INTERNATIONAL MONETARY FUND

MONETARY AND CAPITAL MARKETS; RESEARCH; AND STRATEGY, POLICY, AND REVIEW DEPARTMENTS

Macroprudential Policy Effects

Evidence and Open Questions

Prepared by Nina Biljanovska, Sophia Chen, Gaston Gelos, Deniz Igan, Maria Soledad Martinez Peria, Erlend Nier, and Fabián Valencia

DP/2023/002

2023
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Cataloging-in-Publication Data
IMF Library

Names: Biljanovska, Nina, author. | Chen, Sophia, 1980-., author. | Gelos, Gaston, author. | Igan, Deniz, author. | Martinez Peria, Maria Soledad, author. | Nier, Erlend, author. | Valencia, Fabián, author. | International Monetary Fund, publisher.

Title: Macroprudential policy effects : evidence and open questions / Prepared by Nina Biljanovska, Sophia Chen, Gaston Gelos, Deniz Igan, Maria Soledad Martinez Peria, Erlend Nier, and Fabián Valencia.

Other titles: Evidence and open questions. | International Monetary Fund. Monetary and Capital Markets Department (Series) | International Monetary Fund. Strategy, Policy, and Review Department (Series)

Description: Washington, DC : International Monetary Fund, 2023. | March. 2023. | DP/2023/002. | Includes bibliographical references.

Identifiers:

9798400226304 (paper)
9798400226595 (ePub)
9798400227134 (WebPDF)

Subjects: LCSH: Macroeconomics. | Economic policy.

Classification: LCC HD87.B5 2023

This departmental paper was prepared under the guidance of Martin Čihák, Giovanni Dell'Ariccia, Christopher Erceg, and Kenneth Kang. The authors thank Tobias Adrian, David Florian Hoyle, Pierre-Olivier Gourinchas, Mariusz Jarmuzek, Phousnith Khay, Tetsuo Kurosaki, Pablo Morra, Laura Papi, Ceyla Pazarbasioglu, Roberto Perrelli, Marcos Poplawski-Ribeiro, Silvia Sgherri, Laura Valderrama, Hou Wang, and Yingbin Xiao for their comments and suggestions; Yang Liu and Chau Nguyen for excellent research assistance; and Daniela Rojas and Phyo Zin for their excellent administrative support.

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Executive Summary

The global financial crisis (GFC) underscored the need for additional policy tools to safeguard financial stability and ultimately macroeconomic stability. Systemic financial vulnerabilities had developed under a seemingly tranquil macroeconomic surface of low inflation and small output gaps. This challenged the precrisis view that achieving these traditional policy targets was a sufficient condition for macroeconomic stability. Thus, new tools had to be deployed to target specific financial vulnerabilities and to build buffers to cushion adverse aggregate shocks, while allowing traditional policy levers, including monetary and micro-prudential policies to focus on their traditional roles. Macroprudential policy measures emerged as the solution to this gap.

Some of these measures had been used before the GFC (mostly in emerging markets). But it was only after the crisis that they were more widely adopted, and the toolkit expanded. This spurred a growing body of empirical research on the effects and potential shortfalls of these measures, with a further deepening of this knowledge gaining importance as policymakers confront increased financial stability risks in the post-pandemic world. Recognizing that there still is much to learn, this paper takes stock of our expanding understanding about the effects (and side effects) of macroprudential measures by focusing on the following broad questions.

What have we learned about the effects of macroprudential policy in containing the buildup of vulnerabilities? Existing evidence supports their effectiveness in containing the growth of credit and residential real estate prices. Relatively stronger effects from micro-level data and for sectoral and borrower-based tools (for example, housing) underscore the usefulness of these tools in targeting specific vulnerabilities.

What do we know about the effects on economic activity and resilience? Overall, the evidence supports the notion that macroprudential policy can be used as a "surgical" tool that effectively limits specific vulnerabilities without major side effects on economic activity. In particular, the evidence points to small adverse effects on economic activity in the near term, which should lessen policymakers' concerns about immediate tradeoffs between preserving financial stability and growth. The evidence also suggests that macroprudential policy can strengthen the resilience of economies to external and domestic financial shocks, lowering risks of output declines and output volatility over the medium term.

How do policy effects vary with conditions and over time? Policy effects often involve non-linearities. The evidence points to diminishing marginal benefits, as tightening beyond certain thresholds becomes costly. Early evidence not differentiating across tools also indicates stronger effects for tightening than for loosening measures, and during the buildup phase of the financial cycle. However, the evidence from the COVID-19 experience points to the value of macroprudential bank capital buffers that can be relaxed in periods of stress. Moreover, the resilience-building effects of macroprudential policy appear to persist, rather than wane over time.

How important are leakages and circumvention? Macroprudential tools are subject to domestic and cross-border leakages, with credit substitution by nonbanks and from across the border. Effective regulation of nonbanks is needed to complement macroprudential actions operating through the banking system. Similarly, effective capital flow management measures (CFM) used in tandem with macroprudential measures can help reduce cross-border leakages.

How do the effects on credit depend on other policies? In emerging markets, monetary policy, foreign exchange intervention, and macroprudential policies appear to have mutually reinforcing effects in moderating credit growth—particularly when credit growth is already high. By contrast, the authors' evidence suggests the lack of such reinforcing effects in advanced economies.

Further research and operational guidance could better support policymakers in their use of macroprudential policies going forward. Additional research is needed on the role of macroprudential policy in strengthening the resilience of the financial system and the interaction of macroprudential measures with other policies. Better and more granular data and analysis (by tool) on macroprudential policy actions could help quantify the effects of different tools more precisely and allow policymakers to improve the calibration of these tools. Most of the evidence reviewed in this paper focuses on macroprudential measures imposed on banks and their borrowers. Looking forward, new frontiers of macroprudential policy lie in containing systemic risks stemming from nonbank financial intermediation, as well as from crypto assets and digital money.

Acronyms and Abbreviations

BCBS	Basel Committee on Bank Supervision
BIS	Bank for International Settlements
CCyB	Countercyclical Capital Buffer
CDS	Credit Default Swap
CET1	Common Equity Tier 1
CFM	Capital Flow Management Measure
DSTI	Debt Service-to-Income
EMDE	Emerging Markets and Developing Economies
FSB	Financial Stability Board
FXI	Foreign Exchange Intervention
GFC	Global Financial Crisis
iMaPP	Integrated Macroprudential Policy Database
IMF	International Monetary Fund
IPF	Integrated Policy Framework
IPW	Inverse Propensity-Score Weighted
IPWRA	Inverse Probability Weighted Regression-Adjusted
LCR	Liquidity Coverage Ratio
LFC	Limits on Foreign-Currency Loans
LLP	Loan Loss Provisions Requirements
LTI	Loan-to-Income
LTV	Loan-to-Value
MPM	Macroprudential Policy Measure
NSFR	Net Stable Funding Ratio
OECD	Organisation for Economic Co-operation and Development
O-SII	Other Systemically Important Institution
RR	Reserve Requirement
WEO	World Economic Outlook Database

Introduction

Macroprudential policy is still relatively new. While many emerging economies had been using macroprudential policy tools for some time, their use to safeguard financial stability was embraced more widely only in response to the global financial crisis (GFC). Since then, many countries established dedicated decision-making frameworks (Nier and others 2011, IMF-FSB-BIS 2016); introduced a framework for using a "countercyclical capital buffer" (CCyB) above prudential minimums; and developed borrower-based tools to contain vulnerabilities in the household sector, such as caps on loan-to-value (LTV), loan-to-income (LTI), and debt-service-to-income (DSTI) ratios (Alam and others 2019). Commonly accepted tools to improve banks' resilience to liquidity shocks, such as the liquidity coverage ratio (LCR) and net stable funding ratio (NSFR), were phased in only recently as part of the Basel Committee for Bank Supervision (BCBS) reform package (BCBS 2013).

Greater use of macroprudential policy after the GFC has spawned a rapidly growing body of empirical research. Just after the GFC, limited experience with the use of macroprudential tools meant that very little was known about how they would foster greater financial stability (IMF 2013). However, greater use since then has enabled a large body of empirical research on their effects, aided by the establishment of comprehensive databases, such as the integrated macroprudential policy database (Alam and others 2019) and the IMF's annual Macroprudential Policy (MP) Survey (IMF 2018).

The COVID-19 shock has been an important test of postcrisis reforms but has also created new vulnerabilities and policy challenges. While most countries were activating and tightening the new tools since the GFC, the COVID-19 shock presented a first test of the benefits of a stronger use of macroprudential policy tools, including the ability to relax tools in order to support the provision of credit through downturn conditions (Nier, Olafsson, and Rollinson 2020, Bergant and Forbes 2021, Kirti and others 2022). Overall, the consensus is that financial sector reform since the GFC, including the use of macroprudential policy levers, has helped the banking system to emerge resilient to the stresses from the crisis (BCBS 2021). However, the pandemic has also led to the build-up of new financial and economic vulnerabilities. A sharp increase in real estate prices may have contributed to rising debt levels in several countries. Rising inflation, exacerbated by the war in Ukraine, is leading to a steep tightening of monetary policy, which may come to stress private sector balance sheets. These developments may pose new challenges to the conduct of macroprudential policy, underscoring the importance of a fuller understanding of its effects and its contribution to the overall policy mix to achieve macroeconomic stability.

This paper takes stock of our expanding understanding about the effects and side effects of macroprudential measures. The authors summarize what we know on the effects of macroprudential policy on credit and asset prices drawing from a meta-analysis of empirical research (Araujo and others 2020). The authors then lay out what they are learning from a recently growing literature on the effects on output, on their temporal patterns, as well as on nonlinear, and unintended effects of macroprudential tools, pointing to areas where further work is needed to firm up results. The authors finally present new analysis on the interaction of macroprudential policy with other policy levers, an area where research has been limited. This is one key addition relative to other reviews (Galati and Moessner 2018, Forbes 2019, Araujo and others 2020), which contributes also to the IMF's agenda on an integrated policy framework (IMF 2020). More specifically, this paper addresses the following questions:

- What have we learned about the effects of macroprudential tools in containing the buildup of vulnerabilities?
- What do we know about the effects on economic activity and resilience?

- How do policy effects vary with conditions and over time?
- How important are leakages and circumvention?
- How do the effects on credit depend on other policies?

Based on a meta-analysis of empirical research, the authors find strong support for the effectiveness of macroprudential policy. Findings underscore the notion that macroprudential policy can be effective as a "surgical" tool to tackle specific macro-financial vulnerabilities. Another piece of good news for policy-makers is that the adverse side effects on output and consumption appear relatively modest.

Moreover, growing evidence points to the resilience-building effects of macroprudential policy. The evidence is that these benefits hold up through time, especially for borrower-based tools, suggesting that preemptive use of such policies can have lasting benefits in containing downside risks to growth. Moreover, the experience with releasing capital buffers during the COVID-19 shock suggests that such a release can help cushion the effect of adverse shocks on the supply of credit, supporting the notion that accumulating positive neutral buffers in normal times can increase resilience.

However, macroprudential policies also have their limits. For example, they seem to have decreasing marginal returns. And there is growing evidence of policy leakage to nonbanks as well as across borders, which can require a broadening of the scope of the policy approach. Moreover, asymmetries seem to be important. Early evidence not differentiating across tools suggests that tightening macroprudential policies may have stronger effects on credit than loosening them.

As for interactions with other policies, the evidence is mixed. In emerging markets, monetary policy, foreign exchange (FX) intervention, and macroprudential policies appear to have mutually reinforcing effects on credit. By contrast, such reinforcing effects seem to be less important in advanced economies, in that the marginal effect on credit of one policy is not much affected by the policy settings of another.

More evidence is needed in various areas to better support policymakers in their use of macroprudential policies. These areas include, inter alia, the role of macroprudential policy in strengthening the resilience of the financial system, and the interaction of macroprudential measures with other policies. Continued efforts to explore new methods, and to enhance data quality and granularity on macroprudential policy changes are needed to better quantify effects and better calibrate the range of macroprudential policy tools.

The rest of the paper is organized as follows. Chapter 2 presents the conceptual framework for readers to think about the objectives of macroprudential policy. Chapter 3 summarizes what we know about the effects of macroprudential measures on its immediate targets. Chapter 4 discusses the evidence on the effects of macroprudential policy on economic activity and focuses on nonlinear, leakages, and dynamic effects. Chapter 5 presents new evidence on how macroprudential policy interacts with other policies. Finally, Chapter 6 concludes.

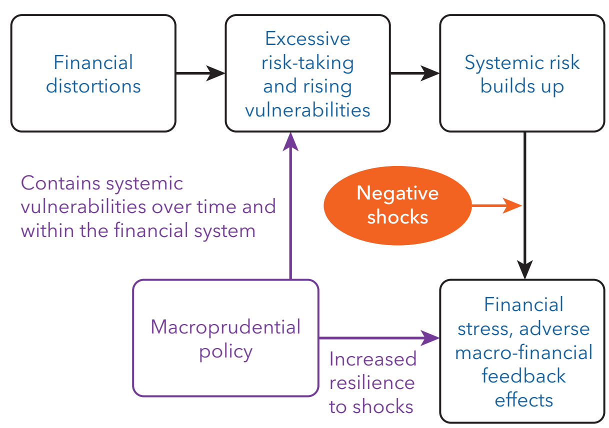
1. Conceptual Framework

The objective of macroprudential policy is to manage tail risks to output by containing systemic financial risk. Systemic financial risk is the risk of widespread disruption to the provision of financial services that is caused by an impairment of all or parts of the financial system, which can lead to serious negative consequences for the real economy (IMF 2013, IMF-FSB-BIS 2016).

The economic rationale for macroprudential policy is anchored on the presence of a range of financial distortions and externalities. Asymmetric information, limited enforcement of contracts, and other forms of market incompleteness have been shown to encourage private agents to take excessive risks, leading to the buildup of systemic vulnerabilities, especially under easy financial conditions. Additional factors, such as strategic complementarities—mutually reinforcing private agents' decisions—and interconnectedness among financial institutions can further exacerbate risk-taking incentives and financial vulnerabilities (for example, Farhi and Tirole 2012, Acemoglu 2015, Farhi and Werning 2016, Davila and Korinek 2018, Mendoza 2018).[1] In aggregate, such effects then give rise to systemic externalities, providing a rationale for policy intervention through macroprudential policies (IMF 2013).

In the presence of these financial vulnerabilities, negative shocks from within or outside the financial system can be amplified, affecting the real economy. Binding borrowing constraints can lead to asset fire sales and defaults on contractual obligations, disruptions in the provision of financial services, and ultimately a significant contraction in economic activity. Therefore, macroprudential policy achieves its ultimate objective by containing or "leaning" against the buildup of systemic financial vulnerabilities ex ante before negative shocks materialize and ensuring the "resilience" of the financial system ex post following the realization of negative shocks (Figure 1). Recognizing that some of these measures may entail costs and side effects, macroprudential policy settings are ideally adjusted according to financial and economic conditions, so as to smooth the provision of credit while avoiding an unnecessary burden on the economy.

Figure 1. Macroprudential Policy Objectives



Source: IMF 2021.

The "leaning" goal has to do with reducing the force of macro-financial feedback mechanisms ex ante, as vulnerabilities are building. A prime example is procyclical feedback between asset prices and credit. Rising asset prices inflate collateral values and relax borrowing constraints. A stronger flow of credit, in turn, can impart momentum to rising asset prices. Macroprudential tools, such as restrictions on loan-to-value (LTV) or loan-to income ratios (LTI) can help to avoid a stretching of balance sheets, thereby reducing this feedback (for example, Biljanovska, Gornicka, and Vardoulakis 2019). A variety of macroprudential tools have been developed to target specific vulnerabilities (IMF 2014a, 2014b), ranging from tools such as CCyB to address broad-based vulnerabilities (for example, generalized credit booms)

[1] The theoretical literature in this area has grown significantly since the GFC. In addition to the examples cited above, infinite-horizon DSGE models with richer characterizations of real-financial linkages are now common. These addressed the shortcomings of the lack of financial frictions prevailing in DSGE models developed prior to the GFC (for example, Gertler and Kiyotaki 2010, Aoki, Benigno, and Kiyotaki 2018).

sectoral tools such as limits to LTV and LTI ratios (e.g. housing sector) liquidity and currency risks tools such as LCRs and limits to open positions in foreign exchange, as well as structural tools such as capital surcharges for systemically important institutions.

The "resilience" goal is about reducing the force of macro-financial feedback mechanisms ex post, after adverse shocks materialize. If these shocks erode bank capital positions or create funding pressures for banks, a credit crunch may ensue with negative consequences for economic activity. These repercussions can be more severe if banks default and the system is highly interconnected. Macroprudential intervention to increase banks' buffers helps them absorb losses and contain or avoid such defaults, or it can limit interconnectedness to reduce the systemic impact of stress.[2] Similar macro-financial feedback effects can work through the behavior of borrowers who may be forced to default in response to adverse shocks or to curtail consumption and investment, then weakening economic activity, and raising financial fragilities in the economy more broadly. Borrower-based tools, such as caps on LTV, LTI, and DSTI limits, can increase the resilience of borrowers and blunt these feedback effects (for example, New Zealand, Sweden, United Kingdom).[3,4]

[2] The "leaning" and "resilience" goals are interrelated and should not be seen as two independent objectives for macroprudential policy.

[3] The Bank of England, among other macroprudential authorities, is known to pay attention to this "borrower resilience" channel. According to its December 2021 Financial Stability Report, the evidence from previous recessions is that highly indebted households are more likely to cut spending sharply. In the past, this has amplified downturns, increasing the risk of losses to lenders on all forms of lending and reducing incomes throughout the economy. Borrower-based tools then have a role both in dampening the build-up of leverage, and, in the event of an adverse shock, limiting defaults and reducing the potential for a cut-back in spending.

[4] Some voices have taken issue with this rationale and emphasize the economic costs and distortions from the use of borrower based tool, see, for example, Svensson 2019.

2. What We Know About the Effects of Macroprudential Policy

Extensive evidence supports macroprudential policy's role in containing vulnerabilities ex ante, particularly in slowing growth in credit and real estate prices. A recent meta-analysis of the empirical literature on macroprudential policy, conducted by IMF staff (Araujo and others 2020), covering 6000+ estimates and about 60 studies, finds that the focus of the literature has been largely on the effects on outcome variables that can be deemed as intermediate targets for macroprudential policy or are related to its ex ante role in containing the buildup of vulnerabilities (that is, releated to "leaning"). Of these, the most studied are credit growth, household leverage, and residential real estate prices. This attention to credit growth and real estate prices is not surprising, given the consistent finding in the literature that increases in these variables make crises more likely (for example, Sufi and Taylor 2021).

Although many tools appear to be effective, estimating their effects with precision is challenging. While there is significant heterogeneity across studies, on average, a wide range of macroprudential policy tools have been found to be statistically significant in containing the growth of (total and household) credit and residential real estate prices (Figure 2; Araujo and others 2020).[5] Moreover, as might be expected, broad-based tools placed on financial institutions (such as capital and provisioning requirements) as well as liquidity tools (such as reserves requirements) appear to have relatively strong effects on total credit growth, while borrower-based tools, which are often housing-related, appear relatively more successful in affecting the flow of household credit. But many results are statistically insignificant, partly due to imprecise measurement of macroprudential policy actions in the data (that is, typically missing the intensive margin or size of policy adjustment), endogeneity problems (Box 1), and limited statistical power in studies with aggregate data.

On average, studies based on micro-level data suggest much larger effects of macroprudential policy than those based on aggregate data. The economic explanation of this difference is that the effects detected in aggregate data reflect the average impact of macroprudential policy on all individuals or institutions, some of whom are, and others are not constrained by the macroprudential policy action (for example, wealthy households are less likely to be constrained by LTV limits). In contrast, the focus of micro studies is often on constrained or near-constrained agents, where the effects are expected to be larger. The statistical explanation is that studies on micro data have more power and may be less subject to reverse causality problems—which tend to bias results towards finding no effects because these tools may be used precisely when credit growth is accelerating, as discussed in Box 1.

The difference in magnitudes between studies based on micro and macro data is largest for liquidity and housing-sector related tools. Table 1 shows the average effects across studies examining the effect of tightening macroprudential policy by type of instrument (Araujo and others 2020). For example, column (1) shows that, on average, the tightening of broad-based tools leads to a decline in total credit growth of 0.056 standard deviations. Looking at studies using micro data only, the largest negative effect on credit is measured for a tightening of housing tools (at –0.192 standard deviations of credit), followed by the tightening of liquidity tools (at –0.13 standard deviations) and with a tightening of broad-based capital tools showing the weakest effects on credit (at –0.045 standard deviations).

[5] The effects on credit, however, are only one dimension. Judging the overall effectiveness of macroprudential policies also requires looking at its effects on resilience and its unintended consequences.

Figure 2. Fraction of Statistically Significant Coefficients

Source: Araujo and others 2020.
Note: The percentage at the top of each bar represents the share of statistically significant coefficients—at the 10 percent level or higher—for each category of coefficients in Araujo and others (2020)'s database. The number of studies from which the coefficients were collected is shown in parenthesis. The *x*-axis' labels denote: loan-to-value limits (LTV); debt service-to-income limits (DSTI); capital requirements/risk weights (CR and CR_HH if specific to housing); taxes and levies (TAX and TAX_HH if specific to housing); loan loss provisioning requirements (LLP); limits on foreign-currency loans (LFC); reserve requirements (RR); index measures constructed with: housing tools only (i_housing); non-housing tools only (i_non_housing); both (i_general).

Table 1. Average Effects of Tightening Macroprudential Tools

	Average Effects on Credit (In standard deviations)		
Type of Macroprudential Tool	(1) All	(2) Micro Data	(3) Macro Data
Broad based	−0.056*** (0.007)	−0.045** (0.018)	−0.032* (0.015)
Housing	−0.045*** (0.011)	−0.192*** (0.009)	−0.039*** (0.009)
Liquidity & Other	−0.129*** (0.009)	−0.130*** (0.007)	−0.030*** (0.009)

Source: Araujo and others (2020).

Note: The table reports the average effects of tightening macroprudential measures on credit (including credit to households) obtained through weighted least squares regressions where the weights are proportional to the precision of each result. The dependent variable in such regressions is the coefficients collected by Araujo and others (2020) from studies where the macroprudential policy is measured through −1,0,1 dummy variable at a horizon of up to one year, normalized by the standard deviation of the outcome variable (in this case total bank credit or transformations of it) and the regressors include dummy variables to identify the type of macroprudential policy, and compute the average effects. All averages reported in the table control for journal quality, publication bias, and whether the specific coefficient was taken from the most complete specification within each paper, in addition, the standard errors are clustered at the study level and reported in parentheses. Column (1) depicts the average across the entire sample; Column (2) restricts the sample to studies where the unit of measurement is at the micro level (i.e., bank, firm, loan); and Column (3) restricts the sample to studies based on aggregate, macro-level data. * significance at 10%; ** at 5%; *** at 1%.

Some evidence suggests slower balance sheet expansion and lower funding cost advantages for systemically important institutions in response to the implementation of structural tools. Very few studies have measured the effects of structural tools in isolation, resulting in limited evidence to be summarized systematically through the meta-analysis. However, there is evidence of some slowdown in balance sheet expansion for systemically important institutions after the announcement of prudential rules (that is, O-SII rules in euro area countries) or the designation as a global systemically important bank (for example, Violon, Durant, and Toader 2020, Grodzicki and Jarmuzek 2021). Furthermore, the too-big-to-fail reforms implemented since 2012 appear to have contributed to a reduction in the funding cost advantages of systemically important banks, although these remain higher than before the GFC (FSB 2021).

Box 1. Empirical Challenges—Endogeneity of Macroprudential Policy

A well-known challenge in the estimation of the effects of macroprudential policy is endogeneity. This problem can manifest itself in at least two ways. First, if macroprudential actions are taken when vulnerabilities are rising (for example, credit is booming), this effect per se will induce a positive association between macroprudential policy tightening and the growth of vulnerabilities. The effect would therefore yield an attenuation bias, underestimating the true effect of macroprudential policies in reducing vulnerabilities. Alternatively, if, because of inertia, macroprudential actions are taken typically at the peak of a financial cycle (before, say, credit growth starts falling), this would yield an overestimation of the effects of macroprudential policy.

Addressing this problem econometrically is important but challenging. Initially, most studies used lagged macroprudential indicators, a strategy that relies on strong assumptions (see, for example, Bellemare, Masaki, and Pepinsky 2017). Examples of papers using this approach (sometimes complemented by GMM techniques) include Claessens, Ghosh, and Mihet (2013), Zhang and Zoli (2014), Cerutti, Claessens, and Laeven (2015), and Akinci and Olmstead-Rumsey (2018), among others. A few have instead used event study analyses (for example, Aiyar, Calomiris, and Wieladek 2014), but clean-cut events are rarely available.

Various studies have sought to exploit cross-sectional heterogeneity in micro data to identify causal effects, following similar approaches in the monetary policy literature (for example, Kashyap and Stein 2000, Jiménez and others 2012, 2014). Examples include Claessens, Ghosh, and Mihet (2013), Altunbas and others (2018), and Morgan and others (2019) who use bank-level balance-sheet data to assess the response to different macroprudential policies. Meeks (2017) uses confidential information on bank-specific changes in microprudential bank capital requirements that are unrelated to macroeconomic conditions from the United Kingdom to assess the macroeconomic impact of such changes. Some studies have also used household data. Nier and others (2019) provide empirical evidence to support the calibration of debt-service-to-income (DSTI) ratios. Gross and Población (2017) use household finance- and consumption data from seven countries to compare the effectiveness of DSTI- versus LTV caps. Ayyagari and others (2018) study the impact of the adoption of macroprudential policies on credit to 900,000 firms from 48 countries.

Some of the studies use credit-registry information with matched borrower and lender data, to disentangle loan demand from loan supply shocks (as pioneered by Khwaja and Mian, 2008). Examples of recent studies using such detailed microdata include Aguirre and Repetto (2017), Jiménez and others (2017), Epure and others (2018), Acharya and others (2020), Peydro and others (2020), the studies covered in Gambacorta and Murcia (2020) and Gómez and others (forthcoming). One limitation of these approaches relying on microdata is that the results can be very particular to the specific segments of the economy examined, limiting inference on economywide effects.

Other studies have instead relied on surveys. Fuster and Zafar (2014) design a survey to measure the impact of changes in macroprudential and monetary policy on households' willingness to pay, circumventing the issue of exogeneity of macroprudential policies. Igan and Kang (2011) use survey data in Korea and find that lower expectation of house prices after policy intervention leads to postponement of plans to buy property, particularly by the households who already own one.

Some recent studies use propensity score matching, which entails comparing outcomes in countries that have taken macroprudential policy measures with those of similar countries that did not change policies. Forbes and Klein (2015) use this method to assess the effects of macroprudential and capital

Box 1. Empirical Challenges—Endogeneity of Macroprudential Policy *(continued)*

flow management measures. Alam and others (2019) employ an inverse propensity-score weighted estimator to assess the impact of LTV ratios on household credit growth and consumption. Cizel and others (2019) use similar techniques to investigate leakage to nonbank credit in response to macroprudential actions. A challenge with this approach is identifying good control groups, which is often difficult because of data limitations.

Some studies have sought to identify exogenous macroprudential measures through a narrative approach following earlier uses in the monetary and fiscal policy literature (for example, Friedman and Schwartz 1963, Romer and Romer 1989, 2007). By studying contemporary primary sources, such as policymakers' stated intentions at the time of policy decisions, the narrative approach aims to identify macroprudential policy actions that are exogenous with respect to current and lagged real variables. For example, Richter, Schularick, and Shim (2019) drop all policy actions that appear to have been motivated by real economy objectives. Rojas, Vegh, and Vuletin (2020) use a similar approach to identify the macroeconomic effects of reserve requirements in Argentina, Brazil, and Uruguay. Further examples include Klingelhöfer and Sun (2019), Budnik and Rünstler (2020), Fernandez-Gallardo and Paya (2020), and Meuleman and Vander Vennet (2020). However, clearly distinguishing between motivations driving the adoption of macroprudential policies is often difficult, and this method does not identify unanticipated measures.

Lastly, various recent studies have used measures of "policy surprises" as deviation from estimated policy rules drawing on the literature in fiscal policy (Auerbach and Gorodnichenko 2013). Examples include Cizel and others (2019), Brandao-Marques and others (2020), Nier, Olafsson, and Rollinson (2020), Ahnert and others (2021), and Gelos and others (2022). Advantages of this approach include its transparency and the fact that it can be implemented readily for many measures. The challenge is to obtain a good fit in the first stage, while retaining sufficient variation in the obtained "policy surprises" for a precise estimation of their effects.

3. What We Are Learning About the Costs and Benefits of Macroprudential Policy for Economic Activity

An emerging literature goes beyond the effects of macroprudential policy on its immediate targets and studies its ultimate effects on real economic activity. This includes near-term costs to output that may arise when macroprudential policy constrains financial and economic activity. But it also includes an investigation of the "resilience benefit" of macroprudential policy discussed above, that would blunt macro-financial amplification of adverse shocks. Building on this, the literature has pioneered the study of the effects on the distribution of future output—that is, examining whether macroprudential policy can be successful in reducing tail risks to output growth.

A. Near-Term Costs to Output

Overall, the near-term negative impact of macroprudential policy on economic activity appears small, supporting the notion of macroprudential policies as an efficient "surgical" tool. Evidence does point to statistically significant negative effects on economic activity in the near term, proxied by a range of indicators (Araujo and others 2020). But the average effects appear small—0.004 standard deviations of output from tightening macroprudential policy measured by broad composite indices—comprising tools across all types. This near-term negative effect is consistent with macroprudential policy's effect in reducing boom-bust cycles and ultimately lowering output volatility in the long term.[6]

The costs of additional capital and liquidity buffers are modest in the short term and might yield output benefits in the long term. A growing literature finds that higher capital buffers may ultimately lead to an increase in the provision of credit, thereby boosting output, once the system has been able to adjust to those buffer requirements (for example, Gambacorta and Shin 2016, Bahaj and Malherbe 2020). However, procyclical effects on output can arise in the short term and can be expected to be stronger if the implementation of buffers does not allow for a gradual phase-in (BIS 2010; IMF 2012; Imbierowicz, Kragh, and Rangvid 2018; Fang and others 2022).

The output effects of LTV caps also appear to be moderate. Studies using novel data on the levels and changes of LTV caps through time—the intensive margin of macroprudential policy variation—find that a tightening by 10 percentage points of the LTV ratio cap yields a decline in output of 1.1 percent after four years, roughly corresponding to the effect of a tightening of monetary policy by 25 basis points (Richter and others 2019). The effect of a 10 percentage points change in the LTV limit on consumption growth is found to be of the same order of magnitude, at around 1 percentage points (Alam and others 2019). Relatively small effects are found empirically, despite there being additional channels of transmission to output, such as increases in desired savings from the imposition of an LTV ratio cap. By contrast, the effects of changes in LTV ratio caps on financial variables, including credit and asset prices, are measured as substantially—about six times—stronger in percentage terms in both studies, pointing to a favorable trade-off between desired effects and the "sacrifice" in terms of economic growth from the use of macroprudential tools.

[6] Ostry and others (2012) and Bergant, Grigoli, Hansen, and Sandri (2020) present evidence consistent with this interpretation.

B. Effects on Resilience

A small but influential literature has started to explore empirically the effects of macroprudential tools on resilience—that is, the system's ability to cushion adverse shocks. These studies typically examine amplification effects in the event of adverse shocks and assess whether the strength of that amplification may be reduced by macroprudential policy. They build on an earlier literature on the resilience-strengthening effects of capital tools (Damar and Molico 2016) and complement more focused analysis of resilience of housing markets (Cournède, Sakha, and Ziemann 2019). And while these studies aim to assess resilience effects, disentangling these from "leaning effects" is not always possible.

The estimated resilience effects tend to be sizeable across different types of macroprudential tools. For the US subprime crisis of 2008, estimates suggest that a countercyclical capital buffer of 4.7 percent would have been sufficient to enable banks to continue growing their balance sheets in line with the long-term average growth rate (Aikman and others 2019).[7] Evidence on the impact of dynamic provisioning also indicates that such provisions contributed to support credit around the economic crisis in Spain. A 1 percentage point higher buffer increased credit to firms by 9 percentage points, and thereby firm employment (6 percentage points) and firm survival (1 percentage point) (Jiménez and others 2017). A number of studies also estimate sizable effects of borrower-based tools in reducing borrowers' probability of default and lenders' loss given default in the event of stress (Nier and others 2019, Ampudia and others 2021), while some others find that certain lender-based macroprudential policy tools, such as liquidity requirements, are able to reduce structural risks arising from interlinkages that would otherwise magnify the impact of bank failures (Meulemann and Vander Vennet 2020).

Recent evidence also suggests that macroprudential policies can help mitigate the impact of external financial shocks on emerging market economies. Various papers reach this conclusion using different methods and data. For example, a study that exploits both time-series and cross-country variation in macroprudential regulation for emerging markets, shows that a more stringent level of macroprudential regulation significantly dampens the fall in GDP growth sustained by these countries in response to adverse global financial shocks (Bergant and others 2020). Macroprudential tools that boost bank capital and liquidity, limit foreign exchange exposures, and contain overly risky forms of credit drive the results. Consistent with these results, there is evidence that prudential policies can dampen the effect of capital inflows on economic growth (Ouyang and Guo 2019, Brandao-Marques and others 2020, Forbes 2020).

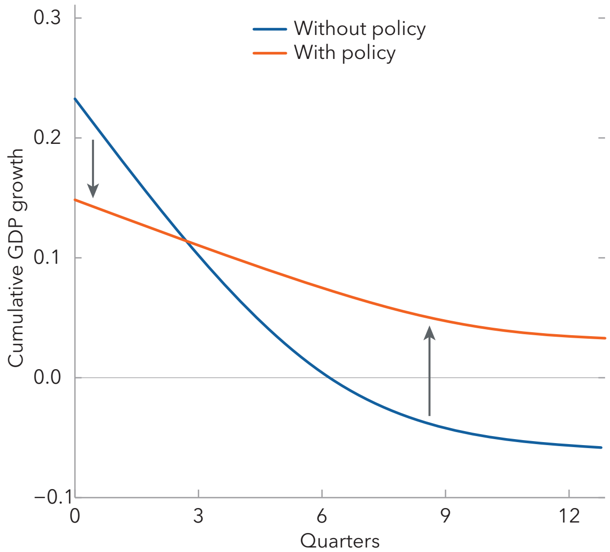
C. Intertemporal Trade-Offs

Conceivably, macroprudential tightening may entail output costs in the short term but strengthen resilience over the medium term. Assessing these trade-offs is conceptually and empirically challenging. A natural starting point is the established empirical regularity where loosening financial conditions lead to better growth outcomes in the short term but increase downside risks to growth over the medium term

[7] They find that the fragility of lenders from excessive leverage and short-term funding can account for about 35 percent of the 2010 GDP gap, or about 3 percentage points of the total gap of 8.5 percent relative to trend in the year 2010, while macrofinancial feedback effects from indebted households' spending cuts explain about one-half of the GDP gap, or slightly more than 4 percentage points of the overall fall in GDP.

Figure 3. Policy Actions and Growth at Risk Trade-Off

Marginal Effect of FCI Shocks on GaR (e.g., 20th percentile cumulative GDP growth)



Source: Authors' calculations.

(Growth-at-Risk).[8] The interaction of looser financial conditions with a tightening of macroprudential policy can then be examined to assess whether deploying these policy tools can flatten the trade-off, by pulling in the tail of the GDP distribution (Figure 3; Brandao-Marques and others 2020, Galan 2020).[9]

Macroprudential policy appears to be very effective at reducing output volatility over time and beneficial for medium-term growth performance. Going beyond tail risks, it is possible to estimate the effects of macroprudential policy over the whole distribution of future growth and compare the outcomes against a counterfactual of no policy action, using simple loss functions. The empirical results suggest that tightening macroprudential policies in response to a loosening of financial conditions reduces losses incurred over the entire policy horizon by about 9 percent (Brandao-Marques and others 2020). The estimated impact from a sample of 37 countries combines both the effects of macroprudential policies through "leaning" and through strengthening resilience.

Moreover, the effect of macroprudential policy actions is far larger than those from monetary policy, foreign exchange intervention, or the use of capital controls. Indeed, responding to easing financial conditions by tightening monetary policy is found to be counterproductive, exacerbating the volatility of output over the entire horizon. This finding therefore echoes arguments made in the literature that monetary policy is much less well equipped than macroprudential policy to build resilience (Adrian 2017). The findings are broadly in line with those in Boar and others (2017) who report that countries that more frequently use macroprudential tools experience stronger and less volatile GDP growth.

Further progress in examining the impact of macroprudential policy action on the probability distribution of output will facilitate calibration and evaluation of macroprudential policy. The lack of consensus on how to operationalize concepts such as systemic risk and financial stability has been a hurdle for the evaluation of macroprudential policy effectiveness. Empirical advances that tie the effects back to the ultimate objective of macroprudential policy, of reducing tail risks to economic activity, can help clarify such concepts and enable policymakers to better articulate their policy framework. Further progress in this direction may ultimately allow for better calibration and use of macroprudential policy tools. Future work should also shed more light on the underlying resilience channels, as well as the distributional implications of the range of macroprudential policy tools, which may also have consequences for long-term growth.

[8] The empirical trade-off at the heart of this literature was first documented for the United States (Adrian and others 2019), and also uncovered in panels of advanced and emerging market economies (for example, Adrian and others 2018).

[9] In line with the ideas set out in Chapter 2, the study addresses the potential endogeneity of policy by using policy "surprises." Specially, the authors regress changes in the macroprudential index on commonly used signals for macroprudential action, such as the credit gap and the house price gap and use the residual from the regression as more exogenous "policy shocks." Further, because policy may not only affect the tail of the distribution, but also shift its mean (potentially entailing output growth costs in the baseline), the study goes on to calculate the effects of policy choices on the entire distribution of output. It then evaluates welfare effects from changes in the shape of the distribution by applying a quadratic loss function that is fed the second moments of the sequence of the output growth distributions through the policy horizon.

4. What We Are Learning About Nonlinear and Dynamic Effects, and the Potential for Leakages

The effects of macroprudential policy are likely to be nonlinear. Most macroprudential tools impose regulatory constraints, which can be either binding or slack, thereby introducing a nonlinearity in behaviors and outcomes. This nonlinearity also means that the costs and benefits of macroprudential intervention may depend on the size and the direction of the policy change, as well as the position of the financial cycle.

Macroprudential policies can also be associated with leakages and asset substitution. When a new constraint is imposed, the financial system can adjust to such a constraint in more than one way. This may include the migration of the activity outside of the scope of the constraint ("leakage"), or unintended effects arising from agents trying to maintain their desired risk exposure ("asset substitution") despite the constraint. These effects then also raise the question of whether the desired effects of macroprudential policy may hold up through time or could erode as the system adjusts (the "time profile" of effects).

Overall, while results in this area are emerging, they are not yet conclusive. An emerging literature suggests tentative answers to these questions, even as further research is needed for policymakers to become more confident in using such insights for the calibration of policy interventions.

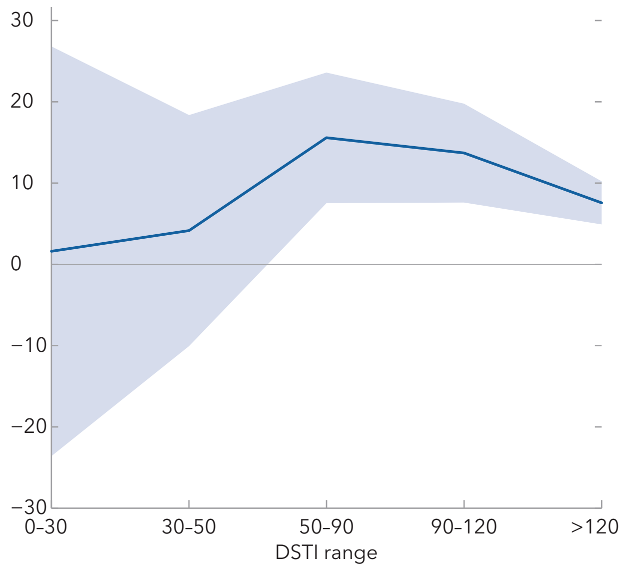
A. Diminishing Marginal Benefits

Recent findings suggest that the net benefits of macroprudential policy tools diminish with progressive tightening. Previous studies have conjectured that the marginal benefit of tightening any one tool is likely to be decreasing since the aggressive use of any tool is likely to create distortions and incentives for circumvention (CGFS 2012, IMF 2013). However, evidence in support of this has emerged only quite recently. For instance, in the abovementioned study of the sensitivity of emerging economies' GDP growth to global financial shocks, tighter macroprudential policy settings have decreasing marginal returns (Bergant and others 2020). A tightening of macroprudential policy from the lowest reading of the aggregate indicator toward the sample median sharply reduces adverse GDP effects of a deterioration in global financial conditions, while the effects of a tightening from higher levels are weaker.

Research has started to uncover such nonlinear impact for the effect of bank capital buffers. In advanced economies, the marginal benefits of increases in capital are high initially but decline rapidly once banks' risk-weighted capital ratios reach the 15–23 percent level. Once capital levels fall within this range, they would have been sufficient to absorb losses in most banking crises in advanced economies, implying that larger buffers would not have been desirable when capital also comes with costs (Dagher and others 2016). There is evidence of similar nonlinear effects of capital on bank lending in Indonesia (Catalán, Hoffmaister, and Anggadewi Harun 2020).

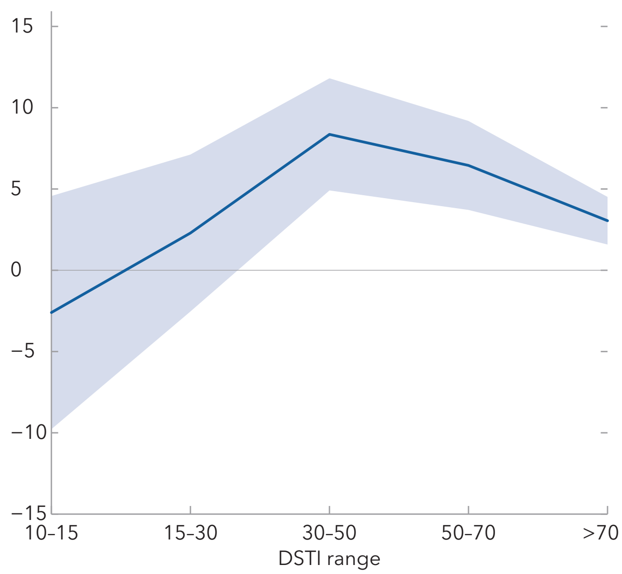
Resilience benefits of borrower-based tools, such as DSTI, tend to feature threshold effects. Nonlinear effects are being uncovered by studies that estimate the impact of borrower characteristics (LTV, DSTI) on the probability of default using loan-level data (Kelly and O'Toole 2018, Nier and others 2019, de Haan and Mastrogiacomo 2020, Gornicka and Valderrama 2020). For instance, the probability of default on a mortgage rises only when the DSTI exceeds a threshold—estimated at 50 percent based on data from the Romanian credit registry (Nier and others 2019; Figure 4). Below this threshold, there is no statistically significant increase in the probability of default associated with a hike in DSTIs for mortgage borrowers. For borrowers who only carry consumer loans, the threshold above which higher DSTI ratios lead to a rise in the

Figure 4. Mortgages
(Percentage increase in probability of default for a 10 percentage points increase in DSTI)



Source: Nier and others (2019).
Note: DSTI = debt service-to-income.

Figure 5. Consumer Loans
(Percentage increase in probability of default for a 10 percentage points increase in DSTI)



Source: Nier and others (2019).
Note: DSTI = debt service-to-income.

probability of default is lower (Figure 5), consistent with the idea that the perceived "penalty" for borrowers from defaulting on these loans is lower than that from defaulting on a mortgage. Such results suggest that the benefits from tightening a debt-service-to-income ratio will at some point be exhausted: when the regulatory limit is set just below the identified threshold, a tightening that reduces the limit much further cannot achieve an additional decrease in a borrower's probability of default.

Side-effects of macroprudential tools seem to be stronger where macroprudential settings are tightened aggressively. For instance, the above-mentioned study by Alam and others (2019) constructs numerical data on prevailing loan-to-value ratio limits across countries and through time to study how changes in the calibration of these limits affect household credit growth and household consumption. Using these granular data, they find that, while effects of varying LTV ratio caps on household credit are sizable, the effect on household credit per unit of the tightening diminishes as the overall size of the change increases. They argue that this is in line with a leakage effect, where tighter macroprudential settings result in a greater substitution of credit away from banks and toward nonbanks. Such findings can be useful for the design of policy measures. For instance, in countries with tight LTV limits a complementary use of other macroprudential tools could improve the efficiency of the overall policy approach.

Overall, evidence points to declining marginal net benefits to the use of macroprudential policies once their stringency exceeds certain levels. Evidence suggest that once thresholds are crossed, the marginal benefits are decreasing in the tightness of macroprudential policy settings for both lender-based and borrower-based tools, while side effects are increasing. Further research on these issues in different settings, and across the range of potential benefits and costs of different macroprudential tools will help policymakers better calibrate macroprudential policies.[10]

[10] A forthcoming paper by Miettinen and Nier (2022) "Efficient Use of Borrower-based Macroprudential Policy" sets out steps in introducing, designing, and calibrating borrower-based tools to reap benefits, while avoiding undue costs, side effects, and distributional impacts of these tools.

Table 2. Reduction in Loss from Macroprudential Measures

	Low Credit			High Credit		
	$\omega_y = 1$, $\omega_p = 0$	$\omega_y = 1$, $\omega_p = 1$	$\omega_y = 0.542$, $\omega_p = 1$	$\omega_y = 1$, $\omega_p = 0$	$\omega_y = 1$, $\omega_p = 1$	$\omega_y = 0.542$, $\omega_p = 1$
MPM All	−0.089**	−0.086**	−0.084**	−0.099**	−0.094**	−0.090**
MPM Borrower-Based	−0.033	−0.032	−0.031	−0.083***	−0.078***	−0.075***
MPM FI-Based	−0.076**	−0.072**	−0.070**	−0.028	−0.027	−0.026
MP	0.137***	0.132***	0.129***	0.126***	0.120***	0.115***

Source: Brandao-Marques and others (2020).

Note: Confidence bands in brackets. Inference based on cluster bootstrap. *, **, *** means significance at 10, 5, 1 percent levels (first column only). Vulnerabilities measured by level of credit to GDP—high (low) vulnerabilities mean credit to GDP at 75^{th} (25^{th}) percentile. ω_y and ω_p capture the weights of output and inflation in the loss function, respectively.

B. Effects over the Financial Cycle

Macroprudential policy appears to have more potent effects on credit and asset prices when vulnerabilities are growing. Several studies in the literature point to evidence of macroprudential policy effects depending on the phases of the financial cycle (Lim and others 2011; Claessen, Ghosh, and Mihet 2013; McDonald 2015; Alam and others 2019; De Schryder and Opitz 2021). The findings generally suggest that the effects of macroprudential policy are stronger when financial vulnerabilities are building, since a tightening of macro-prudential policy constraints can then more readily develop "bite" on the growth of credit or asset prices (Araujo and others 2020).

Moreover, the resilience-building benefits from macroprudential measures appear to depend on the degree to which vulnerabilities are already present. The net benefits of deploying borrower-based tools (such as LTV and LTI ratio caps) appear to be greater than those of using lender-based tools when the ratio of credit-to-GDP is already high (Table 2). This suggests that in economies where a high level of credit is already reached, the benefits from macroprudential policy may derive most strongly from borrower-based tools that are able to support household spending in downturns. By contrast, the benefits of lender-based tools (such as capital and reserves requirements) are larger where credit is still at a lower level relative to GDP, and variation of these tools may be useful in supporting credit in downturns.

C. Effects of Tightening versus Loosening

Some evidence suggests stronger effects of tightening than loosening actions. Although many studies examine the impact of tightening or loosening actions in isolation, some evidence suggests that the effects of tightening are larger than those of loosening macroprudential policies, at least for studies focusing on sample periods before COVID-19 (Araujo and others 2020). The estimated effects of tightening (examined for some tools) are more often statistically significant than those of loosening. This result is also robust when constraining the sample to studies analyzing both tightening and loosening effects in comparable regressions and samples (that is, same specification, tools, and country sample). Moreover, these studies also suggest that the magnitude of tightening coefficients in absolute terms is often, but not always, larger than that of comparable easing coefficients. Such results are consistent with the notion that tightening actions constrain agents' decisions and limit their borrowing while there is no guarantee that economic agents would use the borrowing space provided by the relaxation of macroprudential constraints.

Given the higher incidence of tightening actions in the periods before COVID-19, the above findings are still preliminary. They may in part reflect the higher power in estimating the impact of tightening actions relative to that of loosening measures. Moreover, for most existing studies, loosening actions are typically bunched around the GFC (Alam and others 2019, Figure 4), potentially exacerbating endogeneity concerns (Box 1). Furthermore, the finding does not hold true for all tools. An analysis of the effects of dynamic provisioning in Spain finds that the negative effect on credit flowing to firms was smaller than the benefits derived from the availability of the buffer in the period of stress, when capital was then more scarce and lending to firms more costly (Jiménez and others 2017).

Preliminary evidence from the recent COVID-19 experience points to the value of macroprudential buffers that can be relaxed in periods of stress. A relaxation of capital buffer requirements is found to have supported credit for banks that would otherwise have been close to the regulatory requirements (Box 1), while stigma effects appear otherwise to stand in the way of banks using buffers that are not explicitly relaxed. Overall, though more research is warranted, most evidence from the pandemic suggests that there might be a case for positive neutral buffers that could be drawn down in times of stress (see also BCBS 2022).

The evidence on regulatory measures in response to the pandemic more broadly is consistent with having facilitated the flow of credit during the downturn, but also signaled tradeoffs (Demirgüç-Kunt, Pedraza, and Ruiz-Ortega 2021, Valencia and others 2022). Such trade-offs reflect in part the extensive use of regulatory forbearance, such as relaxation of standards for the accounting of nonperforming loans, which often accompanied macroprudential measures (IMF and WB 2020, Edwards 2021). Greater use of explicit macroprudential policy buffers could in future reduce the need for countries to resort to such forbearance. Moreover, looking further at the experience with macroprudential policy relaxation during COVID-19, including when it was complemented with dividend payment restrictions, could help better understand the strength of effects. Relatedly, examining whether overlapping prudential requirements and/or increased risk aversion during significant distress episodes constrain buffer usability will also help inform the design of macroprudential policy going forward (for example, ESRB 2022).

D. Leakages and Asset Substitution Effects

Macroprudential policy is subject to a "boundary problem" (Goodhart 2008). Activation of macroprudential measures, whenever they are binding, will tend to shift of activity toward less regulated sectors. When macroprudential tools are enforced on the domestic banking system, as would typically be the case, such leakages can occur in the form of an increase in the provision of credit by nonbanks (nonbank leakage), or an increase in credit from across the border (cross-border leakage) (IMF 2014a). There can also be asset substitution (risk-shifting effects) that arises when banks aim to maintain the same risk exposure that was in effect before the introduction of the policy measure. These effects have started to be documented empirically in several studies (for example, Aiyar, Calomiris, and Wieladek 2014; Reinhardt and Sowerbutts 2015; Avdjiev and others 2016).

Growing evidence points to leakage effects from banks to nonbanks. For instance, upon introduction of macroprudential measures, the growth of credit provided by banks is found to shrink relative to a counterfactual without a policy measure, while nonbank credit expands relative to the counterfactual, even if in aggregate total credit declines (Cizel and others 2019). Such leakage of credit activity from banks to nonbanks is stronger in advanced economies, where financial markets are more developed, and relatively more pronounced in response to quantitative constraints (such as bank- or borrower-based limits) versus price-based tools, broadly in line with earlier evidence reported in IMF (2014b).[11]

[11] Leakage can also occur across banks subject to different regulations. Aiyar, Calomiris, and Wieladek (2014) for example, find that in the United Kingdom unregulated banks (resident foreign branches) increased lending in response to tighter capital requirements.

Box 2. Effects of Macroprudential Buffers in Times of Stress: The COVID-19 Experience

Preliminary evidence from the recent COVID-19 experience points to the value of macroprudential buffers in periods of stress—including to the benefits of being able to relax macroprudential requirements when stress materializes. Such effects are not easy to identify since a range of other policy support measures were adopted by central banks, prudential authorities, and governments in response to COVID-19. The existing studies therefore typically adopt a difference-in-difference approach, conditioning on how far individual banks are away from the regulatory constraint.

An analysis of bank funding costs reported in BCBS 2021 offers a first clue to the workings of capital buffers in the COVID-19 shock. The study examines how banks' funding costs, as measured by credit default swap (CDS) spreads, evolved as a result of the COVID-19 shock. It finds that the increase in CDS spreads in the period from end 2019 to March/April 2020 (the onset of the pandemic-induced uncertainty) was strongly conditioned by the capital strength of the banks in the sample. Banks with larger common equity tier one (CET1) ratios before the crisis experienced a far smaller increase in CDS spread than banks with more modest CET1 ratios. Moreover, this effect is almost entirely driven by the "headroom" banks have over and above the combined buffer requirement—that is, the difference between the actual capital ratio and the sum of minimum requirements and mandatory buffers, such as the capital conservation buffer—rather than the size of the CET1 ratio as such. That is, funding costs rose for those banks who were perceived to have little headroom above the combined buffer requirement and rose much less for banks that had ample headroom.

Proximity to minimum requirements also emerges as a key determinant of bank lending behavior during the pandemic. Overall, and in contrast with the GFC, the COVID-19 crisis was not associated with a strong cut-back in bank lending, as banks in many countries accommodated an increase in demand for credit on the part of the corporate and households sectors (see chart 10 in BCBS 2021). Looking across countries and making use of data on individual banks, BCBS (2021) reports that loan growth during the pandemic was stronger for those banks that had more ample capital "headroom." These results indicate that banks with less capital space lent less during the pandemic than did banks with more headroom, in line with the finding that the former saw their funding cost increase by more.

Studies using granular data for the United States and the euro area come to similar conclusions. In an analysis of confidential bank- and firm-level data, Berrospide (2021) finds that banks were reluctant to dip into regions of the capital structure that were subject to regulatory constraints. In the United States, this includes the "stress capital buffer" that plays the same role as the Basel capital conservation buffer and is determined through the Federal Reserve's annual stress tests. Berrospide (2021) shows that banks that started the pandemic with a capital ratio relatively close to the regulatory buffer region reduced loan commitments to small- and medium-sized enterprises by an average of 1.4 percent more (quarterly) and were 4 percent more likely to end pre-existing lending relationships during the pandemic than banks that were less constrained. Recent studies for the euro area also show that banks with capital closer to the regulatory limits reduced their risk exposures and lending to nonfinancial firms more relative to banks that had more ample headroom (Couaillier and others 2022a, 2022b). The reluctance to breach the regulatory buffer requirements and the resulting cut in the provision of loans occurred despite policymakers in both the euro area and the United States publicly encouraging banks to dip into these buffers in times of stress.

Some of these studies assess the effect of a relaxation of capital buffers more directly. For instance, Couailler and others 2022b explore more directly the effect of capital relief measures, such as the explicit release of countercyclical capital buffer requirements and systemic risk buffers, that have been relatively common across countries in the European Union. They find that such an explicit release of buffer requirements—which would lead to an increase in the "headroom" for banks subject to this policy action—leads to an expansion in the amount of credit provided, especially for those banks that otherwise would have been close to their combined regulatory thresholds. Moreover, they find that the expansion in credit from the release of the countercyclical buffers especially benefits small- and medium-sized enterprises.

Taken together, these studies suggest that banks are reluctant to "breach" regulatory requirements, which is consistent with the notion that an explicit release of buffers can support credit. Banks have been reluctant to breach buffers, including the Basel III capital conservation buffer or the stress capital buffer in the United States, even when supervisory agencies signaled that capital should be used. This may be because they fear an increase in funding costs from such a breach. Moreover, the existing evidence suggests that a cut-back in lending is likely to be stronger when losses are incurred or expected in the future, while larger capital buffers can cushion this effect, for example, Nier and Zicchino (2008). As banks move closer to the requirements, either by absorbing losses or otherwise, they appear more strongly to curtail lending. By contrast, the evidence is consistent with the idea that a reduction of the prevailing regulatory threshold through an explicit release of macroprudential buffers can support the provision of credit to the economy in periods of stress.

An important caveat both for the analysis of the COVID-19 episode and for drawing policy conclusions is that a range of other policies also contributed to reducing financial amplification in the COVID-19 crisis. Fiscal support was provided through government guarantees for new lending. In addition, direct fiscal support to households and firms as well the use of payment moratoriums and regulatory forbearance are likely to have reduced banking system losses on existing loans in the near term.[1] Finally, policies to constrain banks' dividend payouts led to increasing, rather than depleting capital resources through the COVID-19 episode in many jurisdictions. In this context, while an effect of the relaxation of macroprudential buffers through periods of stress can be established in the data and appears overall to have worked in line with the desired policy impact, a release of such buffers in the absence of other supporting policies has not been fully tested.

[1] Some of the fiscal and monetary support measures were themselves subject to cost-benefit trade-offs that will take time to fully assess. For instance, the fiscal outlays and fiscal risks of support interventions were high in some countries, and some of the related losses are not yet known, with possible implications for macroeconomic stability (see forthcoming IMF Staff Discussion note, "The State as Financier of Last Resource.")

There is also increasing evidence on cross-border leakages of macroprudential measures. For example, "other flows" from the balance of payments (BOP; cross-border loans and deposits received by financial institutions and nonfinancial corporate sector flows) tend to move in tandem with domestic credit (Nier, Olafsson, and Rollinson 2020). When macroprudential policy is tightened in response to increases in domestic credit, this leads to further rises in foreign inflows. These cross-border leakage effects are strongest for borrower-based limits, suggesting that the increase in cross-border borrowing is driven by firms looking to circumvent such constraints. Similarly, when FX regulations are applied to the banking system, they reduce bank borrowing and lending in FX, but also appear to induce an increase corporate issuance of FX debt securities in international markets, thereby "shifting the snowbanks" of FX vulnerabilities (Ahnert and others 2021).

Some recent studies have also documented asset substitution effects. These effects arise when banks, faced with the introduction of a macroprudential constraint, aim to maintain a similar risk profile as before by increasing exposure to risks less constrained by the macroprudential intervention. In a cross-country set-up, the introduction of macroprudential tools that constrain lending to households, such as LTV, LTI, and DSTI ratio caps, is found to lead those banks with larger initial mortgage portfolios to expand credit to corporate borrowers, especially when the regulations are introduced against the backdrop of buoyant overall credit (Bhargava, Górnicka, and Xie 2021). Evidence from the introduction of LTI and LTV limits in Ireland suggests that banks that were relatively more affected by the new regulation shifted toward high-income borrowers and borrowers less constrained by the regulations, and also increased exposure to high-yield securities and potentially more risky corporate lending (Acharya and others 2020).

Domestic and cross-border leakages appear present across all types of tools. There is evidence showing them present across broad-based, housing, and liquidity tools, albeit with larger effects detected for broad-based and liquidity measures (Table 3).

In sum, there is already strong evidence of domestic and cross-border leakage effects of macroprudential measures, as well as of asset substitution effects. In principle, this would call for policy approaches to extend beyond domestic banks' credit and to capture nonbank credit provision, and credit from abroad (for example, through reciprocity agreements or CFM/MPMs). In practice, more evidence on how well these approaches can work is still needed. Asset substitution effects also deserve close monitoring. Some can

Table 3. Average Leakage Effects (Domestic and Cross-border)

Type of Macroprudential Tool	(1) Domestic or Cross-border Leakages
Broad based	−0.066** (0.024)
Housing	−0.005*** (0.000)
Liquidity & Other	−0. 077**

Source: Araujo and others (2020).

Note: The table reports the average effects of tightening macroprudential measures on domestic and cross-border leakages, reflecting mainly cross-border and nonbank lending. The averages are obtained from weighted least squares regressions where the weights are proportional to the precision of each result. The dependent variable in such regressions is the coefficients collected by Araujo and others (2020) from studies where the macroprudential policy is measured through −1,0,1 dummy variables at a horizon of up to one year, normalized by the standard deviation of the outcome variable (in this case total bank credit or transformations of it) and the regressors include dummy variables to identify the type of macroprudential policy, and compute the average effects. All averages reported in the table control for journal quality, publication bias, and whether the specific coefficient was taken from the most complete specification within each paper, in addition, the standard errors are clustered at the study level and reported in parentheses. * significance at 10%; ** at 5%; *** at 1%.

be desirable, such as shifts away from household lending in response to a tightening of focused household sector lending tools. However, asset substitution effects may also encourage lending into sectors where risks are less easily controlled, thereby potentially contributing to inadvertent increases in overall systemic risk. Such effects are therefore an important area of further investigation.

E. Time Profile of Effects

To date, most studies on the impact of macroprudential policy have focused primarily on the short-term-effects—often up to four quarters. Less is known about how the effects evolve over longer horizons. Are the benefits of macroprudential policy persistent or even strengthening over time? Or are they weakening as time passes, potentially requiring additional policy actions to boost the effects? There are reasons to think that both types of variations may occur.

The effects on credit and asset prices may wane with time. For example, if banks face adjustment costs from an increase in capital requirements, a hike in such requirements may reduce credit growth on impact, as banks adjust by slowing lending. By contrast, the long-term effects could be more muted, since the level of capital is "neutral" or even positive for loan growth in the long-term (for example, Gambacorta and Shin 2016). Similarly, tools may have an effect on asset prices on impact but may not continue to affect prices when these are determined by other factors in the long run. Moreover, if leakage effects are important, the effects on total credit could be stronger in the short run, but then decay over time, as the system finds ways of circumventing the macroprudential constraints, for example, when firms borrow increasingly from nonbanks that are not subject to macroprudential regulation.

There are reasons to think that the effect on resilience could increase with time, especially when constraints are imposed on the flow of credit. For instance, a new LTV or DSTI constraint will only affect the flow of new loans, and it may therefore take some time for the constraint to measurably affect the average LTV ratio. Once the effect of the tool has worked itself through and shaped the distribution of LTV ratios in the stock, the LTV constraint can then help cushion the effects of house price- or other adverse shocks, for a considerable length of time. Similarly, once a higher capital buffer requirement is in place, and banks have adjusted to the requirement, the additional capital remains available to be used in periods of stress and should thereby create additional resilience for a long period. Here again, though, the potential for circumvention is important, because banks are known to "arbitrage" capital requirements over time. This has already motivated policymakers to introduce backstops, such as simple leverage ratios, in addition to risk-based requirements.

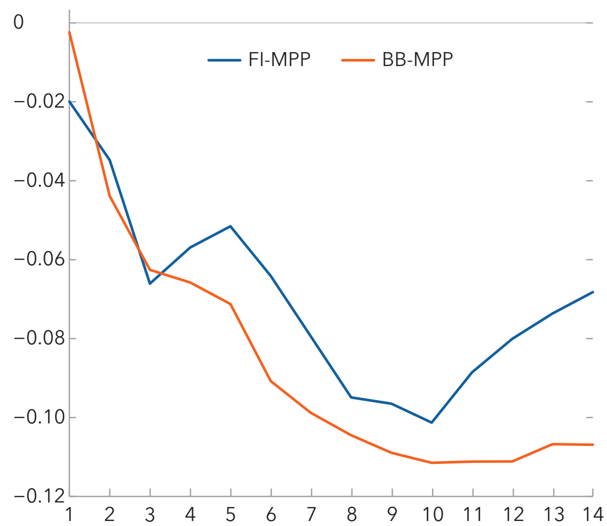
A small literature has begun to shine light on the time profile of policy effects empirically. These studies often estimate impulse response functions over relatively long horizons (typically 14 to 16 quarters), thereby allowing the study of both short- and medium-term effects. There tends to be hump-shaped effects on credit, peaking at a one- to two-year horizon for most studies, while those for macroeconomic variables (GDP, consumption, prices) peak after two to three years (Araujo and others 2020).

The estimated temporal patterns for the effect on credit vary across studies and outcome variables. One recent study finds fairly persistent effects of a tightening of LTV ratio caps on household credit (Richter, Schularick, and Shim 2019)—somewhat in contrast to the notion that effects on credit would wane over time. After a tightening of maximum LTV ratios real household credit is reduced by almost 6 percent after two years and mortgage credit by more than 5 percent. However, while the coefficients remain stable for longer time horizons, confidence intervals widen and, as a result, the effects are no longer statistically significant after four years. Examining the impacts of a broader set of macroprudential policy tools (aggregated into an index) in 13 EU countries over a horizon of 16 quarters De Schryder and Opitz (2021) find similar results, even as the effects differ with the outcome variable considered.

There is also evidence of significant and persistent effects of changes in LTV policies on house prices. The above-mentioned study by Richter, Schularick, and Shim (2019) finds that the impact on the level of real house prices continues to strengthen throughout the horizon, reaching a highly significant eight-percent decline after four years. The stronger effect reported in this study relative to others could stem from addressing the potential endogeneity of macroprudential policy more carefully (by using an inverse probability weighted regression-adjusted (IPWRA) estimator). The effect on asset prices may in other studies be biased more strongly toward zero, because moderating house prices is a common objective in LTV ratio cap tightening (Richter, Schularick, and Shim 2019, Table 1).

The resilience-building effects of macroprudential policy appear to strengthen, rather than wane, over time, especially for borrower-based tools. An examination of the evolution of net benefits of macroprudential policy overt time shows a continued reduction of "losses" until the benefits peak around after 10 quarters (Figure 6, Brandao-Marques and others 2020).[12] In other words, while the net benefits of macroprudential policy start accruing in the short term, they are only fully realized in the medium term. Moreover, borrower-based macroprudential policy tools are found to have a more persistent beneficial effect than financial-institution-based tools (such as capital and reserves requirements). For the latter, about half the initial reduction in losses is reversed after 14 quarters. This suggests that gains associated with the use of such policies are temporary, while the benefits of borrower-based macroprudential tools are longer lasting. More recently, also using a quantile-regression approach, Galán (forthcoming) finds that tightening capital measures during expansions may take up to two years to show evidence of benefits on growth-at-risk, while the positive impact of borrower-based measures is more immediate. By contrast, in downturns the benefits of loosening capital measures materialize more quickly.

Figure 6. Cumulative Effect on Loss Function of the Use of Macroprudential Tools



Source: Authors' calculations.
Note: The figure shows the cumulated change in the loss function when comparing a scenario of loose financial conditions without policy tightening to one where policy is tightened. BB-MPP = borrower-based macroprudential policy; FI-MPP = financial-institutions-based macroprudential policy.

[12] The study calculates the effects of policy choices on the entire distribution of output. It then evaluates welfare effects from changes in the shape of the distribution by applying a quadratic loss function that is fed the second moments of the sequence of the output growth distributions through the policy horizon.

5. What We Are Learning About How Macroprudential Policy Interacts with Other Policies

Macroprudential policy is not the only policy with implications for macro-financial stability and does not operate in isolation from other policies. In a sample of 39 countries during the period 2001:Q1–2018:Q4, macroprudential policies were tightened in more than 40 percent of the observations, but these actions were taken without another policy change in only approximately 3 percent of the time. Yet most existing empirical studies on the impact of macroprudential policies on credit growth (including those surveyed in Chapter 3) have analyzed them on their own, or primarily considered their interaction with monetary policy (Bruno, Shim, and Shin 2017; Gambacorta and Murcia 2017; Takats and Temesvary 2019; Altavilla, Laeven, and Peydró 2020) and ignored the role of other policies.[13]

This section summarizes the findings from a novel empirical analysis that examines how the interaction of macroprudential policies with other domestic policies affects credit. Specifically, this section evaluates whether the response of bank credit to macroprudential policies varies with (1) monetary policy, (2) capital flow management measures (CFMs), (3) foreign exchange market interventions (FXIs), and (4) fiscal policy.[14] The focus of this analysis is understanding what happens to credit when macroprudential policies are adopted in combination with other policies.

Economic theory offers some predictions on the effect of policies, other than macroprudential, on credit. Monetary policy may affect credit through a bank lending channel by affecting the supply of bank loans (Bernanke and Blinder 1988), and a balance sheet channel by affecting borrowers' balance sheets and their ability to borrow (Bernanke and Gertler 1995). For example, a tight monetary policy leads banks to reduce loan supply, thereby raising the cost of capital to borrowers (Jiménez and others 2012). A tight monetary policy also weakens borrowers' balance sheets by reducing cash flow net of interest and lowering the value of collateral assets (Gertler and Gilchrist 1994). Both channels imply a contractionary effect of monetary policy on credit. In an open economy, monetary policy can also affect credit through its effect on the exchange rate and capital flows. A tighter monetary policy will increase interest rate differentials causing capital inflows and an appreciation of the exchange rate. In turn, both factors will result in faster credit growth.

CFMs and FXIs may affect credit through their impact on capital flows and exchange rate movements. Surges in capital inflows can lead to rapid credit expansion due to abundant liquidity and relaxed borrowing constraints (Hahm, Song Shin, and Shin 2013), while credit busts may ensue when capital flows reverse due to changes in global and/or domestic financial conditions (Ghosh, Ostry, and Qureshi 2018). During booms, currency appreciation in capital-receiving countries can also increase the expected net worth of borrowers and lenders with net liabilities denominated in foreign exchange and thus their ability to extend credit and borrow. Subsequent currency depreciation can lead to a credit bust when liquidity dries up (Diamond, Hu, and Rajan 2020). CFMs can curb capital inflows and reduce credit market vulnerabilities associated with excess credit growth during the boom. FXIs, by slowing the pace of appreciation, can also curb capital inflows and excess credit growth during a boom (Hofmann, Shin, and Villamizar-Villegas 2019).

[13] Focusing on the impact on output, Brandao-Marques and others (2020) find that the benefits of a macroprudential tightening in reducing tail risks to GDP are reinforced if it is accompanied by a degree of monetary accommodation. In turn, Mano and Sgherri (2020) examine the interaction of capital flow measures and macroprudential policies with monetary policy in the context of capital outflows.

[14] The empirical analysis in this section considers all possible interactions among the five policies, even though the focus is on interactions between macroprudential regulation and other policies.

The effect of fiscal policy on credit is a priori ambiguous. Tax policy instruments that incentivize borrowing such as subsidies on debt financing can increase credit demand by encouraging leverage (IMF 2016).[15] Tax policy can also relax borrowing constraints facing firms, thereby increasing lending (Zwick and Mahon 2017). Fiscal policy targeted to the real estate sector such as property taxes and stamp duties can also affect credit demand and property prices.[16] The relationship between government spending and credit is more nuanced. Neoclassical and New Keynesian theories predict a negative relationship between government spending and credit demand because government spending leads to higher aggregate demand and higher interest rates (Barro 1984, Devereux, Head, and Lapham 1996). However, empirical evidence fails to support this prediction (Fisher and Peters 2010, Ramey 2011). Expansionary government spending shocks may lower interest rates, possibly because of higher credit supply associated with higher liquidity and lower riskiness of borrowers (Auerbach, Gorodnichenko, and Murphy 2020). Also, government spending can relax firms' borrowing constraints in line with the financial accelerator mechanism (Hebous and Zimmermann 2021).

How policies interact to affect credit is an empirical question. Since the GFC, several theoretical papers have examined the use of monetary and macroprudential prudential policies to achieve macroeconomic and financial stability. While most studies agree that macroprudential policies should be dedicated to achieving financial stability, and monetary policy to attaining macro stability, the optimal interaction between these policies is expected to depend on the nature of the shocks (IMF 2013; Angelini, Neri, and Panetta 2014; Brunnermeier and Sannikov 2016; Collard and others 2017; Van der Ghote 2019; Millard, Rubio, and Varadi 2021).[17] Recently, modeling work under the IMF's Integrated Policy Framework (IPF) agenda (IMF 2020, Basu and others 2020) not only investigates optimal monetary policy and macroprudential policy but also considers CFMs and FXI when pursuing domestic and external stabilization. The model shows that the optimal policies depend on the nature of the shocks and country characteristics. In sum, the theoretical research on interactions has focused on optimal policies to respond to real or financial shocks and not on the de facto impact of policy interactions on credit as this section explores. However, knowledge on how these interactions work in practice, across different types of countries facing different implementation challenges including due to varying quality of institutions, can serve as an input into the operationalization of theoretical prescriptions such as those from the IPF models.

The analysis in this section uses quarterly data for a sample of 23 advanced economies (AEs) and 16 emerging markets and developing economies (EMDEs) over the period 2001:Q1–2018:Q4. Data on macroprudential policies come from the Integrated Macroprudential Policy database (iMaPP; see Alam and others 2019 for a detailed description). The authors consider three indices of macroprudential policies: an overall index encompassing all 17 instruments, an index of borrower-based (or demand) instruments and an index of 15 lender-based (or supply) instruments.[18] The authors construct a CFM index based on the sum of net inflows and net outflows actions identified in Baba and others (forthcoming). Data on FXI are from Adler and others (2021), who define FXI as all transactions that change the central bank's foreign currency position, with a

[15] There are two main ways in which taxation incentivizes leverage. First, offering mortgage interest deductions, without taxing owner occupied imputed rent, encourages household debt. Second, allowing deductions for interest expenses from the corporate income tax without analogous deductions for return to equity encourages corporate debt, distorting firms' financial structure.

[16] In some cases, stamp duties and property taxes could have macroprudential objectives.

[17] In the case of monetary policy tightening, Millard, Rubio, and Varadi (2021) argue that its negative impact on credit can be amplified when macroprudential policies are "turned on": a tightening of monetary policy will lead to a drop in income and a rise in mortgage rates and both factors will lead to a larger drop in lending if a macroprudential measure such as a debt service ratio is also in place as it would become more binding following the monetary policy shock.

[18] The overall index the authors use is described further in Alam and others (2019) and includes the following 17 instruments: countercyclical buffers, conservation buffers, capital requirements, leverage limits, loan loss provisions, limits on credit growth, loan restrictions, limits on foreign currency, limits on the loan-to-value ratio, limits on the debt-service-to-income ratio, tax measures (for example, stamp duties and capital gain taxes), liquidity requirements, limits on the loan-to-deposit ratios, limits on foreign exchange positions, reserve requirements, measures to mitigate risks from global and domestic systemically important financial institutions (for example, capital and liquidity surcharges) and other measures (for example, limits on exposures between financial institutions). The borrower-based (demand) instruments include limits on the loan-to-value ratio and limits on the debt-service-to-income ratio. The non-borrower-based (supply) instruments include the other 15 instruments. All indices record policy actions to introduce, tighten or loosen measures, and they do not contain information on the stringency of measures taken (see further Alam and others 2019).

positive value indicating an increase in the position. The authors collect data on policy rates from the BIS, OECD, and IMF's International Financial Statistics and construct debt-to-GDP ratios using government debt data from the BIS and CEIC and GDP data from IMF World Economic Outlook Database (WEO). Credit data (lending by banks to the nonfinancial private sector) come from the BIS and CEIC. The authors deflate the credit series using national consumer CPI data from the WEO. To mitigate the concern that policies are endogenous to macroeconomic conditions, the authors extract the shock component for each policy. The Annex provides details on the datasets used, the construction of the policy shocks as well as on the empirical specifications described below.

In an empirical model controlling for all policies and possible interactions the authors find evidence of interactions between macroprudential policy, monetary policy, and FXI tools among EMDEs (Table 4a).[19,20] The triple interaction is negative and significant, suggesting that the three policies reinforce each other. A one standard deviation tightening in each of the three policies among EMDEs is associated with a decrease in credit of 0.9 percent over a period of one quarter, which is more than one half of the average quarterly credit growth in the authors' sample. The effect continues to be significant up to four quarters with a cumulative decrease of 1.8 percent, which is equal to one third of the average cumulative credit growth over the same period.

By contrast, there is little evidence of important policy interactions for AEs. Among AEs a tightening of CFMs and an increase in the FX position of the central bank seems to amplify the negative impact of macroprudential tightening on credit for this country group (Table 4b). However, these results are not robust over time. Overall, in advanced economies, there is not much evidence that the marginal effect on credit of any one policy is affected by the policy settings of another.

The authors perform several robustness tests on the results for EMDEs (Table 5). First, separating borrower-based (demand) and lender-based (supply) macroprudential policy shocks, the authors find that the interactive effect of macroprudential policy with monetary policy and FXI on credit is primarily driven by lender-based (supply) macroprudential measures. Second, to ensure that the authors' results are not driven by the fiscal component of macroprudential policy, the authors exclude tax-related measures from the authors' macroprudential indicator,[21] and find that their main results for EMDEs continue to hold, though they are less persistent. Third, to further unpack the impact of lender-based measures, the authors examine the effect of: (1) FX measures (limits on foreign exchange positions and limits on foreign currency); (2) measures to mitigate the risks from systemically important institutions (capital and liquidity surcharges); (3) capital related measures (countercyclical buffers, conservations buffers, capital requirements, leverage limits and loan loss provisions); (4) liquidity related measures (liquidity and reserve requirements); (5) direct measures to curb credit limits (limits on credit growth, loan restrictions, tax measures and limits on loan to deposit ratios); and (6) other measures.

The authors find that results on the triple interaction in EMDEs are largely driven by liquidity measures. This points to specific mechanisms that are known to work in EMDEs: a tightening of monetary policy has a greater effect in reducing credit growth if that tightening is accompanied by FX purchases—which works against inflows and holds down the exchange rate, and if those purchases are in turn accompanied by a tightening of reserves requirements—which sterilizes the effect of the FX purchases.[22] Finally, the authors

[19] While the triple interaction between monetary policy, macroprudential policy and FXI intervention is negative and significant, none of the double interactions among these policies are statistically significant. The authors are unable to test whether the result on the triple interaction is similar during loosening episodes since there aren't enough such episodes during the period they analyze.

[20] Note that the implementation of FXI requires adequate levels of reserves in any framework where monetary policy is credible enough so that agents will not confuse the underlying nominal anchor of the economy (for example an inflation target) with the exchange rate stabilization implied by the FXI.

[21] Tax measures that enter in the overall macroprudential indicator include taxes and levies applied on transactions, assets, or liabilities, which include stamp duties and capital gain taxes.

[22] The sterilization leg of FXI plays a key role in curbing credit growth (as in Hofmann, Shin, and Villamizar-Villegas 2019).

estimate the model using a lasso-based machine learning approach. This approach is advantageous to a linear regression framework in the presence of many covariates and provides consistent estimators for inference (Chernozhukov and others 2018). The authors find that the triple interaction of macroprudential policy, monetary policy, and FXI is negatively significant, consistent with the baseline result.[23]

Macroprudential policies' interactions with other policies are more sizeable when credit growth is high. Quantile regressions for the full model show that the triple interaction of macroprudential policy, monetary policy, and FXI is significant when credit is high (at the 75th percentile) (Table 5). This finding is consistent with other studies that find that the impact and spillovers of macroprudential policies is larger during more extreme events (Chari, Dilts, Stedman, and Forbes 2022).

Overall, the authors' analysis suggests that in evaluating the impact of macroprudential policies in EMDEs it is important to consider possible interactions with other policies. Among EMDEs, FXI, monetary, and macroprudential policies are complementary and tightening these policies simultaneously when credit growth is high leads to a larger reduction in credit growth than when each policy acts in isolation. At a high level, these findings are consistent with the notion that emerging markets and developing economies face more constraints and may need to use a combination of tools to achieve their policy goals.[24]

[23] The authors report results from a cross-fit partially out estimator. In results not shown, the authors obtain similar results using alternative lasso estimators (that is, double selection, and partially-out).

[24] This finding is consistent with the results from Ghosh, Ostry, and Qureshi (2017) who find that in response to capital inflows EMDEs' policymakers respond by raising rates, intervening in the foreign exchange market, and tightening macroprudential policies.

Table 4a. Credit Growth Model with Policy Interactions—EMDEs

(with bivariate, triple, quadruple, and quintuple interactions of macroprudential policies with other policies)

	Coefficient of lag 1 for horizon h =			
	0	1	2	3
MaPP	−0.091 (0.09)	−0.307 (0.21)	−0.395 (0.30)	−0.417 (0.28)
MP	−0.133 (0.35)	−0.312 (0.51)	−0.566 (0.80)	−0.930 (0.85)
CFM	0.011 (0.10)	0.160 (0.15)	0.204 (0.20)	0.067 (0.24)
Fiscal	−0.169 (0.18)	−0.268 (0.21)	−0.196 (0.26)	0.082 (0.26)
FXI	−0.139 (0.09)	−0.166 (0.11)	−0.030 (0.13)	−0.094 (0.14)
MaPP*MP	−0.260 (0.23)	−0.286 (0.35)	−0.011 (0.39)	0.253 (0.38)
MaPP*CFM	0.045 (0.08)	0.084 (0.15)	0.175 (0.17)	0.009 (0.19)
MaPP*Fiscal	0.126* (0.07)	0.256 (0.17)	0.347 (0.25)	0.247 (0.26)
MaPP*FXI	−0.062 (0.06)	−0.202 (0.14)	−0.037 (0.14)	0.110 (0.23)
MaPP*MP*Fiscal	0.045 (0.21)	−0.020 (0.41)	−0.129 (0.58)	−0.040 (0.62)
MaPP*MP*CFM	0.075 (0.18)	0.095 (0.43)	−0.366 (0.56)	−0.068 (0.69)
MaPP*MP*FXI	−0.899** (0.36)	−1.558** (0.53)	−1.658** (0.67)	−1.791** (0.81)
MaPP*Fiscal*CFM	0.039 (0.09)	0.112 (0.15)	0.178 (0.21)	0.184 (0.23)
MaPP*Fiscal*FXI	−0.184 (0.22)	−0.259 (0.30)	−0.304 (0.36)	−0.173 (0.40)
MaPP*CFM*FXI	−0.010 (0.06)	0.023 (0.09)	−0.041 (0.15)	−0.027 (0.22)
MaPP*MP*Fiscal*CFM	−0.165 (0.24)	−0.093 (0.32)	−0.409 (0.41)	−0.055 (0.46)
MaPP*MP*Fiscal*FXI	−0.184 (0.21)	−0.816 (0.48)	−1.349** (0.61)	−1.321* (0.72)
MaPP*MP*CFM*FXI	−0.090 (0.20)	0.099 (0.32)	0.274 (0.55)	−0.123 (0.90)
MaPP*Fiscal*CFM*FXI	0.075 (0.10)	0.157 (0.21)	0.201 (0.26)	0.070 (0.32)
MaPP*MP*Fiscal*CFM*FXI	−0.393 (0.28)	−0.829 (0.62)	−1.428* (0.74)	−1.194 (0.98)
Number of observations	687	687	687	687

Source: Authors' calculations.
Note: MaPP denotes the macroprudential policy shock estimated using the overall index that includes 17 instruments. MP, CFM, FXI, and Fiscal refer to the estimated shocks for monetary, CFM, FXI, and fiscal policy, respectively. All regressions control for quarterly time and country fixed effects. Clustered—by country—standard errors are included in parenthesis. *, **, *** denote significance at 10, 5 and 1 percent, respectively.

Table 4b. Credit Growth Model with Policy Interactions—AEs

(with bivariate, triple, quadruple, and quintuple interactions of macroprudential policies with other policies)

	Coefficient of lag 1 for horizon h =			
	0	1	2	3
MaPP	−0.200** (0.08)	−0.279* (0.15)	−0.097 (0.16)	−0.165 (0.20)
MP	0.013 (0.06)	−0.025 (0.07)	−0.077 (0.11)	−0.123 (0.16)
CFM	−0.071 (0.05)	−0.052 (0.09)	−0.100 (0.10)	−0.132 (0.13)
Fiscal	0.094** (0.04)	0.129 (0.08)	0.164 (0.10)	0.155 (0.12)
FXI	0.054 (0.04)	0.043 (0.07)	0.025 (0.06)	0.055 (0.08)
MaPP*MP	0.031 (0.05)	0.015 (0.07)	0.036 (0.09)	0.069 (0.11)
MaPP*CFM	−0.037 (0.05)	−0.093 (0.07)	−0.138 (0.09)	−0.221* (0.12)
MaPP*Fiscal	0.019 (0.04)	−0.044 (0.06)	−0.084 (0.08)	−0.140 (0.10)
MaPP*FXI	0.017 (0.05)	−0.028 (0.07)	−0.118 (0.07)	−0.195* (0.10)
MaPP*MP*Fiscal	0.017 (0.03)	0.052 (0.04)	0.070 (0.06)	0.021 (0.07)
MaPP*MP*CFM	−0.068** (0.03)	−0.088 (0.07)	−0.086 (0.11)	−0.103 (0.12)
MaPP*MP*FXI	−0.062 (0.04)	−0.085 (0.10)	−0.185 (0.12)	−0.307** (0.13)
MaPP*Fiscal*CFM	0.013 (0.04)	−0.039 (0.08)	−0.057 (0.09)	−0.034 (0.12)
MaPP*Fiscal*FXI	0.050 (0.03)	0.067 (0.06)	0.110 (0.09)	0.129 (0.10)
MaPP*CFM*FXI	0.018 (0.04)	0.031 (0.04)	0.011 (0.05)	0.019 (0.07)
MaPP*MP*Fiscal*CFM	−0.026 (0.03)	0.002 (0.04)	0.021 (0.05)	0.018 (0.08)
MaPP*MP*Fiscal*FXI	0.079 (0.07)	0.035 (0.12)	−0.008 (0.14)	−0.029 (0.16)
MaPP*MP*CFM*FXI	0.027 (0.05)	−0.024 (0.09)	0.043 (0.09)	0.075 (0.13)
MaPP*Fiscal*CFM*FXI	0.001 (0.04)	−0.006 (0.05)	−0.008 (0.06)	0.021 (0.08)
MaPP*MP*Fiscal*CFM*FXI	0.024 (0.07)	0.083 (0.11)	0.189 (0.11)	0.163 (0.15)
Number of observations	1397	1397	1397	1397

Source: Authors' calculations.
Note: MaPP denotes the macroprudential policy shock estimated using the overall index that includes 17 instruments. MP, CFM, FXI, and Fiscal refer to the estimated shocks for monetary, CFM, FXI, and fiscal policy, respectively. All regressions control for quarterly time and country fixed effects. Clustered—by country—standard errors are included in parenthesis. *, **, *** denote significance at 10, 5 and 1 percent, respectively.

Table 5. Robustness Checks for Significance of the Coefficient on MaPP*MP*FXI–EMDEs

Model	Coefficient of lag 1 for horizon h =			
Alternative measures of MaPP	0	1	2	3
1. Demand MaPP	−0.349 (0.52)	−1.283 (0.96)	−1.361 (1.16)	−1.544 (1.32)
2. Supply MaPP	−0.673* (0.32)	−1.215** (0.45)	−1.246** (0.58)	−1.632** (0.72)
a. Capital measures	0.140 (0.19)	0.059 (0.23)	−0.091 (0.28)	−0.583 (0.36)
b. Limits on credit	0.210 (0.32)	−0.468 (0.61)	−0.450 (0.81)	−0.901 (0.92)
c. FX measures	−0.279 (0.44)	0.050 (0.69)	0.303 (0.74)	1.135 (0.94)
d. Liquidity measures	−0.423* (0.24)	−0.691* (0.38)	−0.758 (0.43)	−1.266** (0.54)
e. SIIs measures	0.330* (0.18)	0.148 (0.29)	0.127 (0.43)	−0.510 (0.48)
f. Other	0.109 (0.36)	−0.240 (0.52)	−0.492 (0.52)	−1.417** (0.65)
3. MaPP (excluding tax measures)	−1.141*** (0.26)	−1.122** (0.46)	−0.985 (0.86)	−0.382 (0.98)
4. Machine learning (Lasso)	−0.857*** (0.16)	−1.531*** (0.30)	−1.865*** (0.46)	−1.965*** (0.56)
Quantile regressions				
1. 25th percentile	−0.610 (0.599)	−0.843 (0.782)	0.080 (1.026)	−1.094 (1.136)
2. 50th percentile	−0.217 (0.430)	−0.758 (0.827)	−1.876 (1.298)	−2.412* (1.248)
3. 75th percentile	−1.021** (0.516)	−1.289 (1.322)	−2.673** (1.347)	−2.940 (2.330)

Source: Authors' calculations.
Note: Supply MaPP and Demand MaPP denote the macroprudential policy shocks estimated using indexes that include 15 lender-based and 2 borrower-based instruments, respectively. MP and FXI refer to the estimated shocks for monetary policy and FXI, respectively. Supply capital includes countercyclical buffers, conservation buffers, capital requirements, leverage limits and loan loss provisions. Supply direct includes limits on credit growth, loan restrictions, tax measures (for example, stamp duties and capital gain taxes), limits on loan to deposit ratios. Supply FX includes limits on foreign exchange positions and limits on foreign currency. Supply liquidity includes liquidity measures and reserve requirements. Supply SI includes measures to mitigate risks from global and domestic systemically important financial institutions (for example, capital and liquidity surcharges). Supply other includes all other supply related macroprudential measures. All regressions control for quarterly time and country fixed effects. Clustered–by country–standard errors are included in parenthesis. *, **, *** denote significance at 10, 5 and 1 percent, respectively.

6. Conclusion

Empirical evidence offers consistent support for the effectiveness of macroprudential policy. A meta-analysis of the literature on how macroprudential tools affect asset prices and credit confirms this finding, with micro-level evidence pointing to larger effects than those found in aggregate data, especially for liquidity and housing related tools.

The sacrifice in terms of output foregone tends to be modest when macroprudential policy is used to achieve financial stability goals. Dampening effects on output are found to be modest when tools are tightened outside of periods of stress. Such use can then reduce the build-up of vulnerabilities and increase resilience to shocks, thereby reducing tail-risks to future output, in line with the objectives of the policy.

Effects of macroprudential policy seem to depend on both the direction and the size of the policy change. There is evidence for diminishing marginal returns: the net benefits of tighter policies tend to decline and eventually be exhausted. Some evidence also points to stronger effects of tightening than loosening actions, although evidence on the effectiveness of relaxation measures is still more limited.

The experience during the COVID-19 pandemic suggests that releasing capital buffers, as part of the policy response, helped support the provision of credit to the economy and suggests there might be a case for positive neutral buffers going forward. Additional work should examine how dividend payment restrictions complemented these relaxation measures and enhanced their ultimate effectiveness by helping preserve capital. The emerging evidence also suggest that the resilience-building effects of macroprudential policy hold-up through time, especially for borrower-based tools, suggesting that preemptive use of such tools can reap important benefits.

Further progress evaluating these issues is essential for policymaking. Policymakers need to know not just whether macroprudential intervention is useful, but also "how much" of it is needed to achieve the ultimate policy objectives effectively and efficiently. Some research is already available to help guide the calibration of macroprudential policy but further research and operational guidance are needed to ensure a more effective design and use of tools to mitigate systemic risks. To make progress, better data on the size of policy changes—the intensive margin of the change—is critical.

Additional work is needed to evaluate the role of macroprudential policy in strengthening the resilience of the financial system. The challenge to understanding its ultimate effectiveness has been the lack of consensus on how to best operationalize concepts such as financial stability and systemic risk, including on whether their dimensionality can be reduced to a single or at least a few indicators. Recent empirical progress in estimating the effects of macroprudential policy on risks to output is useful in providing a summary assessment that can be tied back to the ultimate objectives of macroprudential policy, thereby providing an important anchor for policy discussions.

New analysis presented in this paper highlights the interaction of macroprudential measures with other policies, especially in EMDEs. Among EMDEs, FXI, monetary, and macroprudential policies reinforce each other and tightening these policies simultaneously can have a larger impact on credit. In contrast, there is no robust evidence of interactions with macroprudential policies for AEs.

Nonbank financial intermediation (including fintech), crypto assets, and digital money are the new frontier of macroprudential policy. This paper has largely focused on the evidence for traditional bank-centered measures. However, given the rapid recent growth of nonbank financial institutions, including mutual funds and fintech firms, and the growing evidence on leakage to nonbanks, macroprudential regulation in this area will gain further prominence in coming years. Similarly, the emergence of crypto assets and forms of digital money pose new challenges to macroprudential policies that will need to be tackled.

Annex 1. Empirical Analysis of Policy Interactions

A. Construction of Policy Measures

Macroprudential Policy

For macroprudential policy, the authors use the IMF Integrated Macroprudential Policy Database, which provides dummy-type information on tightening and loosening actions for 17 macroprudential policy instruments at a monthly frequency.[25] The dummy takes a value of 1 for a tightening action, –1 for a loosening action, and zero for no change. It is important to note that the index only indicates the direction of a policy change and does not contain information on (1) the starting level of the policy, (2) the intensity of the change, and (3) the distinctions between whether a policy is absent from a country's toolbox or there is simply not enough information about the policy in question.

The authors consider three categories of macroprudential policy indices: (1) an overall index constructed as the sum of all 17 macroprudential instruments, (2) an index for borrower-based (demand) measures—TVDSTI—and, (3) an index for lender-based (supply) measures including all of the remaining 15 instruments.

The authors construct the macroprudential policy shock as follows. For each of the three policy indices, the authors estimate the following fixed effects ordered logit regression:[26]

$$MaPP^*_{it} = \alpha_{0i} + \alpha_1 cgap_{it-1} + \alpha_2 hgap_{it-1} + \alpha_3 vix_{t-1} + \alpha_4 PostGFC_t \alpha_{43} + \tau_i + \eta_t + \varepsilon^{MaPP}_{it},$$

where i and t index country and quarter respectively. $MaPP^*_{it}$ is the latent variable behind the macroprudential policy index. Because the indices are greater (lower) than 2 (–2) in rare cases, the authors replace those values of the index with value 2 (–2) to increase the power of the estimation. $cgap_{it-1}$ is credit-to-GDP gap and $hgap$ is house price gap. Both are measured as deviation from trend estimated using an HP filter. The authors include the VIX index to control for global risk and a dummy for the post GFC period *PostGFC* (2010:Q1 and after) to account for potential regime change in countries' adoption of macroprudential policy after the crisis. The authors also include country and time fixed effects. The authors estimated the regression separately for advanced economies and emerging and developing economies. The authors standardize the residual to have zero mean and unit standard deviation. The authors define the macroprudential policy shock as the residual ε^{MaPP}_{it}.

Monetary Policy

The authors measure monetary policy shocks as the residual of a parsimonious Taylor rule for each country. Specifically, the authors estimate:

$$r_{it} = \alpha_{0i} + \alpha_{1i} r_{t-1} + \alpha_{i2} y_{it} + \alpha_{i2} \pi_{it} + \tau_i + \varepsilon^r_{it},$$

for advanced economies and

[25] The overall index includes the following 17 instruments: countercyclical buffers, conservation buffers, capital requirements, leverage limits, loan loss provisions, limits on credit growth, loan restrictions, limits on foreign currency, limits on the loan-to-value ratio, limits on the debt-service-to-income ratio, tax measures (for example, stamp duties and capital gain taxes), liquidity requirements, limits on the loan-to-deposit ratios, limits on foreign exchange positions, reserve requirements, measures to mitigate risks from global and domestic systemically important financial institutions (for example, capital and liquidity surcharges) and other measures (for example, limits on exposures between financial institutions). The borrower-based (demand) instruments include limits on the loan-to-value ratio and limits on the debt-service-to-income ratio. The non-borrower-based (supply) instruments include the other 15 instruments.

[26] The authors estimate the fixed effect ordered logit model using the "blow-up and cluster" estimator from Baetschmann, Staub, and Winkelmann (2015). The authors implement it using Stata's feologit command.

$$r_{it} = \alpha_{0i} + \alpha_{1i} r_{t-1} + \alpha_{i2} y_{it} + \alpha_{i2} \pi_{it} + \alpha_{i3} \Delta lnreer_{it} + \tau_i + \varepsilon^r_{it},$$

for emerging and developing economies, where r_{it}, y_{it}, π_{it}, and $\Delta lnreer_{it}$ are policy rate, output gap (estimated by HP filtered real GDP), consumer price index (CPI) inflation, and the log difference in real effective exchange rate, respectively. For the policy rate, the authors use policy rate data from the IMF International Financial Statistics, BIS, and OECD, except for the euro area, Japan, United Kingdom, and the United States, for which the authors use Krippner's (2015) shadow short rate to account for conventional and unconventional monetary policy. The authors standardize the residual to have zero mean and unit variance within the country group. The authors define monetary policy shock as the residual ε^r_{it}.

Capital Flow Management (CFM)

The authors use CFM data by Baba and others (forthcoming), who collect data from the IMF Annual Report on Exchange Arrangement and Exchange Restrictions (AREAER). The data provide dummy-type information on the tightening and easing of capital controls on inflows and outflows, each takes a value of 1 for a tightening action, –1 for a loosening action, and zero for no change. The authors construct an overall CFM index as the sum of net inflows and net outflows actions.[27]

The authors estimate the CFM shock using a fixed-effects ordered logit model similarly to the macroprudential policy shock. They estimate:

$$CFM^*_{it} = \alpha_{0i} + \alpha_{1i} X_{it-1} + \tau_i + \eta_t + \varepsilon^{CFM}_{it},$$

where CFM^*_{it} is the latent variable behind the categorical CFM index. Similar to the macroprudential policy indices, the authors top (bottom) censor the CFM index at value 2 (–2). X_{it-1} is a set of predictors for CFM following Forbes and others (2015), including percentage change in real effective exchange rate, percentage change in portfolio flows over the last two quarters, one year ahead CPI inflation from consensus forecast, percentage change in credit-to-GDP, the VIX index, percentage change in commodity price, interest rate differential relative to the US policy rate,[28] foreign reserves as a percentage of GDP, and a dummy variable for floating exchange rate regime. The authors estimate the regression by country groups. The authors normalize the shock to have zero mean and unity standard deviation within a country group. They define CFM shock as the residual ε^{CFM}_{it}.

Foreign Exchange Intervention (FXI)

The authors use a new database on FXI by Adler and others (2021), who combine official FX data with proxies that account for a wide range of central bank operations. They define FXI as any transaction that changes the central bank's foreign currency position, with a positive value indicating an increase in the position. This measure differs from other existing measures due to its focus on (1) active transactions, so that passive changes (for example, interest income or valuation change) are not considered as interventions, (2) central bank as the entity conducting interventions, and (3) currency position (but not foreign assets). It is important to note that the data do not distinguish the type of domestic currency assets (money or debt) supplied in exchange for foreign currency assets, therefore, do not distinguish between sterilized or unsterilized interventions.

The authors construct the FXI shock using a fixed effects model. They regress total FXI in percent of (three-year moving average of) GDP on the same set of variables as in the CFM regression:

$$FXI_{it} = \alpha_{0i} + \alpha_{1i} X_{it-1} + \tau_i + \eta_t + \varepsilon^{FXI}_{it}.$$

[27] In results not shown, the authors also consider a CFM index as the difference of net inflows and net outflows restrictions. Their main results are not affected. This implies that the CFM-related results could be mainly driven by inflow controls.

[28] For the United States, the authors use the interest rate differential against the euro.

Annex Table 1. Sample Economies for the Panel Regression Analysis in Tables 4 and 5

Advanced Economies (AEs)	Emerging Market and Developing Economies (EMs)
Australia	Brazil
Austria	Chile
Belgium	China
Canada	Colombia
Czech Republic	Croatia
Denmark	Hungary
Finland	India
France	Indonesia
Germany	Malaysia
Greece	Mexico
Ireland	Poland
Italy	Romania
Japan	Russia
Korea	South Africa
The Netherlands	Thailand
New Zealand	Türkiye
Norway	
Portugal	
Spain	
Sweden	
Switzerland	
United Kingdom	
United States	

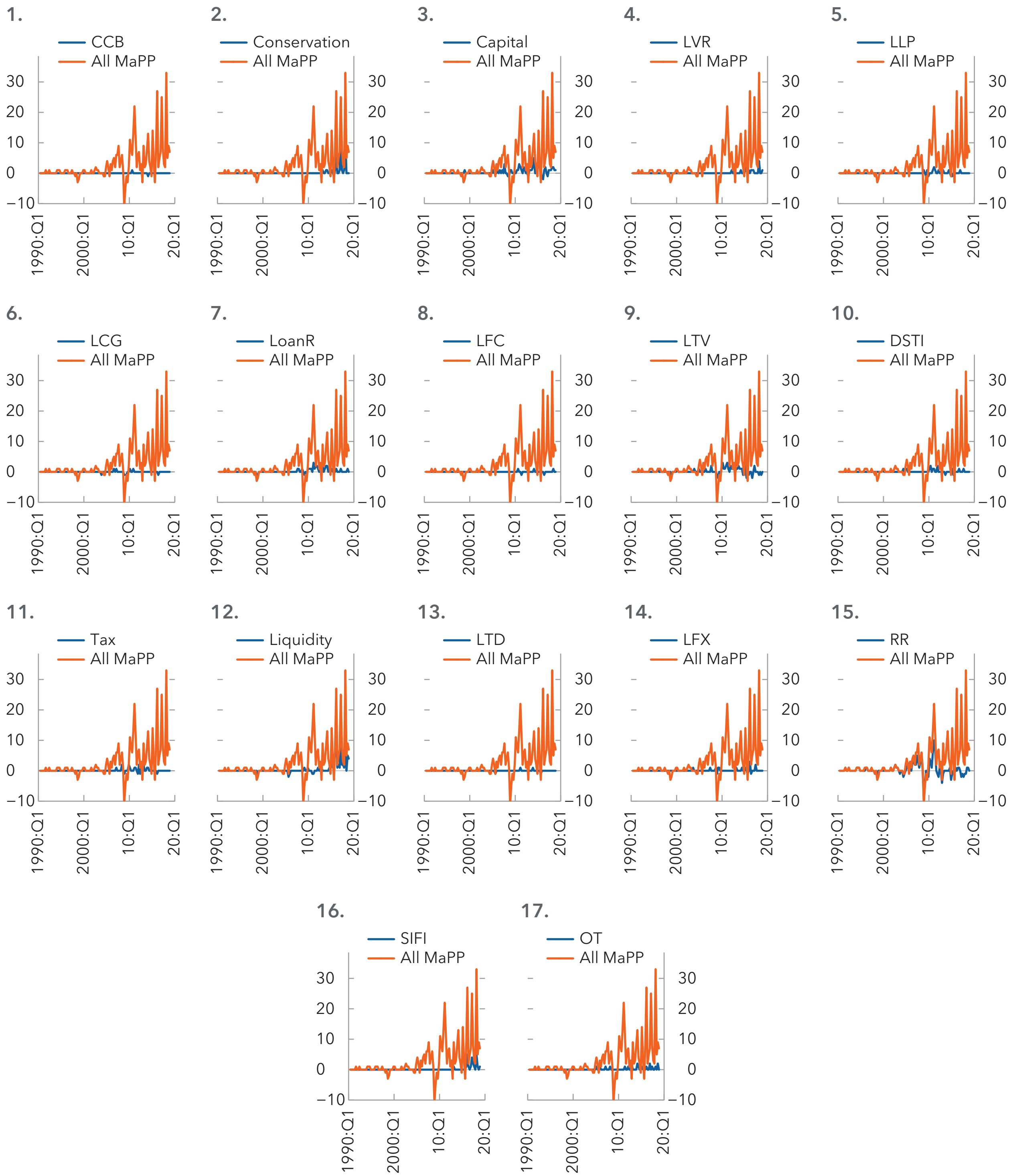
The authors estimate the regression by country group. They define FXI shock as the residual ε_{it}^{FXI}. They normalize the shock to have unity standard deviation within a country group.

Fiscal Policy

The authors construct fiscal policy shocks as a residual from a fiscal-response-function, which is estimated for each country at quarterly frequencies and takes the following form:

$$pb_t = \beta_1 pb_{t-1} + \beta_2 ygap_t D_t + \beta_3 ygap_t(1 - D_t) + pd_{t-1} + \varepsilon_{it}^{f},$$

Annex Figure 1. Macroprudential Policy Actions in EMs



Source: Alam and others (2019) and authors' calculations.
Note: The orange line denotes the sum of all 17 macroprudential policy measures (All MaPP), aggregated for all EMs that we consider in our sample. The blue line denotes individual policy actions, also aggregated for all EMs in our sample. CCB = countercyclical buffers; Conservation = conservation buffers; Capital = capital requirements; LVR = leverage limits; LLP = loan loss provisions; LCG = limits on credit growth; LoanR = loan restrictions; LFC = limits on foreign currency; LTV = loan-to-value ratio limits; DSTI = debt-service-to-income ratio limits; Tax = tax measures; Liquidity = liquidity requirements; LTD = limits on the loan-to-deposit ratio; LFX = limits on foreign exchange position; RR = reserve requirements; SIFI = measures to mitigate actions by systemically important institutions; OT = other macroprudential measures (e.g., stress testing, restrictions on profit distribution, and structural measures).

where *pb* is primary balance (as a ratio of GDP). *ygap* is output gap. *D* is a dummy variable that takes a value of 1 when the output gap is positive.[29] *d* is debt to GDP. The authors interpolate quarterly series from annual series when the former is not available. A similar specification was initially proposed in Bohn (1998) and adopted in IMF (2003), Abiad and Ostry (2005), and Celasun and Kang (2006). The authors normalize the shock to have unity standard deviation within a country group. The authors define fiscal shock as the residual ε^f_{it}.

B. Full Model Empirical Specification

The authors evaluate the dynamic responses of bank credit to the five policies and their interactions. The authors' full specification adopts the following local projections framework:

$$\begin{aligned}\Delta Y_{it+h} = {} & \sum_{k=1}^{4}\alpha_{1kh}\Delta Y_{iit-k} + \sum_{k=1}^{4}\alpha_{2kh}Z_{it-k} + \sum_{m=1}^{5}\sum_{k=1}^{4}\beta^{m}_{1kh}Policy^{m}_{it-k} + \sum_{m\neq n}\sum_{k=1}^{4}\beta^{mn}_{2kh}Policy^{m}_{it-k}Policy^{n}_{it-k} \\ & + \sum_{m\neq n\neq p}\sum_{k=1}^{4}\beta^{mnp}_{3kh}Policy^{m}_{it-k}Policy^{n}_{it-k}Policy^{p}_{it-k} + \sum_{m\neq n\neq p\neq q}\sum_{k=1}^{4}\beta^{mnpq}_{3kh}Policy^{m}_{it-k}Policy^{n}_{it-k}Policy^{p}_{it-k}Policy^{q}_{it-k} \\ & + \sum_{k=1}^{4}\beta^{mnpqs}_{4kh}Policy^{m}_{it-k}Policy^{n}_{it-k}Policy^{p}_{it-k}Policy^{q}_{it-k}Policy^{s}_{it-k} + \tau_i + \delta_t + \varepsilon_{it+h},\end{aligned}$$

where *i* and *t* index country and quarter respectively. *h* is the projection horizon. Δ is the first difference operator. *Y* is real credit. The authors include 1 to 4 lags of the dependent variable as a regressor to capture autocorrelated dynamics. The authors include 1 to 4 lags of real (quarterly) GDP growth, Z, to control for macroeconomic conditions. They also include time and country fixed effects. $Policy^j$ (j=1 to 5) is one of the five policy shocks: macroprudential, monetary, CFM, FXI, and fiscal. They include 1 to 4 lags of all policy shocks and their interactions, although the authors' focus is on the coefficients of the first lag of the macroprudential policy shock and all its interactions: β^{m}_{11h}, β^{mn}_{11h} , β^{mnp}_{11h}, β^{mnpq}_{11h}, and β^{mnpqs}_{11h}, where $Policy^{m}_{it-1}$ is the macroprudential policy shock. The authors estimate the regression by country group and cluster standard errors at the country level.

[29] Including the dummy for positive output gap allows for an asymmetric response of primary balance to output gap, for example, primary balance may deteriorate more when the output gap is negative than it improves when the gap is positive.

References

Abiad, Abdul and Jonathan Ostry. 2005. "Primary Surpluses and Sustainable Debt Levels in Emerging Market Countries." IMF Policy Discussion Paper PDP/05/6, International Monetary Fund, Washington, DC.

Acemoglu, Daron, Asuman Ozdaglar, and Alireza Tahbaz-Salehi. 2015. "Systemic Risk and Stability in Financial Networks." *American Economic Review* 105 (2): 564–608.

Acharya, Viral V., Katharina Bergant, Matteo Crosignani, Tim Eisert, and Fergal J. McCann. 2020. "The Anatomy of the Transmission of Macroprudential Policies." NBER Working Paper No. w27292, National Bureau of Economic Research, Cambridge, MA.

Adler, Gustavo, Kyun Suk Chang, Rui C. Mano, and Yuting Shao. 2021. "Foreign Exchange Intervention: A Dataset of Public Data and Proxies." IMF Working Paper 21/47, International Monetary Fund, Washington, DC.

Adrian, Tobias, Patrick de Fontnouvelle, Emily Yang, and Andrei Zlate. 2017. "Macroprudential Policy: A Case Study from a Tabletop Exercise." *Economic Policy Review* 23 (1): 1–30.

Adrian, Tobias, Nina Boyarchenko, and Domenico Giannone. 2019. "Vulnerable Growth." *American Economic Review* 109 (4): 1263–89.

Adrian, Tobias, Federico Grinberg, Nellie Liang, and Sheheryar Malik. 2018. "The Term Structure of Growth-at-Risk." IMF Working Paper 18/180, International Monetary Fund, Washington, DC.

Aguirre, Horacio, and Gaston Luis Repetto. 2017. "Capital and Currency-Based Macroprudential Policies: An Evaluation Using Credit Registry Data." BIS Working Paper 672, Bank for International Settlements, Basel.

Ahnert, Toni, Kristin Forbes, Christian Friedrich, and Dennis Reinhardt. 2021. "Macroprudential FX Regulations: Shifting the Snowbanks of FX Vulnerability?" Journal of Financial Economics 140 (1): 145–74.

Aikman, David, Jonathan Bridges, Anil Kashyap, and Caspar Siegert. 2019. "Would Macroprudential Regulation Have Prevented the Last Crisis?" *Journal of Economic Perspectives* 33 (1): 107–30.

Aiyar, Shekhar, Charles W. Calomiris, and Tomasz Wieladek. 2014. "Does Macro-Prudential Regulation Leak? Evidence from a UK Policy Experiment." *Journal of Money, Credit and Banking* 46 (1): 181–214.

Akinci, Ozge, and Jane Olmstead-Rumsey. 2018. "How Effective are Macroprudential Policies? An Empirical Investigation." *Journal of Financial Intermediation* 33: 33–57.

Alam, Zohair, Adrian Alter, Jesse Eiseman, Gaston Gelos, Heedon Kang, Machiko Narita, Erlend Nier, and Naixi Wang. 2019. "Digging Deeper: Evidence on the Effects of Macroprudential Policies from a New Database." IMF Working Paper 19/66, International Monetary Fund, Washington, DC.

Altavilla, Carlo, Luc Laeven, and José-Luis Peydró. 2020. "Monetary and Macroprudential Policy Complementarities: Evidence from European Credit Registers." ECB Working Paper Series No 2504, European Central Bank, Frankfurt.

Altunbas, Yener, Mahir Binici, and Leonardo Gambacorta. 2018. "Macroprudential Policy and Bank Risk." *Journal of International Money and Finance* 81: 203–20.

Ampudia, Miguel, Marco Lo Duca, Mátyás Farkas, Gabriel Perez-Quiros, Gerhard Rünstler, and Eugen Tereanu. 2021. "On the Effectiveness of Macroprudential Policy." ECB Working Paper 2559, European Central Bank, Frankfurt.

Angelini, Paolo, Steffano Neri, and Fabio Panetta. 2014. "The Interaction between Capital Requirements and Monetary Policy." *Journal of Money, Credit and Banking* 46 (6): 1073–112.

Aoki, Kosuke, Gianluca Benigno, and Nobuhiro Kiyotaki. 2018. "Monetary and Financial Policies in Emerging Markets." Unpublished, Princeton University.

Araujo, Juliana, Manasa Patnam, Adina Popescu, Fabian Valencia, and Weija Yao. 2020. "Effects of Macroprudential Policy: Evidence from over 6,000 Estimates." IMF Working Paper 20/67, International Monetary Fund, Washington, DC.

Auerbach, Alan J., and Yuriy Gorodnichenko. 2013. "Output Spillovers from Fiscal Policy." *American Economic Review* 103 (3): 141–46.

Auerbach, Alan J., Yuriy Gorodnichenko, and Daniel Murphy. 2020. "Effects of Fiscal Policy on Credit Markets." *AEA Papers and Proceedings* 110: 119–24.

Avdjiev, Stefan, Catherine Casanova, Patrick McGuire, and Goetz von Peter. 2016. "International Prudential Policy Spillovers: A Global Perspective." BIS Working Papers 589, Bank for International Settlements, Basel.

Ayyagari, Meghana, Thorsten Beck, and Maria Soledad Martinez Peria, 2018. "The Micro Impact of Macroprudential Policies: Firm-Level Evidence." IMF Working Paper 18/267, International Monetary Fund, Washington, DC.

Baba, Chikako, Ricardo Cervantes, Salim Darbar, Annamaria Kokenyne, and Viktoriya Zotova. Forthcoming. "New Measures of Capital Flow Restrictions – AREAER Indices." IMF Working Paper, International Monetary Fund, Washington, DC.

Baetschmann, G., K. E. Staub, and R. Winkelmann 2015. "Consistent Estimation of the Fixed Effects Ordered Logit Model." *Journal of the Royal Statistical Society Series A* 178: 685–703.

Bahaj, Saleem, and Frederic Malherbe. 2020. "The Forced Safety Effect: How Higher Capital Requirements Can Increase Bank Lending." *The Journal of Finance* 75 (6): 3013–53.

Bank for International Settlements (BIS). 2010. "Assessing the Macroeconomic Impact of the Transition to Stronger Capital and Liquidity Requirements." Basel.

Barro, Robert J. 1984. *Macroeconomics*. Hoboken, New Jersey: John Wiley and Sons Ltd.

Basel Committee on Banking Supervision (BCBS). 2013. "Basel Committee on Banking Supervision Basel III: The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools." Basel.

Basel Committee on Banking Supervision (BCBS). 2021. "Basel Committee on Banking Supervision Early Lessons from the COVID-19 Pandemic on the Basel Reforms." Basel.

Basu, Suman, Emine Boz, Gita Gopinath, Francisco Roth, and Filiz Unsal. 2020. "A Conceptual Model for an Integrated Policy Framework." IMF Working Paper 20/121, International Monetary Fund, Washington, DC.

Bellemare, Marc F., Takaaki Masaki, and Thomas B. Pepinsky, 2017. "Lagged Explanatory Variables and the Estimation of Causal Effect." *The Journal of Politics* 79 (3).

Bergant, Katharina, and Kristin Forbes. 2021. "Macroprudential Policy during COVID-19: The Role of Policy Space." NBER No. w29346, National Bureau of Economic Research, Cambridge, MA.

Bergant, Katharina, Francesco Grigoli, Niels-Jakob H. Hansen, and Damiano Sandri. 2020. "Dampening Global Financial Shocks: Can Macroprudential Regulation Help (More Than Capital Controls)?" IMF Working Paper 2020/106, International Monetary Fund, Washington, DC.

Bernanke, Ben S., and Alan S. Blinder. 1988. "Is It Money or Credit, or Both, or Neither?" *American Economic Review* 78 (2): 435–39.

Bernanke, Ben S., and Mark Gertler. 1995. "Inside the Black Box: The Credit Channel of Monetary Policy Transmission." *Journal of Economic Perspectives* 9 (4): 27–48.

Berrospide, Jose M. 2021. "Editorial on IFABS 2017 Financial Regulation." *Journal of Banking & Finance* 106391.

Bhargava, Apoorv, Lucyna Górnicka, and Peichu Xie. 2021. "Leakages from Macroprudential Regulations: The Case of Household-Specific Tools And Corporate Credit." IMF Working Paper 2021/113, International Monetary Fund, Washington, DC.

Biljanovska, Nina, Lucyna Gornicka, and Alexandros Vardoulakis. 2019. "Optimal Macroprudential Policy and Asset Price Bubbles." IMF Working Paper 2019/184, International Monetary Fund, Washington, DC.

Boar, Codruta, Leonardo Gambacorta, Giovanni Lombardo, and Luiz A. Pereira da Silva. 2017. "What Are the Effects of Macroprudential Policies on Macroeconomic Performance?" *BIS Quarterly Review* (September) 71–88.

Bohn, Henning. 1998. "The Behavior of U.S. Public Debt and Deficits." *The Quarterly Journal of Economics* 113 (3): 949–63.

Brandao-Marques, Gaston Gelos, Machiko Narita, and Erlend Nier. 2020. "Leaning Against the Wind: An Empirical Cost-Benefit Analysis." IMF Working Paper 20/123, International Monetary Fund, Washington, DC.

Brunnermeier, Markus, and Yuliy Sannikov. 2016. "The I Theory of Money Markus." NBER Working Paper No. 22533, National Bureau of Economic Research, Cambridge, MA.

Bruno, Valentina, Ilhyock Shim, and Hyun Song Shin. 2017. "Comparative Assessment of Macroprudential Policies." *Journal of Financial Stability* 28: 183–202.

Budnik, Katarzyna Barbara, and Gerhard Rünstler. 2020. "Identifying SVARS from Sparse Narrative Instruments: Dynamic Effects of U.S. Macroprudential Policies." ECB Working Paper 2353, European Central Bank, Frankfurt.

Catalán, Mario, Alexander W. Hoffmaister, and Cicilia Anggadewi Harun. 2020. "Bank Capital and Lending: Evidence Of Nonlinearity From Indonesia." *Journal of Asian Economics* 68.

Celasun, Oya, and Joong Shik Kang. 2006. "On the Properties of Various Estimators for Fiscal Reaction Functions." IMF Working Paper 06/182, International Monetary Fund, Washington, DC.

Cerutti, Eugenio, Stijn Claessens, and Luc Laeven. 2015. "The Use and Effectiveness of Macroprudential Policies: New Evidence." IMF Working Paper 15/61, International Monetary Fund, Washington, DC.

Chari, Anusha, Karlye Dilts Stedman, and Kristin Forbes. 2022. "Spillovers at the Extremes: The Macroprudential Stance and Vulnerability to the Global Financial Cycle." NBER Working Paper 29670, National Bureau of Economic Research, Cambridge, MA.

Chernozhukov, Victor., Denis Chetverikov, Mert Demirer, Esther Duflo, Christian Hansen, Whitney Newey, and James Robins. 2018. "Double/Debiased Machine Learning for Treatment And Structural Parameters." *Econometrics Journal* 21: 1–68.

Cizel, Janko, Jon Frost, Aerdt Houben, and Peter Wierts. 2019. "Effective Macroprudential Policy: Cross-Sector Substitution from Price and Quantity Measures." *Journal of Money, Credit and Banking* 51: 1209–235.

Claessens, Stijn, Swati R Ghosh, and Roxana Mihet. 2013, "Macro-Prudential Policies to Mitigate Financial System Vulnerabilities." *Journal of International Money and Finance* 39: 153–85.

Collard, Fabrice, Harris Dellas, Behzad Diba, and Olivier Loisel. 2017. "Optimal Monetary and Prudential Policies." *American Economic Journal: Macroeconomics* 9 (1): 40–87.

Couaillier, Cyril, Marco Lo Duca, Alessio Reghezza, and Costanza Rodriguez d'Acri, 2022. "Caution: Do Not Cross! Capital Buffers and Lending in COVID-19 Times." ECB Working Paper No. 2644, European Central Bank, Frankfurt.

Couaillier, Cyril, Alessio Reghezza, Costanza Rodriguez d'Acri, and Alessandro Scopelliti. "How to Release Capital Requirements During a Pandemic? Evidence from Euro Area Banks." ECB Working Paper No. 2720, European Central Bank, Frankfurt.

Cournède, Boris, Sahra Sakha, and Volker Ziemann. 2019. "Empirical Links Between Housing Markets and Economic Resilience." OECD Economics Department Working Paper No. 1562, Organisation for Economic Co-operation and Development, Paris.

Dagher, Jihad, Giovanni Dell'Ariccia, Luc Laeven, Lev Ratnovski, and Hui Tong. 2016. "Benefits and Costs of Bank Capital." IMF Staff Discussion Note 16/04, International Monetary Fund, Washington, DC.

Damar, H. Evren, and Miguel Molico. 2016. "On the Nexus of Monetary Policy and Financial Stability: Effectiveness of Macroprudential Tools in Building Resilience and Mitigating Financial Imbalances." BOC Staff Discussion Paper 11, Bank of Canada, Ottawa.

Dávila, Eduardo, and Anton Korinek. 2018. "Pecuniary Externalities in Economies with Financial Frictions." *The Review of Economic Studies* 85 (1): 352–95.

de Haan, L., and Mastrogiacomo, M. 2020. "Loan to Value Caps and Government-Backed Mortgage Insurance: Loan-Level Evidence from Dutch Residential Mortgages." *De Economist* 168: 453–73.

De Schryder, Selien, and Frederic Opitz. 2021. "Macroprudential Policy and Its Impact on the Credit Cycle." *Journal of Financial Stability* 53: 100818.

Demirgüç-Kunt, Asli, Alvaro Pedraza, and Claudia Ruiz-Ortega. 2021. "Banking Sector Performance During The COVID-19 Crisis." *Journal of Banking and Finance* 133, Article 106305.

Devereux, Michael B., Allen C. Head, and Beverly J. Lapham. 1996. "Monopolistic Competition, Increasing Returns, and the Effects of Government Spending." *Journal of Money, Credit and Banking* 28 (2): 233–54.

Diamond, Douglas W., Yunzhi Hu, and Raghuram G. Rajan. 2020. "The Spillovers from Easy Liquidity And The Implications For Multilateralism." *IMF Economic Review* 68: 4–34.

Edwards, Sebastian. 2021. "Macroprudential Policies and The COVID-19 Pandemic: Risks and Challenges For Emerging Markets." NBER Working Paper 29441, National Bureau of Economic Research, Cambridge, MA.

Epure, Mircea, Irina Mihai, Camelia Minoiu, and José-Luis Peydro. 2018. "Household Credit, Global Financial Cycle, and Macroprudential Policies: Credit Register Evidence from an Emerging Country." IMF Working Paper 18/13, International Monetary Fund, Washington, DC.

European Systemic Risk Board (ESRB). 2022. "Review of the EU Macroprudential Framework for the Banking Sector." ESRB Concept Note, Frankfurt.

Fang, Xiang, David Jutrsa, Soledad Martinez Peria, Andrea Presbitero and Lev Ratnovski. 2022. "Bank Capital Requirements and Lending in Emerging Markets: The Role of Bank Characteristics and Economic Conditions." *Journal of Banking and Finance* 135: 105806.

Farhi, Emmanuel, and Ivan Werning. 2016. "A Theory of Macroprudential Policies in the Presence of Nominal Rigidities." *Econometrica* 84: 1645–704.

Farhi, Emmanuel, and Jean Tirole. 2012. "Collective Moral Hazard, Maturity Mismatch, and Systemic Bailouts." *American Economic Review* 102 (1): 60–93.

Fernandez-Gallardo, Alvaro, and Ivan Paya. 2020. "Macroprudential Policy in The Euro Area." Lancaster University Management School Working Paper 307121127, Lancaster. United Kingdom.

Financial Stability Board (FSB). 2021. "Evaluation of the Effects of Too-Big-To-Fail Reforms." Basel.

Fisher, Jonas D.M., and Ryan Peters, 2010. "Using Stock Returns to Identify Government Spending Shocks." *Economic Journal* 120 (544): 414–36.

Forbes, Kristin J. 2019. "Macroprudential Policy: What We've Learned, Don't Know, and Need to Do." *AEA Papers and Proceedings* 109: 470–75.

Forbes, Kristin. 2020. "The International Aspects of Macroprudential Policy." NBER Working Paper 27698, National Bureau of Economic Research, Cambridge, MA.

Forbes, Kristin, and Michael Klein. 2015. "Pick Your Poison: The Choices and Consequences of Policy Responses to Crises." *IMF Economic Review* 63 (April): 197–237.

Forbes, Kristin, Marcel Fratzscher, and Roland Straub. 2015. "Capital-Flow Management Measures: What Are They Good For?" *Journal of International Economics* 96: S76–S97.

Friedman, Milton, and Anna Schwartz. 1963. *A Modern History of the United Stated.* Princeton, NJ: Princeton University Press.

Fuster, Andreas, and Basit Zafar. 2015. "The Sensitivity of Housing Demand to Financing Conditions: Evidence From a Survey." FRB of New York Staff Report 702, Federal Reserve Board, New York.

Galán, Jorge E. 2020. "The Benefits Are at The Tail: Uncovering the Impact of Macroprudential Policy On Growth-At-Risk." *Journal of Financial Stability* (November): 100831.

Galati, Gabriele, and Richhild Moessner. 2018. "What Do We Know About the Effects Of Macroprudential Policy?" *Economica* 85: 735–70.

Gambacorta, Leonardo, and Andrés Murcia. 2017. "The Impact of Macroprudential Policies And Their Interaction With Monetary Policy: An Empirical Analysis Using Credit Registry Data." BIS Working Paper No 636, Bank for International Settlements, Basel.

Gambacorta, Leonardo, and Andrés Murcia. 2020. "The Impact of Macroprudential Policies in Latin America: An Empirical Analysis Using Credit Registry Data." *Journal of Financial Intermediation* 42: 100828.

Gambacorta, Leonardo, and Hyun Song Shin. 2018. "Why Bank Capital Matters for Monetary Policy." *Journal of Financial Intermediation* 35: 17–29.

Gelos, Gaston, Lucyna Gornicka, Robin Koepke, Silvia Sgherri, and Ratna Sahay. 2022. "Capital Flows at Risk: Taming the Ebbs and Flows." *Journal of International Economics* 34:103555.

Gertler, Mark, and Simon Gilchrist. 1994. "Monetary Policy, Business Cycles, And the Behavior of Small Manufacturing Firms." *The Quarterly Journal of Economics* 109 (2): 309–40.

Gertler, Mark, and Nobuhiro Kiyotaki. 2010. "Financial Intermediation and Credit Policy in Business Cycle Analysis." *Handbook of Monetary Economics* 3: 547–99.

Ghosh, Atish , Jonathan Ostry, and Mavash Qureshi. 2017. "Managing the Tide: How do Emerging Markets Respond to Capital Flows?" IMF Working Paper 17/69, International Monetary Fund, Washington, DC.

Ghosh, Atish, Jonathan Ostry, and Mavash Qureshi. 2018. T*aming the Tide of Capital Flows: A Policy Guide*. Cambridge, MA: MIT Press.

Gómez, Esteban, Andrés Murcia, Angélica Lizarazo, and Juan Carlos Mendoza. Forthcoming. "Evaluating the Impact of Macroprudential Policies in Colombia's Credit Growth." *Journal of Financial Intermediation*.

Goodhart, Charles. 2008. "The Boundary Problem in Financial Regulation." *National Institute Economic Review* 206 (1).

Gornicka, Lucyna, and Laura Valderrama. 2020. "Stress Testing and Calibration of Macroprudential Policy Tools." IMF Working Paper 20/165, International Monetary Fund, Washington, DC.

Grodzicki, Maciej, and Mariusz Jarmuzek. 2021. "The Impact of Regulatory Reforms for Systemically Important Institutions, Defined as "Other" (O-SII)." *Journal of Policy Modeling* 43 (6): 1344–53.

Gross, Marco, and Javier Población. 2017. "Assessing the Efficacy of Borrower-Based Macroprudential Policy Using an Integrated Micro-Macro Model for European Households." *Economic Modelling* 61: 510–28.

Hahm, Joon-Ho, Hyun Song Shin, and Kwanho Shin. 2013. "Noncore Bank Liabilities and Financial Vulnerabilities." *Journal of Monetary, Credit and Banking* 45 (s1): 3–36.

Hebous, Shafik, and Tom Zimmermann. 2021. "Can Government Demand Stimulate Private Investment? Evidence from U.S. Federal Procurement." *Journal of Monetary Economics* 118: 178–94.

Hofmann, Boris, Hyun Song Shin, and Mauricio Villamizar-Villegas. 2019. "FX Intervention and Domestic Credit: Evidence From High-Frequency Micro Data." BIS Working Paper No 774, Bank for International Settlements, Basel.

Igan, D., and H. Kang. 2011. "Do Loan-to-Value and Debt-to-Income Limits Work? Evidence from Korea." IMF Working Paper 11/297, International Monetary Fund, Washington, DC.

Imbierowicz, Bjorn, Jonas Kragh, and Jesper Rangvid. 2018. "Time-Varying Capital Requirements and Disclosure Rules: Effects on Capitalization and Lending Decisions." *Journal of Money, Credit, and Banking* 50 (4): 573–602.

International Monetary Fund (IMF). 2012. "The Interaction of Monetary and Macroprudential Policies – Background Paper." Washington, DC.

International Monetary Fund (IMF). 2013. "Key Aspects of Macroprudential Policy." Policy Paper, Washington, DC.

International Monetary Fund (IMF). 2014a. "Staff Guidance Note on Macroprudential Policy." Policy Paper. Washington, DC.

International Monetary Fund (IMF). 2014b. "Staff Guidance Note on Macroprudential Policy—Detailed Guidance on Instruments." Policy Paper, Washington, DC.

International Monetary Fund (IMF). 2016. "Tax Policy, Leverage, and Macroeconomic Stability." Policy Paper, Washington, DC.

International Monetary Fund, Bank of International Settlements, and Financial Stability Board (IMF-BIS-FSB). 2016. "Elements of Effective Macroprudential Policies." Washington, DC.

International Monetary Fund (IMF). 2018. "How to Calibrate Fiscal Rules: A Primer." Washington, DC.

International Monetary Fund (IMF). 2020. "Toward an Integrated Policy Framework." IMF Policy Paper No. 2020/046, Washington, DC.

International Monetary Fund (IMF). 2021. "2021 Comprehensive Surveillance Review – Background Paper on Systemic Risk and Macroprudential Policy Advice in Article IV Consultations." IMF Policy Paper No. 2021/033, Washington, DC.

International Monetary Fund, and World Bank (IMF-WB). 2020. "COVID-19: The Regulatory and Supervisory Implications for the Banking Sector." Joint IMF-World Bank Staff Position Note, Washington, DC.

Jeanne, Olivier. 2012. "Capital Flow Management." *American Economics Review: Papers and Proceedings* 102 (3): 203–6.

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina. 2012. "Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications." *American Economic Review* 102 (5): 2301–26.

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina. 2017. "Macroprudential Policy, Countercyclical Bank Capital Buffers, and Credit Supply: Evidence from The Spanish Dynamic Provisioning Experiments." *Journal of Political Economy* 125 (6): 2126–77.

Kashyap, Anil K., and Jeremy C. Stein. 2000. "What Do a Million Observations On Banks Say About The Transmission Of Monetary Policy?" *American Economic Review* 90 (3): 407–28.

Kelly, R., and C. O'Toole. 2018. "Mortgage Default, Lending Conditions and Macroprudential Policy: Loan-level Evidence from UK Buy-To-Lets." *Journal of Financial Stability* 36: 322–35.

Khwaja, Asim Ijaz, and Atif Mian. 2008. "Tracing the Impact of Bank Liquidity Shocks: Evidence from An Emerging Market." *American Economic Review* 98 (4): 1413–42.

Kirti, Divya, Yang Liu, Maria Soledad Martinez Peria, Jan Strasky, and Prachi Mishra. 2022. "Tracking Economic and Financial Policies During COVID-19: An Announcement-Level Database." IMF Working Paper No. 2022/114, Washington, DC.

Klingelhöfer, Jan, and Rongrong Sun. 2019. "Macroprudential Policy, Central Banks and Financial Stability: Evidence from China." *Journal of International Money and Finance* 93 (C): 19–41.

Krippner, Leo. 2015. *Zero Lower Bound Term Structure Modeling: A Practitioner's Guide*. Berlin: Springer.

Lim, Cheng H., Francesco Columba, Alejo Costa, Piyabha Kongsamut, Akira Otani, Mustafa Saiyid, Torsten Wezel, and Xiaoyong Wu. 2011. "Macroprudential Policy: What Instruments and How Are They Used? Lessons from Country Experiences." IMF Working Paper 11/238, International Monetary Fund, Washington, DC.

Mano, Rui, and Silvia Sgherri. 2020. "One Shock, Many Policy Responses." IMF Working Paper 20/10, International Monetary Fund, Washington, DC.

McDonald, Chris. 2015, "When Is Macroprudential Policy Effective?" BIS Working Paper 496, Bank for International Settlements, Basel.

Meeks, Roland. 2017. "Capital Regulation and The Macroeconomy: Empirical Evidence and Macroprudential Policy." *European Economic Review* 95: 125–41.

Mendoza, Enrique. 2018. "Macroprudential Policy: Promise and Challenges." In Monetary Policy and Global Spillovers: Mechanisms, Effects and Policy Measures, edited by Enrique G. Mendoza, Ernesto Pastén, and Diego Saravia, 225-277, Central Bank of Chile, Santiago.

Meuleman, Elien, and Rudi Vander Vennet. 2020. "Macroprudential Policy And Bank Systemic Risk." *Journal of Financial Stability* 47 (C).

Millard, Stephen, Margarita Rubio, and Alexandra Varadi. 2021. "The Macroprudential Toolkit: Effectiveness and Interactions." BoE Staff Working Paper No. 902, Bank of England, London.

Morgan, Peter J., Paulo José Regis, and Nimesh Salike, 2019. "LTV Policy as a Macroprudential Tool and Its Effects on Residential Mortgage Loans." *Journal of Financial Intermediation* 37: 89–103.

Neanidis, Kyriakos. 2019. "Volatile Capital Flows and Economic Growth: The Role of Banking Supervision." *Journal of Financial Stability* 40: 77–93.

Nier, Erlend, Tjoervi Olafsson, and Yuan Gao Rollinson. 2020. "Exchange Rates And Domestic Credit-Can Macroprudential Policy Reduce The Link?" IMF Working Paper 20/187, International Monetary Fund, Washington, DC.

Nier, Erlend, Jacek Osinski, Luis Jacome, and Pamela Madrid. 2011. "Institutional Models for Macroprudential Policy." IMF Staff Discussion Note 018, International Monetary Fund, Washington, DC.

Nier, Erlend, Radu Popa, Maral Shamloo, and Liviu Voinea. 2019. "Debt Service and Default: Calibrating Macroprudential Policy Using Micro Data." IMF Working Paper 19/182, International Monetary Fund, Washington, DC.

Nier, Erlend, and Lea Zicchino. 2008. "Bank Losses, Monetary Policy and Financial Stability—Evidence on The Interplay From Panel Data." IMF Working Paper 08/232, International Monetary Fund, Washington, DC.

Ostry, Jonathan D, Atish R Ghosh, Marcos Chamon, and Mahvash S Qureshi, 2012, "Tools For Managing Financial-Stability Risks From Capital Inflows." *Journal of International Economics* 88 (2): 407–21.

Ouyang, Alice Y., and Shen Guo. 2019. "Macro-Prudential Policies, The Global Financial Cycle and The Real Exchange Rate." *Journal of International Money and Finance* 96: 147–67.

Peydro, Jose-Luis, Francesc Rordriguez-Tous, Jagdish Tripathy, and Arzu Uluc. 2020. "Macroprudential Policy, Mortgage Cycles and Distributional Effects: Evidence from the UK." BoE Staff Working Paper 866, Bank of England, London.

Ramey, Valerie A. 2011. "Can Government Purchases Stimulate the Economy?" *Journal of Economic Literature* 49 (3): 673–85.

Reinhardt, Dennis, and Rhiannon Sowerbutts. 2015. "Regulatory Arbitrage In Action: Evidence From Banking Flows And Macroprudential Policy." BoE Working Paper 546, Bank of England, London.

Richter, Björn, Moritz Schularick, and Ilhyock Shim. 2019. "The Costs of Macroprudential Policy." *Journal of International Economics* 118: 263–82.

Rojas, Diego, Carlos Vegh, and Guillermo Vuletin. 2020. "The Macroeconomic Effects of Macroprudential Policy: Evidence From A Narrative Approach." NBER WP 27687, National Bureau of Economic Research, Cambridge, MA.

Romer, Christina, and David H. Romer. 1989. "Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz." *NBER Macroeconomics Annual* 4: 121–70.

Romer, Christina, and David Romer. 2007. "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks." NBER Working Paper 13264, National Bureau of Economic Research, Cambridge, MA.

Sufi, Amir, and Alan M. Taylor. 2021. "Financial Crises: A Survey." NBER Working Papers 29155, National Bureau of Economic Research, Cambridge, MA.

Svensson, Lars E. O. 2019. "Amortization Requirements, Distortions, And Household Resilience: Problems of Macroprudential Policy II." Stockholm School of Economics. Working Paper, Stockholm.

Takats, Elöd, and Judit Temesvary, 2019. "How Does the Interaction of Macroprudential And Monetary Policies Affect Cross-Border Bank Lending." BIS Working Paper No 782, Bank for International Settlements, Basel.

Van der Ghote, Alejandro. 2019. "Interactions Between Monetary and Macroprudential Policies." *Research Bulletin* 56.

Valencia, Fabian, Richard Varghese, Weijia Yao, and Juan Yepez. 2022. "Handle with Care: Regulatory Easing in Times of COVID-19." *The B.E. Journal of Macroeconomics* 22-1: 363–96.

Violon, Aurelien, Dominique Durant, and Oana Toader. 2020. "The Impact of the Designation of Global Systemically Important Banks on Their Business Model." *International Journal of Central Banking* 16 (5): 95–142.

Zhang, Longmei, and Edda Zoli. 2014. "Leaning Against the Wind: Macroprudential Policy in Asia." IMF Working Paper 14/22, International Monetary Fund, Washington, DC.

Zwick, Eric, and James Mahon. 2017. "Tax Policy and Heterogenous Investment Behavior." *American Economic Review* 107 (1): 217–48.

PUBLICATIONS

Macroprudential Policy Effects:
Evidence and Open Questions

DP/2023/002

ISBN 979-8-4002-2630-4