paper, WP/11/88.
- Crowe, C., G. Dell'Ariccia, D. Igan and P. Rabal (2013). "How to deal with real estate booms: Lessons from country experiences", *Journal of Financial Stability*, 9(3), pp. 300-319.
- Dell'Ariccia, G., D. Igan, L. Laeven and H. Tong (2016). "Credit Booms and Macrofinancial Stability", *Economic Policy*, vol. 31(86), pp. 299-355.
- Estrada, Á., and J. Mencía (2021). "El cuadro de mandos de la política macroprudencial", *ICE, Revista de Economía*, no 918, January-February.
- European Banking Authority (2019). *EBA Guidelines on ICT and security risk management*, Final report, November.
- European Central Bank (2009). *Financial Stability Review*, December, pp. 134-142.
- European Systemic Risk Board (2020a). *Mitigating the procyclicality of margins and haircuts in derivatives markets and securities financing transactions*, January.
- European Systemic Risk Board (2020b). *Systemic cyber risk*, February.
- Ferrari, S., M. Pirovano and P. Rovira Kaltwasser (2017). *The impact of sectoral macroprudential capital requirements on mortgage lending: Evidence from the Belgian risk weight add-on*, mimeo.
- Freixas, X., L. Laeven and J. L. Peydró (2015). *Systemic risk, crises and macroprudential regulation*, Cambridge, The MIT press.
- G20 Sustainable Finance Study Group (2018). *Synthesis Report*, July, G20 Argentina.
- Galán, J. (2020). "The benefits are at the tail: uncovering the impact of macroprudential policy on growth-at-risk", *Journal of Financial Stability*, online version.
- Galán J., and M. Lamas (2019). *Beyond the LTV ratio: new macroprudential lessons from Spain*, Working Papers, no 1931, Banco de España.
- Galán, J., and M. Rodríguez-Moreno (2020). "At-risk measures and financial stability", *Financial Stability Review*, no 39, Autumn, Banco de España.
- Hartmann, P. (2015). *Real estate markets and macroprudential policy in Europe*, ECB Working Paper Series, no 1796, May.
- He, D. (2014). "The effects of macroprudential policies on housing market risks: evidence from Hong Kong", *Financial Stability Review*, April, Banque de France, pp. 105-120.
- Huremovic, K., G. Jiménez, E. Moral-Benito, J. L. Peydró and F. Vega-Redondo (2020). *Production and financial networks in interplay: crisis evidence from supplier-customer and credit registers*, Working Paper, no 1191, Barcelona Graduate School of Economics.
- Iyer, R., and J. L. Peydró (2011). "Interbank Contagion at Work: Evidence from a Natural Experiment", *The Review of Financial Studies*, vol. 24(4), pp. 1337-1377.
- Janus, T., and D. Riera-Crichton (2016). *Banking Crises, External Crises and Gross Capital Flows*, Working Paper, no 273, Federal Reserve Bank of Dallas.
- Jiménez, G., D. Martínez-Miera and J. L. Peydró (2020). *Who truly bears (Bank) taxes? Evidence from only shifting statutory incidence*, Working Papers, no 2040, Banco de España.
- Jiménez, G., S. Ongena, J. L. Peydró and J. Saurina (2014). "Hazardous Times for Monetary Policy: What do Twenty-Three Million Bank Loans Say About the Effects of Monetary Policy on Credit Risk-Taking?" *Econometrica*, vol. 82(2), March, pp. 463-505.
- Jiménez, G., S. Ongena, J. L. Peydró and J. Saurina (2017). "Macroprudential Policy, Countercyclical Bank Capital Buffers and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments", *Journal of Political Economy*, vol. 125(6), pp.2126-2177.

- Lane, P. R., and P. McQuade (2014). "Domestic Credit Growth and International Capital Flows", *Scandinavian Journal of Economics*, vol. 116, pp. 218-252.
- Martínez-Miera, D., and R. Repullo (2017). "Search for Yield", *Econometrica*, vol. 85(2), March, pp. 351-378.
- Martínez-Miera, D., and J. Suárez (2012). *A macroeconomic model of endogenous systemic risk taking*, CEPR Discussion Paper no 9134, September.
- Martins, B., and R. Schechtman (2014). *Bank capital requirements and loan pricing: Loan-level evidence from a macro prudential within-sector policy*, mimeo.
- Poghosyan, T. (2019). *How effective is macroprudential policy? Evidence from lending restriction measures in EU countries*, IMF working paper, 19/45.
- Reinhart, C., and K. Rogoff (2008). "Is the 2007 U.S. subprime crisis so different? An international comparison», *American Economic Review*, Papers and Proceedings, 98(2), pp. 339-344.
- Reinhart, C., and K. Rogoff (2009). *This Time Is Different: Eight Centuries of Financial Folly*, Princeton, NJ, Princeton University Press.
- Richter, B., M. Schularik and I. Shim (2019). "The Costs of Macroprudential Policy", *Journal of International Economics*, 118, pp. 263-282.
- Ros, G. (2020). *The making of a cyber crash: a conceptual model for systemic risk in the financial sector*, ESRB Occasional Paper Series, no 16, May.
- Taleb, N. N., and C. Sandis (2014). "The skin in the game heuristic for protection against tail events", *Review of Behavioural Economics*, no 1(1), pp. 115-135.
- Tinbergen, J. (1956). *Economic Policy, Principles and design*, Books (Jan Tinbergen), North-Holland.
- Trucharte, C. (2021). "Nuevas herramientas macroprudenciales para las entidades de crédito", *ICE, Revista de Economía*, no 918, January-February.
- Tzur-Ilan, N. (2017). *The Effect of Credit Constraints on Housing Choices: The Case of LTV limit*, Bank of Israel Discussion Paper 2017/3.