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On the effectiveness of macroprudential policy

Discussion Papers

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Discussion papers

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Abstract

Since the global financial crises, many countries have implemented macroprudential policies with the aim to render the financial system more resilient to shocks and limit the procyclicality of the financial system. We present theoretical and empirical evidence on the effectiveness of macroprudential policy, on both, financial stability and economic growth focussing on capital measures and borrower-based measures.

Keywords: Macroprudential policy; financial stability; bank capital; borrowers.

JEL Codes: G21

Non-technical summary

Since the global financial crises, many countries have implemented macroprudential policies. The aim of these reforms has been to render the financial system more resilient to shocks and limit the procyclicality of the financial system.

This paper presents theoretical and empirical evidence on the effectiveness of macroprudential policy, with special emphasis on the European Union. The focus of the analysis is on capital measures and borrower-based measures.

We find clear evidence that macroprudential policies have a positive impact on financial stability. Based on both macro-level and micro-level evidence, we find that macroprudential policies increase the resilience of banks and borrowers and can curb excessive credit growth when intended.

Moreover, we show that financial stability has an impact on long-term economic growth. Financial stability mitigates the deepness of recessions, with a positive impact on long-term growth, but tight credit constraints contribute negatively to the length of the expansions. This could pose a long run trade-off between financial stability and economic growth.

1 Introduction

Financial crises have large economic and social costs. Typically, financial crises result in sizeable output losses, forgone GDP growth, high unemployment and increasing inequality in the distribution of income and wealth. While the economic and financial implications of the Covid-19 pandemic cannot be fully appreciated yet, the aftermath of the global financial crisis (2008-2009) clearly shows how crises have the potential to affect the standards of living of a large share of the population. Ultimately this can have implications for social cohesion, political developments, and economic policies, thereby affecting long term growth and broader economic development. While the global financial crisis (2008-2009) was particularly severe and synchronised across countries, the costs and aftermath of domestic financial crises in the last 30 years (and beyond) follow similar patterns (Laeven and Valencia (2020), Lo Duca et al (2017)).

A striking feature of the period preceding the global financial crisis was the difficulty for policy makers and market participants to fully appreciate the broader macro-financial vulnerabilities that were accumulating and their potential economic costs.[1] First, in the years preceding the global financial crisis, risk premia were compressed at historically low levels and financing conditions remained extremely favourable for a relatively long period of time, supported by accommodative monetary policy and low macroeconomic volatility—the so-called "great moderation" (Taylor (2009); McConnell and Perez-Quiros (2000); Stock and Watson (2003)). At the same time, systemic vulnerabilities were growing: debt ratios in the private sector increased to record levels, especially in the US (Mian and Sufi (2011); the share of unsecured short term market funding in the financial sector grew to unprecedented levels, leaving parts of the financial system exposed to "runs" (IMF (2009)); and imbalances in real estate markets in the US and other countries started to emerge (Case and Shiller (2003)). Second, policy makers and market participants appeared to underestimate the costs stemming from the potential adjustment of the growing imbalances. Measures of tail risks in financial markets remained low even when imbalances started to unwind in the US in 2007. Moreover, policy makers also appeared to underestimate risks. In the spring of 2007, the Fed Chairman Ben Bernanke reassured markets that the subprime problem appeared contained.[2] In mid-2008, when problems in the subprime mortgage segment already emerged and some US banks were already in distress, the economic forecasts were hardly indicating recession risks for 2008 and 2009.[3] Overall, this indicates that it is difficult to appreciating the potential for financial amplification effects ex-ante.

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[1] See Gorton and Metrick (2012) for an overview of studies on features of the financial crisis and macro-financial conditions that anticipated it.

[2] "At this juncture, however, the impact on the broader economy and financial markets of the problems in the subprime market seems likely to be contained" Ben Bernanke, Testimony to the Congress, 28 March 2007. Link: https://www.federalreserve.gov/newsevents/testimony/bernanke20070328a.htm

[3] The IMF Spring 2008 World Economic Outlook (released on 9 April 2008) forecast 0.5 % and 0.6% annual real GDP growth in the US in 2008 and 2009 respectively. The IMF Autumn 2008 World Economic Outlook (released on 10 October 2008) forecast 1.6 % and 0.1% annual real GDP growth in the US in 2008 and 2009 respectively. Ex-post, real GDP growth in the US -0.3% in 2008 was and -3.1% in 2009.

The difficulty for policy makers/market participants to fully appreciate risks and anticipate costs largely relates to changes that made the financial system larger and more complex in the decades preceding the crisis (Rajan (2006)). In particular, the role of less regulated entities in financial intermediation (the so-called “shadow banks”) grew largely and banks became more intertwined with these non-bank financial intermediaries. Overall, this increased the potential for shock amplification within the financial system (i.e. the cross-sectional dimension of systemic risk) and to the rest of the economy. Furthermore, it also increased the propensity of the financial system to behave pro-cyclically through the build-up of systemic risk in normal times and exacerbate financial amplification during crises (i.e. time-series dimension of systemic risk).[4]

Several interdependent factors contributed to the growing complexity of the financial system and the accumulation of systemic risk before the global financial crisis. First, the implementation of more stringent regulation for banks incentivised the migration of financial intermediation outside the perimeter of the banking sector (Goodhart (2008), Brunnermeier et al. (2009)). Second, growing global imbalances, also in relation to worldwide patterns of capital flows and savings, resulted in strong demand for financial assets and in the compression of risk premia, thereby also contributing to the growth of the non-bank financial system (Bernanke (2005)). By interacting with the regulatory framework, global demand for financial assets spurred the engineering of financial products with appealing risk / return profiles for investors. This in turn resulted in favourable financing conditions and overborrowing in some economic sectors in the US (Mian and Sufi (2011)). The new financial assets, mostly linked with the US real estate markets, turned out to be opaque and difficult to price when conditions deteriorated, leading to a market freeze, fire sales and large financial amplification effects (Acharya et al. (2013)).

Overall, the large costs of the financial crisis increased the focus of policy makers worldwide on crisis prevention (Borio (2003)). At same time, the complexity of the financial system and its potential for shock amplification called for a change in the approach to financial stability in order to put more emphasis on a “system wide” perspective to keep the negative effects of externalities under control. In other words, the global financial crisis highlighted the limits of microprudential supervision and monetary policy in crisis prevention and resolution and highlighted the need for macroprudential surveillance and policies to address emerging imbalances in the financial sector.

While, from a microprudential perspective, financial intermediaries might appear individually sound in good times, their collective action may be conducive to imbalances at the system level, (for example through excessive credit growth and leverage, interconnectedness and concentrated exposures) which may remain outside the “radar screen” of micro supervision. However, in bad times, sound financial intermediaries can quickly be put to the brink of bankruptcy by financial system wide distress. At the same time, the collective action of financial intermediaries that attempt

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4 According to ECB (2009), systemic risk “refers to the risk that financial instability becomes so widespread that it impairs the functioning of a financial system to the point where economic growth and welfare suffer materially”

to strengthen their balance sheet during adverse market conditions can amplify market distress and might not be fully internalised by micro supervision.

The global financial crisis has also brought to the fora the limits of monetary policy in "cleaning up" the costs of crises and its possible limitations in crisis prevention. The recovery from the crisis was protracted despite central banks across the world substantially expanded their balance sheet once interest rates approached the zero-lower bound (Bech et al. (2014) and Borio (2014)). At the same time, there is widespread concern that monetary policy alone could not be an effective tool for crisis prevention. This stems from the observation that endogenous cyclical imbalances can build-up in the financial system also when macroeconomic developments (e.g. inflation) are consistent with central bank targets. This implies that taming the "financial cycle" would force central banks to deviate from their targets, at least in the short term.[5]

In this context, macroprudential policy has gained prominence as a third policy function with the goal of addressing externalities and market failures associated with financial intermediation, thereby complementing "micro" supervision and monetary policy (De Nicolò et al. (2014)). The main objective of macroprudential policy is to ensure that the entire financial system is resilient to shocks of different nature and, therefore, that it does not amplify economic downturns. Second, macroprudential policy aims to limit the procyclicality of the financial sector by preventing the build-up of imbalances in the upswing of the financial cycle, thereby allowing it to absorb losses and support the real economic during downturns (Constâncio et al (2019)).

Macroprudential policy has several tools at its disposal. These tools, however, depend on the specific regulatory framework that a country adopts (Box 1). For banks, tools that are available and widely used include capital measures and borrowed based measures. For non-banks, macroprudential instruments are not yet fully developed and used, FSB (2020). Other measures, which can be available and have been used to different extent, especially in emerging economies, include provisioning requirements, other quantitative restrictions on the balance sheets of financial intermediaries (e.g. exposure limits, liquidity requirements, etc), taxation/levies on activities or balance sheet composition.[6]

The importance of capital measures as macroprudential tools for banks has gained importance in the aftermath of the financial crisis. Capital measures encompass a set of capital requirements which increase the loss absorption capacity of banks, thereby contributing to the goal of overall financial sector resilience. By altering banks' cost of capital, capital measures affect the intermediation capacity of banks with impact on the terms and volumes of credit, thereby contributing to goal of taming the financial cycle. While microprudential capital measures are set to address bank specific risks, macroprudential capital measures are generally linked to risks that have system wide implications. In most countries, the capital framework of banks is disciplined by the Basel III agreements, BCBS (2013) which have incorporated several lessons from the

[5] The concept of financial cycle, as a separate object from the business cycle that describes cyclical fluctuations in the real economy, emerged in the aftermath of the financial crisis (Borio, 2012).

[6] For tools that have been used from a macroprudential perspective see Budnik and Kleibl (2018).

global financial crisis[7]. In particular, from a macroprudential perspective, the Basel III capital framework introduces a counter cyclical capital buffers (CCyB) and buffers targeting risks of a structural nature, such as the Systemic Risk Buffer (SyRB), and buffers for “too-big-too fail” institutions such as those for Globally Systemically Important Institutions (G-SII) and Other Systemically Important Institutions (O-SII). The CCyB is expected to be accumulated during the upturn of the financial cycle to increase resilience and limit the build-up of financial imbalances e.g. in the form of excess credit. The CCyB should be used (or released) in downturns to facilitate loss absorption and ensure a smooth provision of credit, thereby limiting financial amplification effects produced by bank de-leveraging. The objective of buffers for “too-big-too fail banks” is twofold: first, to limit the probability of default of large institutions the bankruptcy of which could lead to systemic financial and economic disruptions. Second, by forcing these institutions to have more “skin in the game”, the buffers limit the incentives for risk taking which are normally spurred by the expectation of public intervention in case of distress for these institutions.[8] Another macroprudential capital measures entails the adjustment of the risk weights that bank should apply to specific exposures, as for example to the real estate sector. By increasing risk weights, regulators force banks to set aside more capital for a given exposure.[9] [10]

Borrower based instruments directly affect the availability, terms and conditions of lending which normally relate to the riskiness of loans. Borrower-based instruments which may be available in individual countries[11] consist of limits to the size of the loan in relation to (i) the value of the underlying collateral (loan to value ratio, LTV), (ii) the income of the borrower (loan to income ratio, LTI) or (iii) limits to loan servicing costs in relation to the income of the borrower (LSTI)[12]. Other measures include maximum maturity for loans and amortisation requirements. Borrower measures contribute to system resilience in different ways. First, they reduce the probability of default of individual borrowers. Second, over time, they contribute to safer lending portfolio of banks as the average riskiness of borrowers decreases. In addition, as borrowers are on average more resilient, they also are in a better position to absorb shocks, thereby limiting macro amplification effects (e.g. by lower consumption and investment). In addition, borrower-based measures contribute to taming the financial cycle by reducing credit growth, as banks are not allowed to supply loans to certain categories of borrowers (or will not be allowed to meet all the demand from these borrowers).

[7] The legal framework for the implementation of these instruments is harmonised in the EU and is provided by the EU Capital Requirements Directive (CRD IV) and the Capital Requirements Regulation (CRR).

[8] These expectations can also result in lower funding costs for these institutions.

[9] Risk based capital ratios in the Basel framework are calculated by dividing capital (numerator) by risk weighted assets (denominator). Risk weighted assets are the sum of different exposures each multiplied by a parameter called “risk weight” which should reflect the risk of the exposure.

[10] In Europe, another relevant macroprudential capital buffer is the Systemic Risk Buffer. This buffer is not embedded in Basel III framework, but it is included in the EU Capital Requirements Directive (CRD). The buffer has been used to address systemic risk of non-cyclical nature (e.g. stemming from high levels of indebtedness on the non-financial private sector).

[11] Activation of borrower-based instruments is at national discretion and subject to national legal or macroprudential frameworks.

[12] In some cases, limits are calculated based on the consolidated debt of the borrower (debt to income, DTI; debt service to income, DSTI).

The goal of this discussion paper is to present theoretical and empirical evidence on the effectiveness of macroprudential policy focussing on capital measures and borrower-based measures.

Section 2 outlines the general framework. Section 3 explores the implications of macroprudential policies from theoretical grounds. Section 4 presents the empirical evidence using respectively macro and micro data. Section 5 discusses the relationship between financial stability and growth. Section 6 concludes.

2 A general framework for macroprudential policy

According to the European Systemic Risk Board (2014), the ultimate objective of macroprudential policy is to contribute to the safeguarding of the stability of the financial system as a whole. This includes strengthening the resilience of the financial system and taming the build-up of vulnerabilities and smoothing the financial cycle, thereby ensuring a sustainable contribution of the financial sector to economic growth.

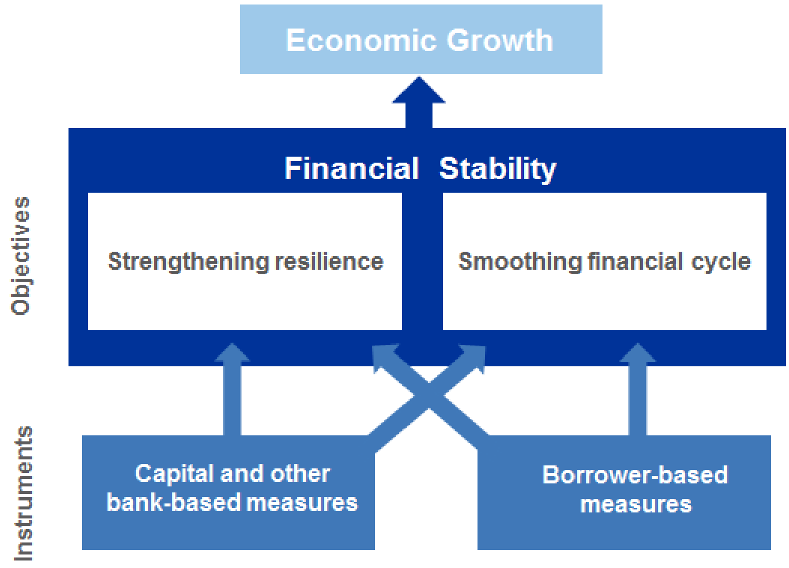
This definition is aligned with other statements from different institutions. For example, according to the FSB-IMF-BIS (2011), the objective of macroprudential policy is "to limit systemic or system-wide financial risk, thereby limiting the incidence of disruptions in the provision of key financial services that can have serious consequences for the real economy". The argument is that macroprudential policies should be implemented because they affect intermediate variables that can result in financial distress, and that financial distress has a direct impact on the volatility of GDP growth and the depth of recessions.

While several macroprudential policy instruments exist, we will concentrate our analysis on capital and borrowed based instruments affecting the banking sector. Even though both types of measures influence the resilience of the financial system and the building up of vulnerabilities, capital measures seem to be more focused on strengthening resilience while borrower measures focus on containing the build-up of vulnerabilities, at least in the short term.[13] The general framework of the impact of macroprudential policy can be represented as in Chart 1.

[13] Borrower based measures are quantitative limits to certain type of lending. Therefore, first they affect the flows of lending contributing to contain the build-up of vulnerabilities. Second, in the medium term, as flows accumulate into stocks, borrower-based measures contribute to resilience by improving the risk features of the average loan and borrower.

Chart 1

Transmission mechanism of macroprudential policies to economic growth



Each type of instrument affects financial stability through different channels, with the ultimate goal to ensure stable economic growth.

Surprisingly, the existing literature concentrates mainly on the effects of macroprudential policies on financial stability, with only few studies measuring the effect on the final goal, economic growth.   The papers that include GDP growth in their analysis, included in the most comprehensive meta-analysis available in the literature by Araujo et al (2020), provide statistically significant negative effect of macroprudential policies on economic activity, in particular when referring to tightening actions. This effect is so clear that some papers directly refer to the "Cost of macroprudential policies" (Richter et al., 2018). By taking these results at face value, it would be difficult to propose macroprudential policy measures when the only statistically significant impact on economic activity found in the literature is a negative one.

Then, if this is the case, where are the gains of macroprudential policies? The evidence that we will present in this paper shows that macroprudential policies have a positive impact on financial stability, by strengthening resilience of both borrowers and lenders and by containing vulnerabilities. At the same time, we will present statistical evidence that recessions associated with financial imbalances, particularly with credit booms, tend to be deeper and recoveries tend to be sluggish. This result is not new in the literature, Jorda et al (2013) and Claessens et al (2011) among many others present already this type of evidence. Given these facts. there is a clear indirect effect of macroprudential policies on a stable growth pattern. By avoiding financial distress, recessions become milder, which implies a positive impact on long-term economic growth. We will also show that the right amount of financial distress makes expansions longer, but too much or too little control shorten the expansions, with the consequent effect on economic growth. In addition, as we mentioned before, in the short term, economic growth decrease as a result of the negative demand shock resulting from the activation of macroprudential policy.

The purpose of this discussion paper is to put together these alternative views, the negative demand shocks against the positive effect on stability of GDP, and therefore, future growth, assessing and measuring the benefits and costs of the implementation of these policies. The paper presents evidence from a range of cutting-edge models assessing how a variety of macroprudential policy instruments affect the stability of euro area banks, households and aggregate credit. It also shows how some novel models can balance the short-term costs of constraining aggregate credit growth with prudential measures with their long-term benefits.

Given the difficulty to measure these opposing effects, the analysis in this paper relies on both theoretical and empirical approaches: in particular, we will provide empirical evidence for the theory predictions. Also, the effects of the policies will be measured both at the aggregate and at the micro level. This is because the effects of macroprudential policies, especially the borrower-based ones, depend on the distribution of the individuals, and particularly on the proportion of borrowers bounded by the measure. The analysis follows a two-pronged approach focussing, first, on the effects of macroprudential policies on financial stability and, secondly, on future growth.

3 Macroprudential policy and financial stability: theory

Dynamic stochastic general equilibrium models (DSGE) integrate macroprudential policy into a general equilibrium framework to study the systemic role of the financial sector and its regulation. In DSGEs, optimal decisions of economic agents are derived from micro-foundations. The economy is subject to distortions, in form of real- and nominal rigidities and financial frictions which amplify the effect of shocks on the real economy[14]. Macroprudential policy in DSGEs aims to address the distortions and limit the impact of financial amplification effects using various instruments, usually categorized into capital- or borrower-based measures.

In what follows we employ the 3D DSGE model of Clerc et al. (2015), featuring multiple types of financial frictions, to explore the impact of capital and borrower-based measures, in particular focussing on their impact on building resilience and containing vulnerabilities[15]. First, we review how capital measures affect the long-run properties of the economy and credit volatility. Second, we introduce an extension of the 3D model with borrower-based measures and present results on their impact on the steady state of the model and the volatility of credit. We conclude that capital regulation is effective in increasing bank resilience, by reducing bank leverage and the probability of bank defaults, while borrower-based measures are more effective in increasing borrowers' resilience, by reducing defaults, leverage and indebtedness of borrowing households.

The 3D model is a DSGE model with financial frictions developed by Clerc et al. (2015) to assess the impact of capital regulation. The three layers of default (3D) refer to the fact that households, entrepreneurs and banks may all default on their liabilities[16]. The model features three types of financial frictions, namely (1) costly state verification on housing, capital and bank loans, (2) costly disruption of deposit service to households and (3) collateral constraints on entrepreneurs and lending for housing. The financial frictions in the financial sector affect the credit market for investment goods, housing capital and deposits, all affecting the transmission of exogenous shocks to the economy. Macroprudential policy sets capital requirements and LTV limits.

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[14] See De Nicolò, Favara and Ratnovski (2014), Guibourg et al. (2015) and Finocchiaro and Grodecka (2018) for a detailed discussion of how macroprudential measures affect the economy in presence of different financial frictions.

[15] We chose the 3D model as it is the flagship DSGE model for macroprudential policy calibration in the ECB. The model was used in the context of the MPPG Task Force on Operationalising Macroprudential Research (TF OMR), which was established in 2015 and tasked with assessing the costs and benefits of macroprudential policy implementation in SSM countries building on four classes of models: a DSGE model, a factor augmented VAR model (FAVAR), a micro-econometric model and a network model.

[16] Borrowing households finance house purchases with bank loans. Households default on their mortgage loans when the value of the collateral is lower than the outstanding debt obligations. Entrepreneurs engage in capital investment, financing their capital purchases with entrepreneurial wealth and bank loans. Entrepreneurs default on their loans when the return on their investments is lower than the contractual debt obligations. The financial system is represented by two types of banks, one specialised in lending to households and one specialised in lending to entrepreneurs. Each type of bank raises equity from shareholders and deposits from saving households to finance their loan portfolio. Banks fail when the realised return on the loan portfolio is lower than the banks' deposit repayment obligations.

The model features three types of capital-based macroprudential instruments: a minimum fixed capital requirement, risk weights for household mortgages and a time-varying capital requirement which is a function of the deviation of total bank loans from trend (the CCyB). In the model, all banks are required to retain equity in proportion to the amount of issued loans. In the following, we focus on examining the effect of changes in broad fixed capital requirements.

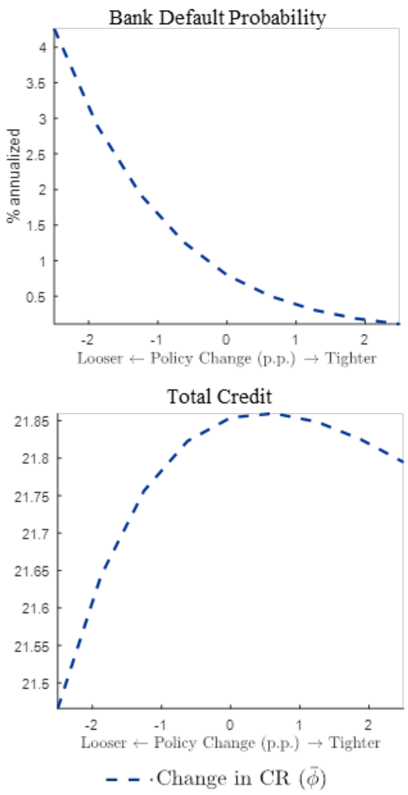
The following two charts summarise the transmission of capital-based measures in the 3D model. Chart 2 shows the steady state level of selected variables as a function of the capital ratio, while Chart 3 decomposes the changes of total volatility credit volatility to exogenous sources of risks[17]. We find that a tighter capital regulation compared to the euro area baseline reduces bank riskiness on the long run measured as the steady state bank default probability. This is represented by a movement to the right on the horizontal axis in the upper panel of Chart 2.

Chart 2

Transmission of capital-based measures on bank defaults and credit

Steady state level of key model variables

(% and level deviation from steady state; Y-axis: level of the steady state (mean); X-axis: policy change (in %))
Notes: The values here represent the mean on the long run of steady state of key model variables in response different capital ratio calibrations. Steady state impacts are based on the nonlinear solution of the steady state dynamics of the model. Positive values represent a tightening of the capital ratio (CR), negative values represent a loosening.
Source: ECB Staff Calculations



[17] We use the euro area calibration of the model to conduct our analysis.

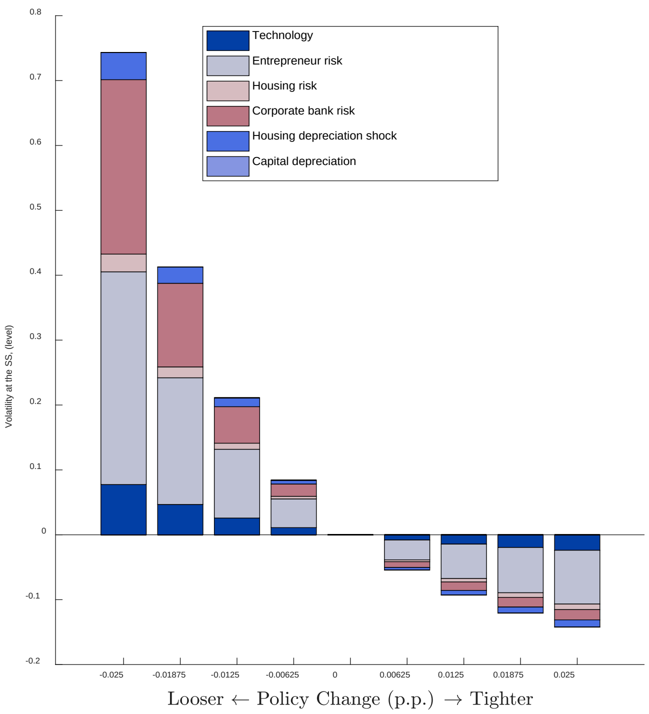
The overall effect on total credit depends on which of the two of the following channels dominates: a small tightening of capital requirements initially increases credit, as it reduces the cost of deposit funding and allows banks to increase their loan supply, i.e. the risk reduction channel. On the other hand, the balance sheet channel stems from the necessity of banks to rely more on expensive equity to finance lending, increasing banks' cost of funding and putting downward pressure on their loan supply. The bottom panel of Chart 2 plots the equilibrium level of the total credit at the steady state for different values of the tightening/loosing measure. The non-linear impact of bank capital regulation is also evident: when initial bank riskiness is high, the risk reduction channel dominates rendering capital-based measures particularly effective.

Chart 3

Transmission of capital-based measures on credit volatility

Total credit volatility

(% deviation from steady state, level; Y-axis: volatility at the steady state (variance); X-axis: policy change (in %))
Notes: Change in resilience is measured as changes of contributions to volatility at the steady state of key model variables in response different capital ratio calibrations. Positive values represent a tightening of the capital ratio (CR), negative values represent a loosening. The 6 colour blocks represent the different sources of shocks in the model.
Source: ECB Staff Calculations



Furthermore, we find that higher capital requirements reduce the volatility of economic variables mostly in response to corporate bank risk shocks and entrepreneur risk shocks. Chart 3 depicts a decomposition of the volatility of total credit for different calibrations of capital requirements to highlight the contribution of the different shocks hitting the economy. A better capitalised banking leads to lower total credit volatility as the financial sector is less prone to default and therefore can continue to provide of credit to the economy even in adverse circumstances. It is important to note that the effect is highly asymmetric, as the increase in the volatility of total credit when capital requirements are loosened is much higher than the decrease in volatility when capital requirements are tightened.

While the 3D model has originally been designed to assess capital-based macroprudential policies, we extend it to conduct exercises on the impact of borrower-based instruments, by introducing a LTV ratio for housing credit. We implement the LTV as a “Pigouvian tax” (τ_{LTV}) levied on impatient households that distorts their housing related borrowing decision, leaving their per period budget constraint unchanged:

$$\mathrm{LTV_t} = (1 - \tau_{\mathrm{LTV}})\frac{\text{credit for housing}}{\text{value of real estate collateral}}$$

If this “Pigouvian tax” is set equal to the “shadow cost” between the desired and the LTV limit implied amount impatient households can borrow against, then it implements the LTV regulation. A more stringent LTV limit is equivalent to an increased “Pigouvian tax” on housing credit, similarly a looser LTV is equivalent to a reduced “tax”. By targeting different levels of LTV limits, we can understand how borrowing-based measures affect resilience and contain vulnerabilities.

Chart 4

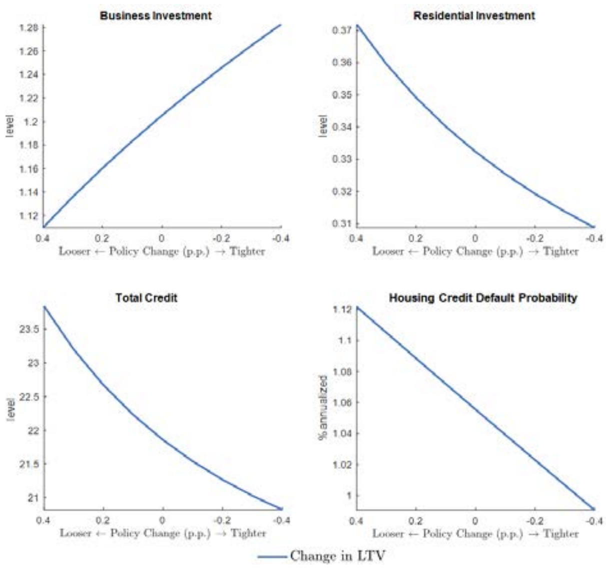
Transmission of borrower-based measures

Steady state level of key model variables

(% and level deviation from steady state; Y-axis: level of the steady state (mean); X-axis: policy change (in %))

Notes: The values here represent the mean on the long run of steady state of key model variables in response different levels of LTV limits. Steady state impacts are based on the nonlinear solution of the steady state dynamics of the model. Negative values represent a tightening of the LTV ratio, positive values represent a loosening.

Source: ECB Staff Calculations

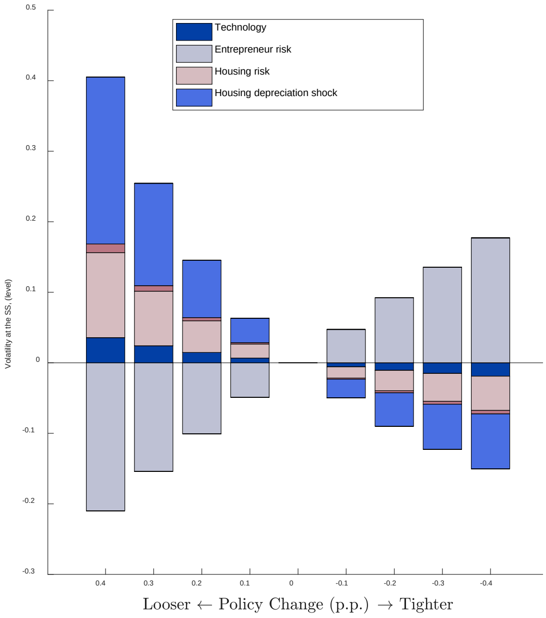


We find that, in the long-run, borrower-based measures are effective in increasing borrowers’ resilience, by reducing defaults, leverage and indebtedness of borrowing households. In addition, borrower -based measures lead to portfolio rebalancing effects, channelling savings from housing capital to firm investments. Chart 4 shows the steady state effects of tightening (negative values of the x-axis) and loosening (positive values of the x-axis) the LTV ratio on the main model variables. Tighter LTV limits reduce mortgage credit, as borrowers are constrained in the amount they can borrow to finance their housing projects. More stringent LTV caps reduces borrowing households’ leverage, making them less likely to default, as well as reduces steady state residential investment. At the same time, saving households divert their extra savings to finance the entrepreneurial sector, and loans to firms increase and partially offsetting the decrease in total credit. This is a general equilibrium portfolio rebalancing effect of LTV limits.

Chart 5
Transmission of LTV measures on credit volatility

Total credit volatility

(% deviation from steady state, level; Y-axis: volatility at the steady state (variance); X-axis: policy change (in %))
Notes: Change in resilience is measured as changes of contributions to volatility at the steady state of key model variables in response different levels of LTV limits. Negative values represent a tightening of the loan-to-value (LTV) ratio, positive values represent a loosening.
Source: ECB Staff Calculations



More stringent LTV limits reduce the volatility of economic variables in response to shocks affecting the housing sector. Chart 5 decomposes the changes of total credit volatility around the steady state at different levels of LTV limits. A tighter LTV than the baseline reduces the impact of housing related risks on total credit volatility: as tighter LTV limits constrain the demand for mortgage credit, thereby reducing the volatility of household credit, which constitutes approximately 60% of total credit. However overall, tighter LTV limits do not imply a lower volatility of total credit. This is due to the portfolio rebalancing effect the sensitivity of total credit to entrepreneurial risk increases.

The results presented suggest that capital regulation is more effective in increasing bank resilience, by reducing bank leverage and the probability of bank defaults, while borrower-based measures are more effective increasing borrowers' resilience, by reducing defaults, leverage and indebtedness of borrowing households. Annex 1 presents additional results on the joint implementation of capital and borrower-based measures.

4 Macroprudential policy and financial stability: empirical evidence

4.1 Macro evidence

As we saw in the previous section, according to theory, there is a direct impact of macroprudential policies on steady state credit. Even though theory is silent about the path to achieve the new steady state, obviously, a tightening in policies will imply a decrease in the level of credit and a loosening in policy will have the reverse effect. This is, perhaps, the most empirically measured effect analysed in the empirical literature of macroprudential policies. The most standard method used in the literature is a panel regression where

$$y_{t+h} = C + \beta Mac_{t-1} + \gamma X_t + \varepsilon_t$$

where y_{t+h} is credit growth in period t+h, Mac_{t-1} the stance of macroprudential policy in t-1 and X_t is the set of control variables. β is the parameter of interest and represents the semi-elasticity of credit to the stance of macroprudential policy.

Most of the papers provide positive and statistically significant estimates of the parameter β.[18] In Gadea and Perez Quiros (2021), a Fisher test is proposed, calculating the probability that the null hypothesis of $\beta = 0$ be true, when more than 100 independent estimates reject the null. The p-value of this test is 0.00, showing that there is a sound statistical evidence that there is an effect of macroprudential policies on credit growth. However, the results are very heterogeneous. They differ across instruments, across databases, across controlling variables, across estimation methods across samples, and across time horizons (h). However, the meta-analysis[19] studies of Araujo et al. (2020) and Gadea and Perez Quiros (2021) present very similar estimates of the β parameter (-0.12 and -0.17 respectively). Therefore, according to the existing literature, macroprudential policies are effective in controlling credit.

However, as we said, most empirical evidence on the impact of macroprudential policies is limited to cross country panel regressions, testing for significant effects of policy measures on credit[20] One of the main drawbacks of these studies is the difficulty that they face with the construction of quantitative indicators which is precluded by the high diversity of the various policy measures. Hence, policy measures are typically represented by qualitative variables, that give the timing and direction of individual policy events. That is, the policy indicators take a value of +1 in case of a policy tightening, -1 in case of an easing and are zero otherwise.

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[18] Just to quote a few, Kuttner and Shim (2012), Akinci and Olmstead (2015), Cerutti et al. (2015), and Vandenbussche et al. (2015).

[19] Meta-analysis is a quantitative survey of the literature reporting estimates of the same parameter.

[20] Some papers also analyze house prices.

In addition, as noted by Galati and Moessner (2016), panel regressions remain silent on two important issues, namely the effects of macroprudential policies on GDP and inflation, and the potential second round effects of these variables on future values of credit. The same shortcomings apply to event studies based on credit registry data.[21] Only one study, Richter et al. (2019), uses local projection methods to assess dynamic effects.

The narrative panel VAR approach closes this gap and allows for studying the dynamic responses of macroeconomic aggregates based on qualitative indicators. The approach has also the advantage that it is less prone to endogeneity issues, as the dynamics of the dependent variables is explicitly modelled.

Therefore, in order to precisely measure the empirical effects of macroprudential policies, we present estimates of the macroeconomic effects of macroprudential policy from a structural VAR approach. The estimates are taken from a forthcoming paper by Budnik and Rünstler (2021). They employ a narrative panel VAR approach to obtain the dynamic responses of the economy to macroprudential policy measures for euro area member states. The set of policy measures stems from the Macroprudential Policies Evaluation (MaPPED) database by Budnik and Kleibl (2018).

The study finds a sizeable impact of macroprudential policy measures on credit (and house prices) together with small effects on output and inflation. In our sample, borrower-based measures have on average a larger effect than capital requirements, which goes in line with the anticipated by the DSGE model of previous section.

However, the empirical results provide some illustration on the dynamics for the transition to the new steady state, which theoretical models are silent about. What we find is that, in general, policy measures are subject to long policy lags. While their impact on GDP and inflation is rather short-lived, the responses of credit aggregates and house prices reach their maximum only after three years or more and remain highly persistent thereafter. Such delayed response has implications for the conduct of counter-cyclical macroprudential policies, suggesting a need for a rule-based forward-looking approach.

The policy indicators are constructed from the Macroprudential Policies Evaluation (MaPPED) database by Budnik and Kleibl (2018), which covers a wide range of macroprudential policy measures in the member states of the European Union in between 1995 and 2017.

The estimates are limited to the 12 initial member states of the euro area (excl. Luxembourg) and focus on three categories, i.e. minimum capital requirements, limits on loan-to-value (LTV) ratios, and other borrower-based measures (such as debt-to-income and debt-service-to-income ratios). The MaPPED database lists 33 events related to capital requirements, all of which are tightening measures, and 11 events on LTV ratios, of which 8 are tightening measures, and 19 events on other borrower-based measures (11 tightening measures).

[21] See e.g. Jimenez et al. (2017) and Gambacorta and Murcia (2017).

The identification scheme is based on an adaptation of the proxy VAR approach to qualitative data by Budnik and Rünstler (2020). Proxy VARs refrain from using the index as a regressor. Instead, they identify policy shocks as a linear combination of the VAR residuals by projecting the latter on the index. The approach has been widely used for the assessment of fiscal and monetary policies.[22] Budnik and Rünstler (2020) propose a Bayesian version that it suitable for the case of purely qualitative data. They also show that this approach is superior to regression-based methods, including local projections as used by Richter et al. (2019), as the latter are subject to considerably larger confidence bounds and prone to measurement error.

The approach works in two steps. In a first step, a panel VAR is estimated for the 11 countries in the sample. The VAR includes quarterly GDP, inflation, short term rates, credit volumes, and house prices over the period of 1998 Q1 to 2017 Q4. It is estimated by Bayesian methods, imposing partial shrinkage on the coefficients across countries, thereby allowing for some variation.

The VAR is estimated by Bayesian methods employing a partial shrinkage prior to ensure that estimates of the VAR coefficients are similar across countries. Specifically, it is assumed that coefficients for individual countries are distributed with a common mean and covariance matrix. Consider the VAR for country c

$$y_{c,t} = d + \sum_{k=1}^{p} A_{k,c} y_{c,t-k} + u_{c,t}$$

and let $\beta_c = vec(d, A_{1,c}, \dots, A_{p,c})$ the stacked vector of coefficients. The shrinkage prior assumes that coefficients β_c for country c are distributed with common mean β,

$$\beta_c \sim N(\beta, \lambda\Omega)$$

where the amount of shrinkage is given by $\lambda\Omega$. Ω is a pre-specified diagonal matrix to account for parameter-specific tightness and parameter λ determines the amount of shrinkage. Following Jarocinski (2010) we assume an inverse-gamma prior for λ.[23]

Given estimates of the VAR parameters, macroprudential policy shocks ε_t are then identified as a linear combination of the VAR residuals, $\varepsilon_t = \alpha u_t$, by making use of the information from the policy events z_t. Basically, this exploits the fact that the policy shocks ε_t is expected to be positive (negative) in case of a tightening (easing) policy measure and zero otherwise. Formally, $\mathrm{E}\varepsilon_t > 0$ if $z_t = 1$, and $\mathrm{E}\varepsilon_t = 0$ if $z_t = 0$. Hence, loosely speaking, policy shocks are identified as those linear combinations of residuals, for which the sign of the resulting shocks equals the sign of the policy shocks for a sufficiently high number of events.

Chart 6 shows the dynamic responses of the system to a tightening policy measure for the three aforementioned types of policy measures. The responses are scaled to reflect the average impact of policy measures in our sample.

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[22] See e.g. Mertens and Montiel-Olea (2018) for fiscal and Jarocinski and Karadi (2018) for monetary policies.

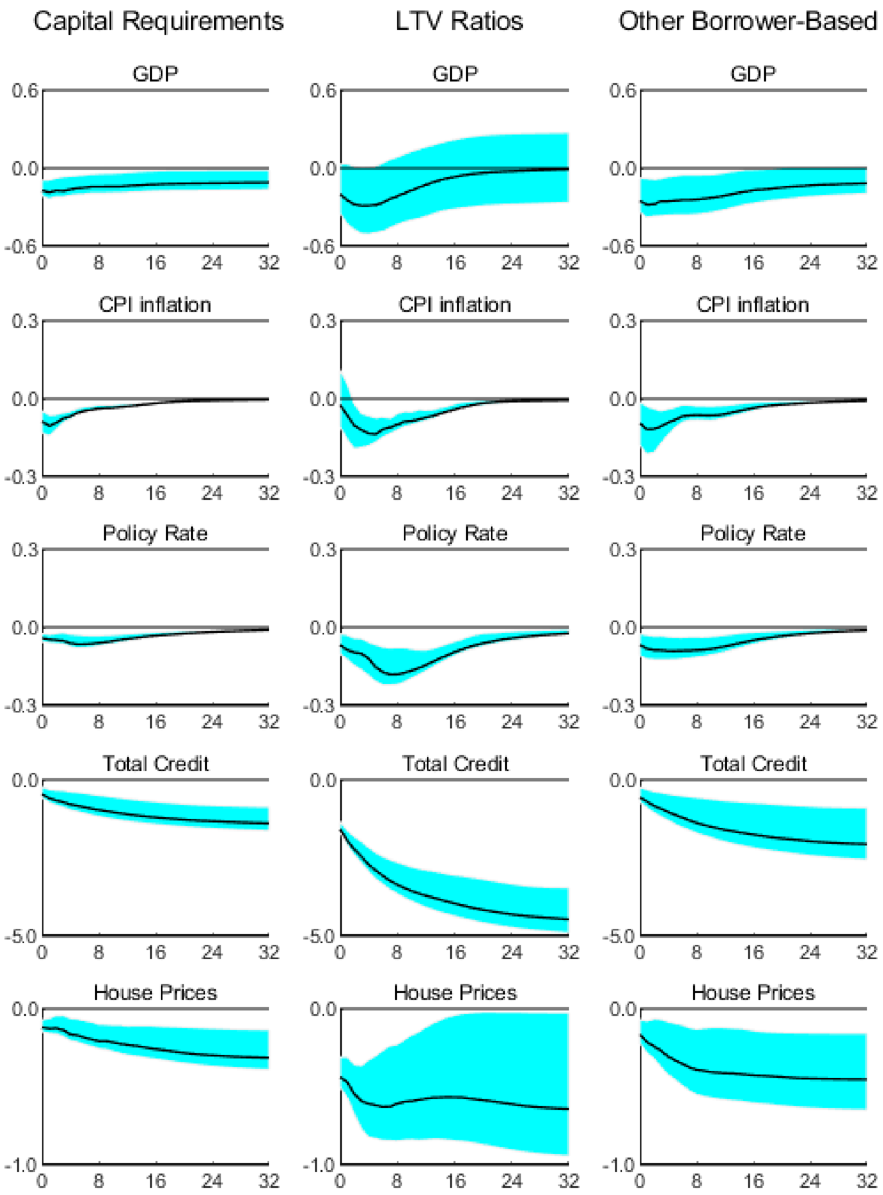
[23] The partial shrinkage estimator has the advantage of being more robust to outliers and cross-section dependence (see Hsiao et al., 1990).

The responses are similar for all three types of policy measures, but they differ in their scale. Borrower-based measures, especially limits on LTV ratios, appear to have larger effects than capital requirements. The average policy measure related to LTV ratios results in a decline in credit of 4.5%, while GDP temporarily drops by about 0.3%. For other borrower-based measures and capital requirements the decline in credit amounts to 2.1% and 1.4%, respectively.

Chart 6

Impulse responses to macroprudential policy measures

Notes: The charts show the impulse responses to policy measures related to capital requirements, loan-to-value ratios, and other borrower-based measures. The size of the response reflects the average effect of a policy measure.



Overall, the results from the narrative VAR are roughly in line with estimates from earlier studies based on panel regressions. However, the narrative VAR also points to the presence of long policy lags. In particular, the effects on credit are very persistent, lasting up to 20 quarters to reach the maximum effect. This has implications for the conduct of counter-cyclical macroprudential policies, suggesting a need for a rule-based forward-looking approach.

To conclude, it is clear, both from the theoretical and the empirical analysis that macroprudential policies influence financial stability, through their ability to control credit. But it is difficult from a macro perspective to find evidence on the other “pillar” of financial stability, the increase in resilience, because, as a difference of the financial vulnerabilities, where the level of credit could be consider a sufficient statistic, there is no a clear macro-variable that could summarize the level of resilience. Resilience of banks and borrowers has an individual component that need to be analyse under the microscope. This is the purpose of the following section.

4.2 Micro evidence

Borrower-based macroprudential measures have been increasingly used to support borrower and bank resilience and to contain the build-up of risks during an economic upturn[24]. Often used in combinations and applied in residential real estate markets, limits to loan to value (LTV), debt to income (DTI), and debt service to income (DSTI) ratios increase the households’ resilience to economic downturns, in addition to containing possibly excessive credit growth and household indebtedness during an economic upturn. Furthermore, borrower-based instruments improve the quality of banks’ mortgage loan portfolios through more prudent lending standards, which gradually render loan portfolios less risky over time. In turn, the decrease in risk of banks’ exposures to riskier households (relative to no policies) increases the resilience of banks during periods of negative economic shocks with positive spillovers to the broader economy.

The relation between lending standards (LTV, DSTI, DTI) at loan origination and probabilities of default supports the rationale for borrower-based measures. By construction, some borrowers, especially riskier ones, will have limited, if any, access to loans, and therefore, some potentially risky loans will not be originated, decreasing the aggregate probability of default in adverse scenario[25]. To analyse this relationship, we use household level survey data to study the effect of LTV at origination ratios on the probability of default. In particular, we look at Italy and Spain using data from the Survey of Household Income and Wealth (SHIW) and the Encuesta Financiera de las Familias (EFF), respectively. Both datasets collect household level information on assets, liabilities, income, consumption and demographic characteristics from a nationally representative sample of households. SHIW is conducted bi-annually while EFF is conducted every 3 years.

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[24] Macroprudential analysis of residential real estate markets Lo Duca et al. (2019) and Alam et al. (2019).

[25] Potential concerns related to distributional effects in particular for more vulnerable income categories will be covered in a separate section of the paper.

We run a probit model in which our dependent variable is a dummy variable indicating whether the household has been late or missed payments on its loans during the last 12 months. The independent variable of interest is the LTV at origination for the main loan on the household's main residence. We control for a series of loan and household characteristics.[26] We pool information from the 2014 and 2016 surveys for Italy and years 2011 and 2014 for Spain.

In particular, we formulate the model as

$$\Pr(default_i = 1|x) = \Pr(default_i^* > 0|x) = \vartheta(x)$$

$$default_i^* = \beta_0 + \beta_1 * LTVorigination_i + \beta_2 * x_i + \varepsilon_i$$

This model implies that the probability that household i defaults at time t is a function of various determinants x, which affect the latent variable $default_i^*$. If that latent variable is larger than 0, the household defaults on its debt. The latent variable itself is modified by the second equation as a function of a series of loan and household characteristics which include: year when loan was granted, age, income, income squared, financial assets, financial assets squared, unemployed, education, current debt-service-to-income ratio, current LTV, time since origination and loan rate.

Chart 7 shows that the probability of defaulting increases with the level of the LTV at origination. For Italy, an LTV at origination of 20% is associated with a probability of default of around 1%, while an LTV at origination of 80% is associated with a probability of default of almost 6%. In the case of Spain, for the same LTV at origination range the probability of default increases from 10% to 15%. Looking at both graphs, we can quantify the increase in resilience due to LTV regulation. By increasing LTV, some of the riskiest loans are left out, decreasing the average probability of default.

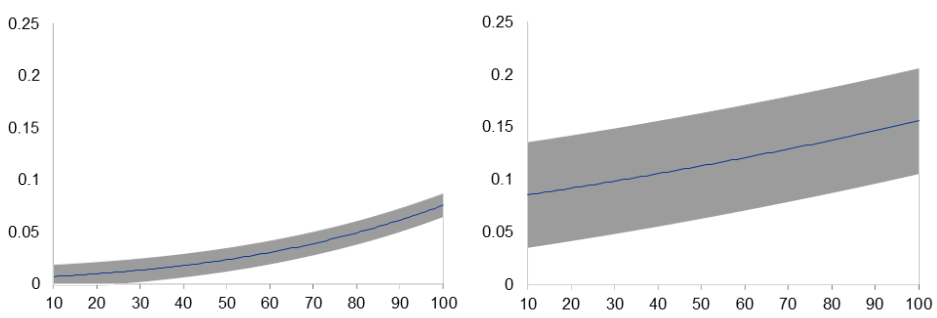
Chart 7

Probability of default for mortgage loans within different LTV at origination

Notes: The shaded areas represent two standard deviation bands. Chart shows estimated probability of being late or missed payments in loans during the last 12 months from the point of the survey. The X axis represent the levels of LTV at origination. Regression controls for: year when loan was granted, age, income, income squared, financial assets, financial assets squared, unemployed, education, current debt-service-to-income ratio, and loan rate.
Source: ECB staff calculations based on Encuesta Financiera de las Familias (EFF) and Survey of Household Income and Wealth (SHIW).

Panel A. Probability of default, Italy

Panel B. Probability of Default, Spain



[26] See Appendix 2 for the full probit results.

Even though the previous microscope view is very informative, it is a partial view on the effects of macroprudential regulation at the micro level because it does not consider the general equilibrium effects on the economy of implementing this regulation. In order to analyse these effects, we apply a more complex modelling framework to study the interaction of combinations of borrower-based measures and their impact on the resilience of banks and borrowers while accounting for macro-economic feedback effects. Specifically, we use the semi-structural, micro-macro integrated household balance sheet model of Gross et al. (2021). The model concludes that the resilience of households and banks improves notably as a result of implementing individual and joint borrower-based measures. The analysis looks at the gross resilience benefits of implementing these measures (improvement in credit risk), while accounting also for second round macro effects due to the credit constraining effects of policy limits. The analysis distinguishes the resilience benefits across income categories and finds that policies are more effective across lower income borrowers which are characterized by higher default risk.

The methodology integrates an empirical micro module simulating the unemployment status of borrowers and a semi-structural macro module (SVAR) into a dynamic household balance simulator to determine the impact on household and bank resilience of borrower-based measures, relative to a no-policy scenario. On the micro side, a logit model is used to determine the probability of staying employed and, when integrated with the aggregate unemployment paths from the macro module, simulate the employment status of household members. Macroeconomic forward paths for variables such as unemployment rate, wages, house prices, and interest rates are generated by country-specific SVAR models but can also be aligned with specific external scenario assumptions instead. A household balance sheet simulator combines the micro and macro inputs to determine the mortgage debt servicing capacity of households and detect defaults over a simulated 1-year horizon.

The impact of macroprudential policies is measured in terms of changes to resilience parameters, probability of default (PD), loss given default (LGD), and expected losses on bank mortgage portfolios, relative to a no-policy scenario. Credit constraints resulting from policy implementation are accounted for and identified as negative credit demand shocks which in turn depress house prices and employment in the short run. This short-run, negative macro shock usually results in a slight upward move in PDs and LGDs which, however, does not outweigh the initial reduction under the 1st round impact, thus resulting in a positive net benefit from the implementation of policies. The model uses data from the 3rd wave of the HFCS (mortgage loans originated over the 2014-17 period) to simulate household balance sheets forward and characterize the distribution of lending standards (LTV, DSTI and DTI) across a sample of 19 EU countries. The methodology considerably extends and enhances the model of Gross and Población (2017) and has also been implemented, with country-specific modifications, in a related policy analysis for Slovakia (Jurča et al. 2020).

Chart 8

Median PDs and LGDs after the 1st and 2nd round effects of borrower-based measures

Notes: The box plots reflect the median and 25th-75th percentile distribution across households' PDs and LGDs aggregated at the country level across the sample of countries. In each of the charts, the green bar and the respective median line refer to the PDs (LGDs) without borrower based measures in place (no policies), the dark blue bars and median lines refer to the 1st round impact of the policy tightening in terms of increase in resilience (reduction in PDs (LGDs)), separately for each policy instrument (LTV, DSTI, DTI) and also for their joint constraint. The light blue bars and median lines also account for 2nd round negative macroeconomic effects from the policy induced negative credit demand shock.
Source: Gross et al. (2021).
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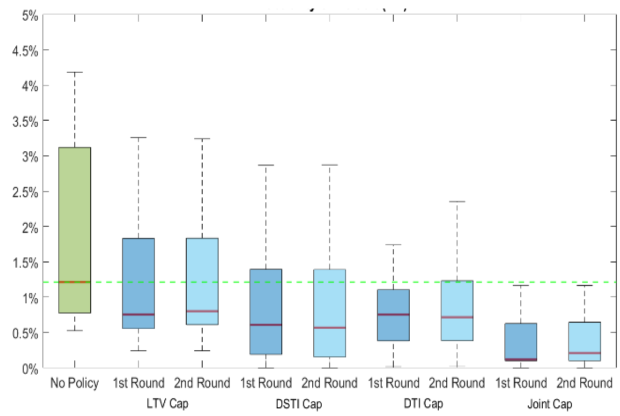
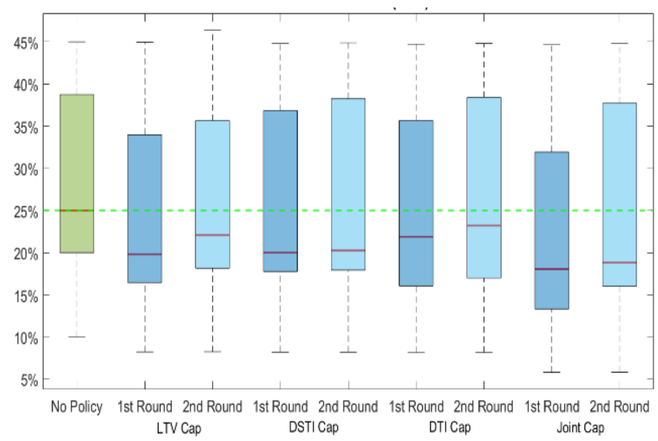
Panel A. Probability of Default (PD)



Panel B. Loss Given Default (LGD)

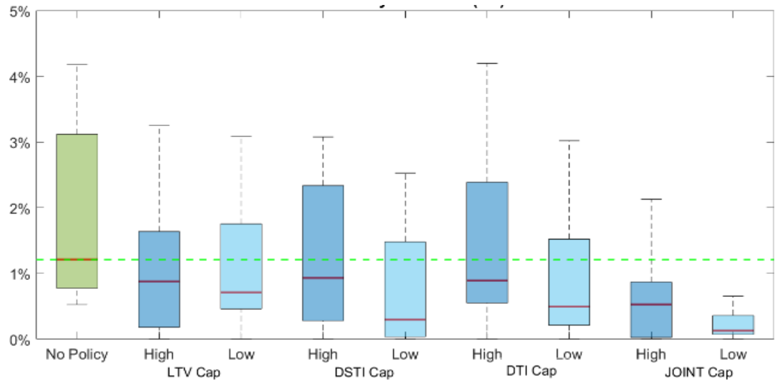


The results suggest that borrower-based measures can visibly enhance borrower resilience and support bank solvency ratios (Chart 8). Income-based policies (DSTI and DTI) improve resilience of borrowers and risk profile of mortgage exposures primarily through compressing PDs, while collateral-based policies exert their impact primarily through reducing LGDs. After accounting for macroeconomic feedback, the cross-country, cross-household median net improvement in PDs as a result of implementing income-based measures (DSTI or DTI) is about 50-60 bps relative to a no-policy baseline scenario. PDs drop by as much as 100 bps when considering the joint implementation of LTV, DSTI and DTI caps. Implementing collateral-based policies (LTV limits) results in a reduction in the median LGD of about 300 bps, and results are again stronger when considering the policies jointly.

Chart 9

The effectiveness of borrower-based measures across income groups

Notes: The box plots reflect the median and 25th-75th percentile distribution across households' PDs aggregated at the country level across the sample of countries. The green bar and the respective median line refer to the PDs without borrower based measures in place (no policies), the dark blue bars and median lines refer to the 2nd round (including macroeconomic feedback) impact of the policy tightening in terms of increased resilience (reduction in PDs) across the high income households, separately for each policy instrument (LTV, DSTI, DTI) and also for their joint constraint. The light blue bars and median lines refer to similar effects across low income households.
Source: Gross et al. (2021).

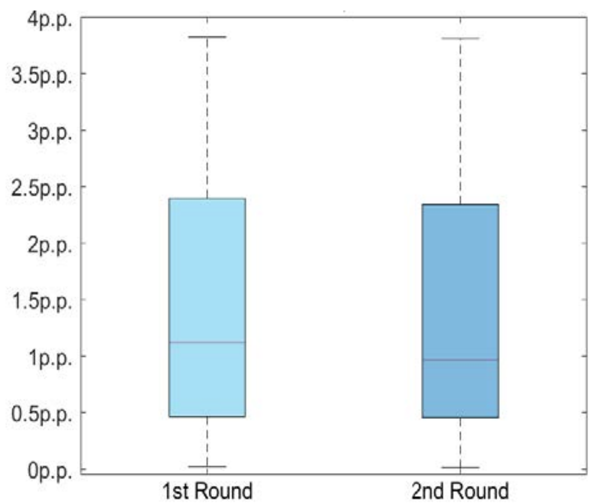


The analysis suggests that borrower-based measures are relatively more effective in containing the risks associated with lower income borrowers (Chart 9). The median reduction in the PD for borrowers below the income median is stronger, compared to higher income borrowers. This is associated with the fact that the borrowing of lower income households is often associated with higher (looser/riskier) lending standards. Importantly, for purposes of determining the impact of policy on resilience parameters, the model does not assume the exclusion of borrowers with lending standards above the regulatory caps from the market, but only a reduction of the size of the new mortgage loans to comply with the policy cap (referred to as "borrow at the cap").

Chart 10

Impact of borrower-based measures on banks' solvency positions

Notes: The plot reflects the median and 25th-75th percentile distribution of improvements in capital ratios across the banking systems in our sample resulting from the implementation of borrower-based measures. The overall improvement is a combination of a reduction in loan losses and a decrease in risk weighted assets resulting from the increased credit quality of mortgage portfolios (via lower PDs and LGDs). The light blue bar and median line refer to the 1st round impact under the joint policy caps (LTV and DSTI and DTI) while the dark blue bar and median line refer to a similar effect but now accounting for 2nd round macroeconomic impact via the negative credit demand shock.
Source: Gross et al. (2021).



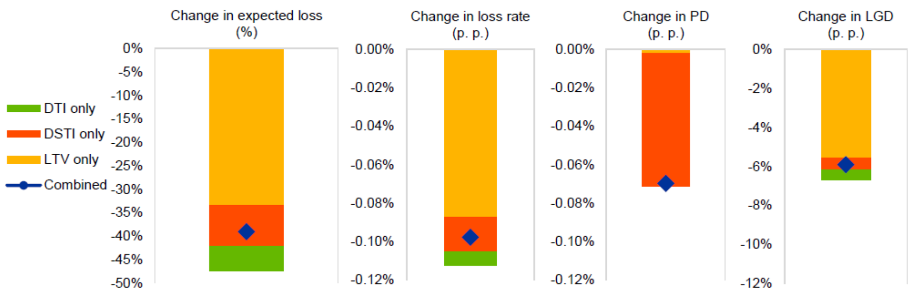
Borrower-based measures are found to increase the quality of bank mortgage portfolios over time and thereby support the capital position of banks (Chart 10). Assuming a 100% pass-through of the simulated PDs and LGDs into the regulatory credit risk parameters associated with the mortgage loan exposures of banks (that is, borrower-based measures have been implemented sufficiently early to allow the new mortgage loan flows to feed into more resilient loan stocks on banks' balance sheets), the median increase in the capital ratio across the 19 banking systems in the sample of countries is about 100 bps compared to a no policy scenario. This effect is partial in that the impact of policy measures translates into capital ratios only via mortgage portfolios. About 1/5th of the contribution to improved solvency results from the reduction in loan loss provisioning affecting the numerator of the capital adequacy ratio and the rest to the reduction in risk weighted assets as a result of the decreased credit risk parameters.

Chart 11

Increased resilience from borrower-based measures: the case of Slovakia

Relative Contributions of Borrower-based Measures to Increased Resilience under the Adverse Scenario

Notes: The chart indicates the joint policy impact in terms of reducing expected losses, loss rate and household PDs and LGDs over a 3-year adverse period. The effects are all decomposed into the separate contributions of the individual policy instruments. The decomposed impact does not always equal the joint impact, because some loans are affected by multiple limits at the same time, but the combined impact only reflects the limit with the most significant impact.
Source: Jurča et al. (2020).



A country-specific implementation to Slovakia, Jurča et al. (2020) confirms the key messages and highlights the specific contributions of different policy instruments to enhanced resilience (Chart 11). The country-specific analysis represents a deep dive into policies at the single country level and closely approximates the fully phased-in tightening of the borrower-based measures in Slovakia in 2018. The modular framework quantifies the change in the resilience of households and banks, resulting from the policy action under an adverse macroeconomic scenario. In addition to deriving results consistent with the cross-country analysis of Gross et al. (2021), the country-specific assessment looks in more depth at the complementarity of individual borrower-based measures and finds that the resilience gains are more sizeable if the measures limit the accumulation of risks before an economic downturn occurs.

The expected portfolio losses on new mortgage loans granted under the policy scenario decline by almost 40 percent by the end of the adverse horizon, resulting in a reduction of 10 basis points in terms of the mortgage portfolio loss rate. The results also confirm that the main losses stem from new loans granted during the exuberant period, before the simulated economic downturn.

In these country-specific simulations, the joint measures exert their impact primarily through changes in LGDs rather than PDs. The higher impact through the LGD channel stems from the fact that a larger proportion of borrowers in the sample are constrained by the LTV limit (in addition, the tightening of the LTV limit in Slovakia was the most significant relative to the other borrower-based instruments). In terms of relative effects, the results suggest that the LTV cap exerts its impact primarily via the LGD channel, while the DSTI works via the PD channel. The main contribution to the reduction of the overall expected loss is in the segment of loans previously granted with LTV above 90 percent, where the expected loss halves. Loans with an LTV below 80 percent experience only a small decline in expected losses. At the same time, the results indicate a higher contribution by the DTI to slowing down the growth of household indebtedness—via its impact on new mortgage lending volumes—compared to its impact on portfolio riskiness, in line with the original policy objective of the DTI measure. The impact of macroprudential measures on new mortgage lending is moderate.

The quantitative evidence provided so far clearly shows the financial stability benefits of macroprudential policies. The benefits stem from preventing the build-up of vulnerabilities and increasing the resilience of both borrowers and lenders. However, the jury is still open on whether macroprudential policy did enough to make the system more resilient before the recent Covid-19 pandemic and on whether the macroprudential policy response to it was effective (Box 1).

From a broader macroeconomic perspective, the analysis so far has quantified only the short-run negative effects on GDP growth. The increase in financial stability should have a positive effect on long term growth, otherwise it is difficult to justify why macroprudential policies should be implemented. This is the purpose of the following section.

Box 1
Macroprudential policy in the Single Supervisory Mechanism: Experience so far

Prepared by Marco Lo Duca, Mara Pirovano, and Eugen Tereanu

This box reviews the institutional setting and the experience to date of macroprudential policy in the euro area's Single Supervisory Mechanism.

The jury is still out on the effectiveness of macroprudential policy actions

The Single Supervisory Mechanism (SSM) Regulation disciplines macroprudential policy for countries in the SSM (currently all euro area countries) and for country in the so called "close cooperation" agreement (currently Croatia and Bulgaria). According to the SSM Regulation, macroprudential policy can be considered as shared responsibility between national authorities in the SSM area and the ECB (see e.g. ECB, 2019). The ECB assesses national macroprudential policy decisions (ECB has the right to object) and can potentially apply more stringent measures ("top up" power) in case of need. Shared powers between national authorities and ECB relate to instruments in the Capital Requirement Directive (CRD) and Capital Requirement Regulation (CRR) which translate into national and European law the Basel III capital framework. Shared powers mostly relate to capital measures while borrower-based measures are in the remit of national law and, therefore, a responsibility of national authorities.

As of end 2019, before the Covid pandemic, all countries in the SSM made use of macroprudential policy. Seven countries had positive Counter Cyclical Capital Buffer (CCyB) rates, five countries had a Systemic Risk Buffer (SyRB) in place, some countries applied more stringent risk weights to some type of exposures, all countries had buffers for systemic institutions. Finally, several countries applied borrower-based measures either in a legally binding fashion or in the form of comply or explain recommendations (ECB, 2019).

Since the start of the Pandemic macroprudential authorities in the euro area took actions in order to contain the risk of pro-cyclical financial amplification via bank de-leveraging. Specifically, macroprudential authorities made capital more useable to absorb losses and support lending by releasing several macroprudential capital buffers, including the Counter Cyclical Capital buffer (CCyB). In addition, some countries relaxed borrower-based measures in order to facilitate the access to credit to borrowers facing temporary income and liquidity shocks. These actions were complementary to microprudential measures by ECB Banking Supervision that made around 120 bn of bank capital available for the absorption of losses and to support lending. Finally, it is worth nothing that by making capital more usable, prudential measures overall facilitate the transmission of other policy measures in the response to the pandemic, as for example monetary policy.

Currently, the jury is still out on the effectiveness of the overall policy actions during the pandemic, including macroprudential measures. Crucially, to ensure a smooth credit supply, banks should be willing to use their capital buffers in case of need. However, impediments to buffer use might emerge. (ECB, 2020) First, there could be stigma effects for banks associated to declining capital ratios. Second, banks might be wary of difficulties in restoring capital ratios due to low profitability and high cost of equity in markets. Third, banks might be unwilling to use remaining regulatory capital buffers due to the restrictions associated with the use of them (e.g. limits to dividend distributions). Finally, other regulatory requirements, as for example the leverage, ratio, might imply that part of capital buffers are not usable.

While it is early to draw conclusions, an initial lesson for macroprudential policy from the pandemic relates to the desirability of a larger share of releasable capital buffers to respond to macroeconomic and financial shocks. A key capital buffer to address pro-cyclicality in the baking system, the CCyB was a only small fraction of the overall capital ratios in the SSM banking system when the pandemic started (ECB, 2019). This implied that macroprudential policy had little policy space to respond to shocks. While the relatively small CCyB at the start of the pandemic relate to the relatively moderated credit developments in the euro area since in the aftermath of the global financial crisis and to relatively strong build-up of microprudential capital buffers, the experience with the pandemic suggests that macroprudential space could also build up for precautionary reasons to respond to shocks that are exogenous to the financial system.

5 Financial stability and growth

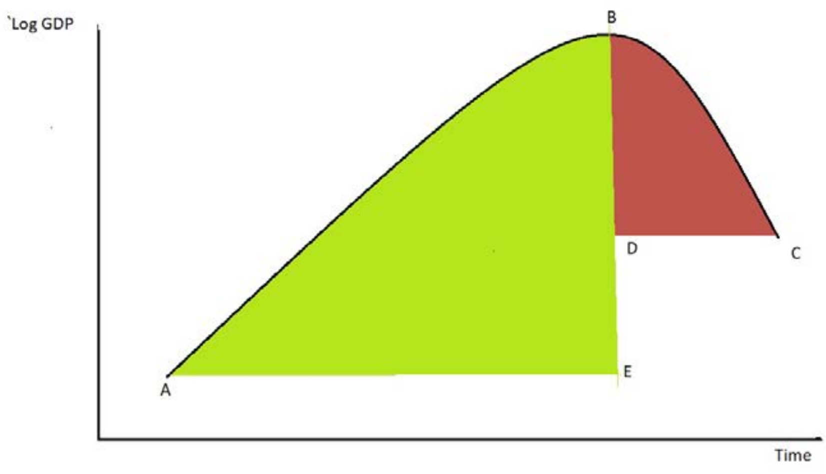
Episodes of rapid growth in credit tend to forecast recessions (e.g., Kaminsky and Reinhart (1999), Adrian et al (2020), and Gadea et al. (2020)). Moreover, containing vulnerabilities, by decreasing the deepness of recessions, has a positive effect on economic growth. However, financial deepening is positively associated with long term economic growth e.g., in Levine (2005). In addition, there is evidence that expansions not fuelled by an increase in credit result in below-average growth, Abiad et al. (2011).

Macroprudential tools are chiefly designed to curtail rapid growth in credit. However, how much containment of credit growth to avoid deep recessions is optimal, given its positive effects on the expansions? Gadea et al. (2020) analyse the effect of credit on the business cycle characteristics. They show that rapid credit expansions imply longer and deeper recessions, but the proportion of these periods in the economy is smaller than 20% of the observations. In order to understand the effects of credit on the business cycle, the effects on the expansions will be key, and after analysing this effect, the comparison with the negative effect on recessions will be necessary to measure properly benefits and costs. They propose a stylized business cycle, where every expansion if followed by a recession period following the scheme of Chart 12.

Chart 12

A stylized business cycle

Notes: The figure presents a stylized business cycle with the main features. The green block represents the expansion period, the red block represents the recession period. The solid line represents the evolution of Log GDP.
Source: Gadea, Laeven, and Perez-Quiros (2020).

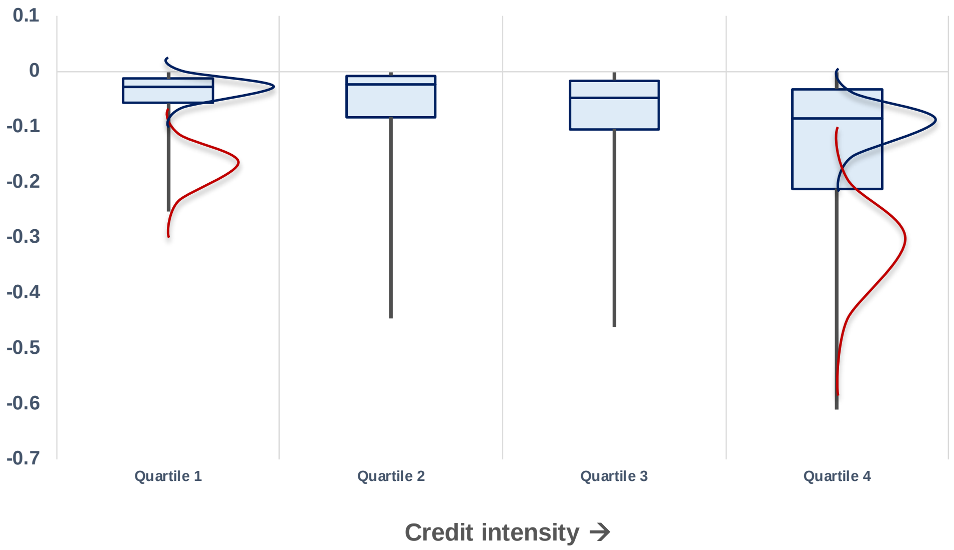


The chart contains the main ingredients to understand the effect of credit on business cycle. The green block represents the economy in an expansion and the red block represents the economy in a recession. The chart matches the main characteristics of business cycle as can be obtained by the empirical observations. Expansions are longer, on average, than recessions. The segment $\overline{AE}$ is bigger than $\overline{DC}$ and the amplitude of the expansions is also bigger than the amplitude of recessions, $\overline{BE}$ is bigger than $\overline{BD}$. Looking at the graph, it is easy to see the sufficient statistic that summarize the information about the characteristics of business cycle. The green shaded area represents the cumulation of the expansion periods. The cumulation represents the total gain in wealth associated with the expansion period. It is therefore the integral of the flow variable (GDP) during the expansion period. As can be seen in the figure, cumulation is related to duration and amplitude, but modified by the shape of the recession period. For the same argument, for the recession periods, we can also define cumulation, that will be the red area under the curve of GDP during the downturn of the economy. The benefits and cost of the business cycle will be the difference of the green minus the red area. The effects on credit on the business cycles are measured by how this difference change according to the level of credit.

Chart 13

Credit intensity and cumulation in recessions

Notes: The box plot graph represent the cumulation of every recession grouped by the quantile of the distribution of credit to GDP changes prior to the recession period. Numbers above represent the parameters of the mixture of normal distributions that approximate the distribution of the cumulation. Quartile 1 is low credit. Quartile 4 is high credit.
Source: Gadea, Laeven, and Perez-Quiros (2020).



Gadea et al (2020), using data from 53 countries for an unbalanced panel of quarterly data starting in 1947, find that, for recessions, the variation in credit to GDP on the two year before the recession starts has a non-linear relation with the size of the cumulation of the recession. They illustrate their results adjusting a mixture of normal distributions, showing that if the variation of credit belongs to the first quartile of the distribution of the data, with an 80% probability, the recession will imply a loss in wealth of 3% of GDP with a 80% probability, and a loss in wealth of 20% of GDP otherwise. On the contrary, being in the fourth quartile imply a loss in wealth of 6% in the mild scenario, which has a probability of 58% and a 42% probability of having a loss of -30%[27]. Chart 13 shows the relationship between credit intensity and cumulation in recessions, showing that stronger variation in credit is associated with deeper recessions.

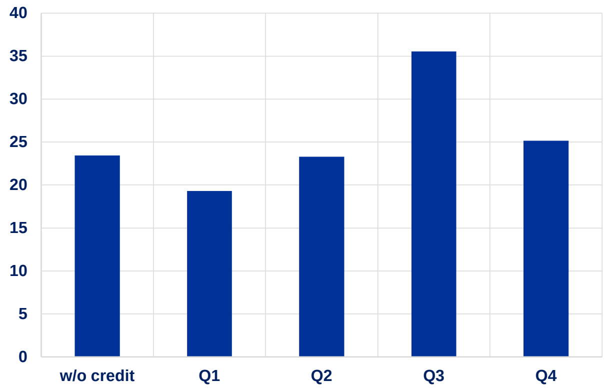
[27] The numbers presented in Gadea et al (2020) are somehow different but depends only on the inclusion or not of the atypical observations.

During the expansion periods, Gadea et al. (2020) finds a completely different channel of the relation between credit and cumulation: the duration of expansions depends on the intensity of credit during the expansion periods. In particular, they adjust a survival function, where credit intensity, measured as the variation in credit divided by the duration of expansion, is determinant to characterize the probability of an expansion ending. Obviously, different probabilities of recession ending imply different expected duration of the expansion periods. Chart 14 plots the results obtained by the survival model grouping the data by quartile of the distribution of data. As can be seen in the figure, on average, unconditional to the level of credit, the expected duration of an expansion is close to 25 quarters. If credit is low, expected duration is 18 quarters. This confirm the results of Abiad et al. (2011) on creditless recoveries. On the contrary, when expansion has been correctly fuelled by credit, the expansion on average around 35 quarters. This is almost double the expected duration that expansions not fuelled by credit, which implies that the gain in cumulation is more than four times the cumulation of the first quarter[28].

Chart 14

Credit intensity and expected duration of expansions

Notes: The box plot graph of the expected duration of expansions for every quartile of credit intensity. The first column represents the average duration, each of the other four columns represents the expected duration conditional to different levels of credit intensity.
Source: Gadea, Laeven, and Perez-Quiros (2020).



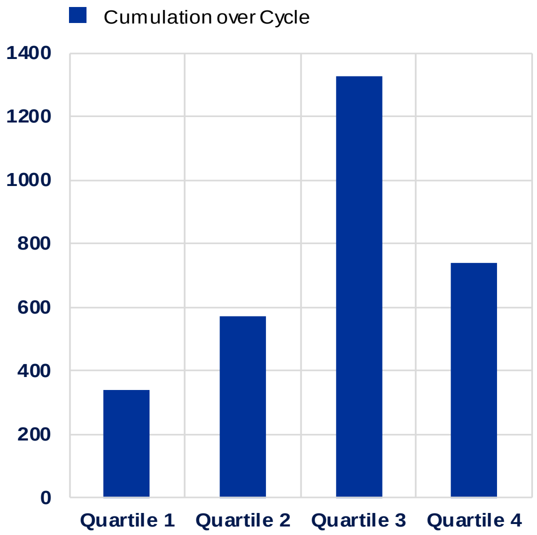
To finally address the relative important of the green area (cumulation in expansions) vs the red area (cumulation in recessions) and its relationship with credit, Gadea et al. (2020) compare the different areas according to different paths of credit. The results are displayed in Chart 15. As can be observed, variation in credit in the third quartile of the distribution implies the maximum amount of cumulation over the cycle. The increase in cumulation is related with a higher expected GDP growth due, basically to longer expansions that more than compensate the deeper recessions.

[28] The cumulation is related to the squared of duration. See details in Gadea et al (2020).

Chart 15

Cumulation over the cycle and credit

Notes: The box plot graph the expected cumulation over the cycle depending on the level of credit. The x axis represents each of the four quartiles of the distribution of credit.
Source: Gadea, Laeven, and Perez-Quiros (2020).



To sum up, the evidence presented in this section shows that there is a clear link between financial stability and economic growth. This relationship is non-linear. The implementation of monetary policy, often geared toward curtailing rapid credit growth, should account for this nonlinearity, striking the right balance between preventing dangerous credit booms while tolerating episodes of robust financial deepening.

6 Conclusion

There is clear evidence that macroprudential policies have an impact on financial stability. We find that macroprudential policies increase the resilience of banks and borrowers and can curb excessive credit growth when intended. Moreover, we show that financial stability has an impact on long term economic growth, both because it controls the deepness of the recessions but also influences the length of the expansions.

However, there are challenges to macroprudential policies. First, the jury is still open on whether macroprudential policy did enough to make the system more resilient prior to its first test case (i.e., the recent Covid-19 pandemic) and on whether the macroprudential policy response to it was effective. This raises important questions about whether existing frameworks and governance needs to be refined and improved. Second, the implementation of macroprudential policy going forward poses several challenges. There is a lack of clarity on the appropriateness of instruments, the interaction among instruments, and how such interactions can be internalised in macroprudential actions. There is also a need to further improve the quantitative approach to macroprudential policy calibration and measurement, including the measurement of the macroprudential stance, and there is a need to consider to what extent the boundary of macroprudential regulation must be extended to non-banks.

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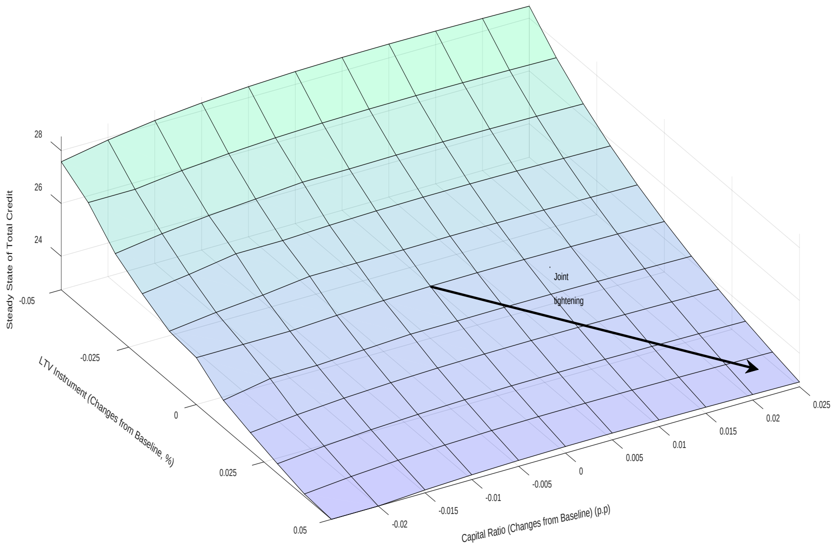
Annex 1. The interaction of capital- and borrower-based instruments

This section presents results related to the impact of the simultaneous activation of capital requirements and LTV limits in the 3D DSGE model of Clerc et al. (2015). The results presented below show how simultaneous changes in capital requirements and LTV limits affect the simulated first (Figure A1) and second moment (Figure A2) of total credit.

Chart A1

Steady state impact on total credit of jointly changing bank capital requirements and LTV limits

(y-axis: steady state of variable; x-axis: calibration of LTV (change from the baseline, %). Positive values represent a tightening of the LTV ratio, negative values represent a loosening. z-axis: calibration of capital requirements (change from the baseline, percentage points); positive values represent a tightening, negative values represent a loosening.

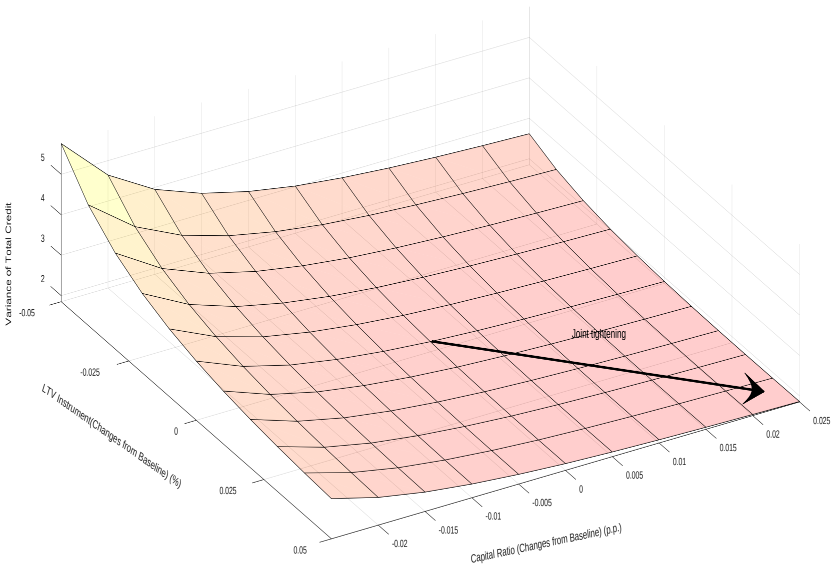


We find that LTV limits and capital requirements are complementary in reducing leverage in the economy. When the policymaker's objective is to affect the level of credit in the economy, LTV limits have a dominant role. Chart A1 shows that LTV limits lead to a reduction of total credit in the long-run, and the magnitude of the effect is similar for different calibrations of capital requirements. On the other hand, higher capital requirements result in a negligible effect on total credit. This is driven by two effects. First, the LTV regulation directly targets housing related credit, while capital regulation mainly addresses the moral hazard of bankers (i.e. the financial friction), affecting only one aspect of the lending contract. Second, and more importantly, the leverage of the banking sector changes in response to LTV regulation as well, thus acting as if the capital regulation would have been activated. However, negative synergies emerge in a loose LTV environment, where higher capital requirements increase total credit. This is because higher capital requirements lead to a shift from corporate loans to mortgage loans (carrying a lower risk weights). As borrowers are less constrained by the LTV limit, they can easily satisfy their demand for new mortgages, leading total credit to rise. Finally, a joint tightening from baseline, i.e. movement to the lower right-hand side on the surface, would reduce total credit by approximately 8%, of which 0,5% is due to capital and 7,5% is due to borrower-based measures.

Chart A2

Volatility at the steady state of total credit in response to shocks for different calibrations of capital requirements and LTV limits

(y-axis: steady state of variable; x-axis: calibration of LTV (change from the baseline, %). Positive values represent a tightening of the LTV ratio, negative values represent a loosening. z-axis: calibration of capital requirements (change from the baseline, percentage points); positive values represent a tightening, negative values represent a loosening.



LTV limits and capital requirements reinforce each other in reducing the volatility of total credit in response to shocks: A joint tightening of the instruments leads to a lower volatility of total credit (Chart A2). While capital requirements unequivocally reduce the volatility of total credit in the event of negative shocks (see Chart 3 in the main text), LTV limits are effective against shocks in the housing sector, however expose the economy to increase volatility in response to shocks related to the entrepreneurial sector (see Chart 4). By implementing both instruments simultaneously, the overall volatility of total credit is reduced, revealing a complementary effect of the two instruments. It is important to note the asymmetric effect of a joint tightening and a joint loosening. The volatility of total credit in the event of a joint loosening of both instruments increases by a greater amount than the decrease resulting from a joint tightening of the instruments.

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