WP/20/67

IMF Working Paper

Effects of Macroprudential Policy: Evidence from Over 6,000 Estimates

by Juliana Araujo, Manasa Patnam, Adina Popescu, Fabian Valencia and Weijia Yao

IMF Working Papers **describe research in progress by the author(s) and are published to elicit comments and to encourage debate.** The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

INTERNATIONAL MONETARY FUND

© 2020 International Monetary Fund WP/20/67

IMF Working Paper

Strategy, Policy and Review Department

Effects of Macroprudential Policy: Evidence from Over 6,000 Estimates[1]

Prepared by Juliana Araujo, Manasa Patnam, Adina Popescu, Fabian Valencia and Weijia Yao

Authorized for distribution by Vikram Haksar

May 2020

IMF Working Papers **describe research in progress by the author(s) and are published to elicit comments and to encourage debate.** The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

Abstract

This paper builds a novel database on the effects of macroprudential policy drawing from 58 empirical studies, comprising over 6,000 results on a wide range of instruments and outcome variables. It encompasses information on statistical significance, standardized magnitudes, and other characteristics of the estimates. Using meta-analysis techniques, the paper estimates average effects to find i) statistically significant effects on credit, but with considerable heterogeneity across instruments; ii) weaker and more imprecise effects on house prices; iii) quantitatively stronger effects in emerging markets and among studies using micro-level data; and iv) statistically significant evidence of leakages and spillovers. Other findings include relatively stronger impacts for tightening than loosening actions and negative effects on economic activity in the near term.

JEL Classification Numbers: E28, G28.

Keywords: Macroprudential Policy, financial stability, Meta-analysis.

Authors' E-Mail Addresses: jaraujo@imf.org; mpatnam@imf.org; apopescu@imf.org; fvalencia@imf.org; wyao@imf.org.

[1] The authors would like to thank Tamim Bayoumi, Gaston Gelos, Gita Gopinath, Lucyna Gornicka, Vikram Haksar, Mahmut Kutlukaya, Maria Soledad Martinez Peira, seminar participants at the IMF, and numerous authors who graciously shared additional results and data from their papers which made it feasible to standardize results and enhance comparability of estimates.

Contents Page

I. Introduction

Macroprudential policy has by now been deployed in over one hundred countries using a wide range of instruments (Alam and others, 2019; Cerutti, Claessens, and Laeven, 2017). The prominence of its use has grown over the years, with more recent actions concentrated in relaxation measures as part of the policy response to the COVID-19 pandemic to support the flow of credit to the real economy (Benediktsdóttir, Feldberg, and Liang, 2020; IMF, 2020).

However, there is still limited consensus on how well the toolkit works in practice, and even less on which instruments work best, despite the rapidly increasing empirical literature on its effectiveness.[1] While considerable empirical work has so far been conducted, the pieces of evidence remain fragmented.

This paper aims to fill this gap by constructing a novel database of empirical findings on the effects of macroprudential policy and undertaking a forensic examination of the existing evidence. The database comprises 6,627 results from fifty-eight papers, selected through a systematic approach, split evenly between cross-country and country-specific studies. The database captures information on the effects of macroprudential policies by (i) outcome variable, (ii) instrument, (iii) measurement of macroprudential policy, (iv) categories of controls (v) time horizon of effect, (vi) sample (i.e. country and period) and (vii) methodology and unit of analysis. In addition to the actual estimated coefficients, it also includes standardized coefficients (i.e. effects expressed in standard deviations of the outcome variable), to ensure comparability across studies. The database is available through the accompanying data file.

The paper then summarizes the effects of macroprudential policy on the most widely studied outcomes. Extracting a summary view and deriving an "average" effect requires an approach that combines information about precision of estimates and their magnitudes. To this end, the paper uses a meta-analysis framework, to quantitatively synthesize research on policy effects and examine how this average vary with some study or results characteristics. The paper focuses on the following specific questions: what are the average effects of macroprudential policies on credit, household credit, and house prices? How do these average effects vary by, either the type of instrument deployed, the country setting, or the unit of analysis (macro-level vs. micro-level data)? In answering these questions, the paper also looks at the unintended effects that may arise due to leakages or spillovers (e.g., through cross-border or non-bank lending) or costs from reducing economic activity.

The paper finds that a tightening of macroprudential policy has statistically significant effects on credit, with stronger effects found for liquidity measures, with considerable variation in the distribution of these effects across tools and outcomes; for instance, tightening limits on loan-to-value (LTV) or debt-service-to-income (DSTI) ratios produce similar average effects

[1] While in theory there are strong arguments why macroprudential policy should work, in practice there can also be factors such as circumvention that could undermine its effectiveness (Bengui and Bianchi, 2018) or general equilibrium effects that may present trade-offs potentially rendering the net effects of macroprudential policy ambiguous (Agénor, 2019). This ambiguity means that the overall effectiveness of macroprudential policy is ultimately an empirical question, and thus a growing body of literature attempts to shed light on it.

on reducing household credit but have weaker and imprecise effects on house prices.[2] The paper also finds that housing and liquidity-based measures appear to have larger average effects, but with wider confidence bands, in emerging markets. Overall, these findings are robust to controlling for selection bias, and whether studies are published in a peer-reviewed journal.[3]

Furthermore, the average effects are up-to three times larger among studies using micro-level data than those found in studies using aggregate data. This could be partly explained by the stronger identification power provided by micro-level data or the existence of spillovers and leakages which reduce the transmission of the micro-level effects of macroprudential policy on bank lending to aggregate credit. The paper also finds statistically significant average leakages and spillover effects, which is consistent with the hypothesis that international banks or other unconstrained institutions may respond to domestic credit demand when local banks become constrained (Reinhardt and Sowerbutts, 2015).

Beyond leakages and spillovers, the paper also documents statistically significant and negative effects on economic activity, at least in the near term. When considering symmetry of effects (i.e. tightening versus easing macroprudential measures), there is a somewhat larger body of evidence supportive of more significant and quantitatively stronger effects for tightening than loosening actions. Finally, the literature also documents a persistent impact of macroprudential policies, but with a large fraction of effects observed within the first year. Several papers in the database also document how the effects of macroprudential policy vary depending on financial and macroeconomic conditions. However, summarizing these and other non-linearities comprehensively requires additional information that was not included in any of the papers in the database, as explained later in Section II.

This paper contributes to the broader empirical literature on the effects of macroprudential policy which has predominantly focused on testing whether the adjustment and/or adoption of macroprudential policy tools affects outcomes that could signal the buildup of systemic risk such as credit growth, household leverage and house prices (e.g. Alam and others, 2019; Cerutti, Claessens, and Laeven, 2017; Claessens, Ghosh, and Mihet, 2013). A few studies explore the effects of macroprudential policy on the probability of a banking crisis (e.g. Crowe and others, 2012); other studies also provide supporting evidence of unintended consequences, such as a negative impact on economic activity (e.g. Richter, Schularick, and Shim, 2019) or leakages and spillovers (e.g. Ahnert and others, 2018; Aiyar, Calomiris, and Wieladek, 2014). However, getting a comprehensive picture of what the literature finds requires going well beyond a selective and qualitative review.

This paper provides a novel comprehensive synthesis of the evidence on macroprudential policies. Previous related studies include (Galati and Moessner, 2013, 2018), who conduct a narrative review of the literature, and Gambacorta and Murcia (2019), who conduct a focused

[2]The meta-analysis focuses on results where the macroprudential policy variable is measured through dummies reflecting loosening, hold, or tightening actions, which represent the majority of the results in the database.

[3]Quality of papers and results is addressed in several ways, including by controlling for selection bias, journal of publication, and completeness of the econometric specification within each paper, among others explained later in the paper.

meta-analysis of 7 studies.[4] While building on these existing reviews, this paper considerably expands the scale (from 15 to 58 papers) and scope of the review, covering also leakages and spillovers and economic costs. Further, in contrast to narrative literature reviews, this paper uses meta-analysis techniques based employing objective procedures for the selection of studies to avoid any biases that could ultimately influence the conclusions. These techniques also allow examining the factors driving the heterogeneity across results (Stanley, 2001).

The next section describes the construction of the database (Section II), followed by descriptive statistics in Section III. Section IV.A lays out the methodology for the meta-analysis and its main results and Section V concludes.

II. Construction of the Database

In describing how the database was built, it is useful to start by noting that all empirical studies in the review estimate the effect of macroprudential policy tool(s), MPM, on an outcome variable y, after controlling for factors collected in the vector $\mathbf{X}$. The unit of analysis, i, can be measured using aggregate data (e.g. country level) or micro data (e.g. banks, firms, or loans). The period of analysis, t, can be one month, quarter, or year.

$$y_{it} = \hat{\beta} \cdot MPM_{it} + \zeta \cdot \mathbf{X}_{it} + u_{it}$$

Because there is no "standard" specification, the literature includes many variations of the above equation, often involving multiple tools, outcome variables, set of controls, and different ways to measure them.

The main goal is to construct summaries of the β, using meta-analysis techniques, for each outcome variable/MPM tool pair from a systematically selected set of papers. Because of the significant variation in tools and outcome variables studied in the literature, the scope of the meta-analysis is comparable to Magud, Reinhart, and Rogoff (2011), who study the effects of capital flow management measures; but it is broader than meta-analyses conducted in areas where there is stronger consensus on definitions and measurement (e.g. Gechert, 2015; Havranek, Rusnak, and Sokolova, 2017, on fiscal multipliers, and the habit formation parameter, respectively).

A. Paper Selection

The paper selection approach consisted of three methods. The approach started by collecting all papers whose main focus was an empirical analysis on the effects of macroprudential policy cited in the most recently published literature reviews on the subject, (Galati and

[4] Gambacorta and Murcia (2019) summarize the results of seven studies (covering five Latin American countries) that evaluate the effectiveness of macroprudential tools on credit.

Moessner, 2018) and (Gambacorta and Murcia, 2019). This is represented by step 1 and 2 in Figure 1. The second method relied on Google Scholar's search engine using "effectiveness of macroprudential policies" as keywords and focused on the empirical papers among the first 100 hits, which is illustrated by step 3 in Figure 1 .[5]

Figure 1. Paper Selection Criteria

	Reference Source					Papers in the Database
	Literature Review	Meta Analysis	Google Search	Cross-Referencing	Repeated Papers	Paper Count
	Galati and Moessner (2018)	Gambacorta and Murcia (2019)	*Key Word: "Effectiveness of MPP"*			#
Published Papers	7	1	9	12	6	23
Working Papers	2	5	9	21	2	35
Total	**9**	**6**	**18**	**33**	**8**	**58**

The third method consisted in *snowballing* and encompassed collecting all empirical papers from the references of all studies identified in steps 1-3. This was followed by all empirical papers from the new empirical papers' reference list, and so on. The iteration stopped when no new empirical papers were identified (illustrated by step 4 in Figure 1). The final set of papers in the database (step 6) excludes 8 papers that appeared under multiple methods (step 5), and is broadly balanced between published and unpublished papers. Appendix Table A12 shows the final list of papers in the database. The three methods complemented each other. The second method allowed capturing recent papers, while the other two helped identified additional papers on specific tools, which may not have used the term "macroprudential" in the text. The paper selection approach is similar to Havranek and Sokolova (2020) and Havranek and Irsova (2011) who also use Google Scholar and cross-referencing.[6]

B. Estimates and Statistics Selection

The collection of results within the selected papers included all estimated $\hat{\beta}$ coefficients to reduce the risk of introducing arbitrariness in the selection rule. Such an approach is also followed by other meta-analyses in the literature (Cipollina and Salvatici, 2010; Disdier and

[5]Google Scholar searches throughout the entire text of the studies, not just the title and abstract. Using other keywords such as "effect/impact of macroprudential policies" and other databases such as IDEAS/RePEC databases did not yield more papers than the baseline search.

[6]Havranek and Sokolova (2020) cover 144 papers and about 3,000 results, compared to 58 papers and over 6,000 estimates in this paper.

Head, 2008; Doucouliagos and Stanley, 2009; Havranek and Irsova, 2011).[7] One exception to the rule is the exclusion of estimates from specifications with interactions between MPM's and other variables. To include this information, a necessary input is a statistical test (and its standard error) of the linear combination of the MPM coefficient and the interacted one, evaluated at some value of the interacted variable. No paper reported this test. Results presented only in charts were requested from the authors and included in the database if provided by the authors.

The collection of results included the coefficient $\hat{\beta}$, its standard error, the type of MPM tool and how it was measured, the outcome variable, the estimation methodology, the unit of analysis (e.g. macro or micro level), sample characteristics (e.g. EM countries or all), whether the specification corresponded to the most complete one in the paper, and the journal of publication if any.

C. MPM's and Outcome Variables Classification

Given the lack of an universally accepted taxonomy of MPM tools, the classification of MPM measures relied on the IMF's Integrated Macroprudential Policy Database (iMaPP) as a benchmark taxonomy. [8] The taxonomy includes 17 categories (e.g. capital requirement, loan restrictions) and 4 classes of subcategories (e.g. household, corporate, broad-based and FX targeted measures).[9] This approach helped increase the comparability of tools across studies. The database also provides a mapping of these individual tools into broader groups, using the classification in IMF (2014): (i) Broad-based tools which include counter-cyclical capital buffers, conservation buffers, capital requirements, leverage limits, loan loss provisions, limits on credit growth, loan restrictions and limits on foreign currency loans; (ii) Liquidity tools which include liquidity coverage ratios, limits on loan-to-deposit ratio, limits on FX positions, and reserve requirements; (iii) Housing tools which include housing sector specific measures such as limits to loan-to-value ratios, limits to debt-service-to-income ratio, loan restrictions, and other sector-specific capital requirements, loan loss provisions, and taxes and levies; (iv) Other tools which include measures on systemically important financial institutions, taxes and levies, and other measures.[10] Appendix Table A1 provides details on the individual macroprudential tools, relying mainly on the description provided in the iMaPP, along with how they map into the groups of measures described above.

[7] Section IV.A addresses also concerns related to quality of estimates within and across papers, since Andrews and Kasy (2019) note that some estimates may correspond to inferior specifications.

[8] The iMaPP is a comprehensive macroprudential policy database in terms of instruments, countries, and time periods combining information from five existing databases, as well as the IMF's Annual Macroprudential Policy Survey, and various additional sources (see Alam and others, 2019, for details).

[9] If a paper reports a measure belonging to one of the categories (e.g. loan loss provision (LLP)) and subcategories (e.g. household (HH)), it was recorded as such, even if it implied adding an MCM category. For example, the iMapp does not report the classification LLP_HH. On the other hand, not all iMapp categories were used if there were no papers on those tools, for example the breakdown of limits on credit growth (LCG) into household (HH) and corporate (CORP) sectors. As a result, the total number of categories and subcategories used in the database is 33 while the iMapp includes 27.

[10] If there is no information on whether the measure is targeted, it is classified as broad-based.

Finally, for parsimony, the database groups the dependent/outcome variables according to 10 categories: balance sheet fragility, bank default risk, capital flows, corporate credit, credit, house price, household credit, economic activity, non-bank credit and other outcomes. The Appendix Table A2 shows a description of the relevant outcome variables included in each of these categories.

D. MPM's Measurement

The way $MPM's$ are measured in the literature can be grouped into three types. The first group, corresponding largely to the first wave of studies measures the impact of macroprudential tools based on the cross-country variations in policy settings (e.g. Cerutti, Claessens, and Laeven, 2017; Claessens, Ghosh, and Mihet, 2013; Lim and others, 2011). Typically, studies of this sort define MPMs as a set of dummies that take the value one during the years in which the instrument was used and/or in place in a country and zero otherwise.

A second, more predominant strand of literature relies on the direction of change of the policy stance to identify impacts. Here, MPM is typically a discrete variable taking the values -1, 0, and 1, indicating episodes of loosening, neutral, and tightening actions, respectively (Kuttner and Shim, 2016, and many others). Within this set of papers, the bulk of the evidence comes from tightening episodes with fewer papers exploring loosening actions.

Finally, few and more recent studies measure MPM's with attention to the intensive margin. Examples include Jiménez and others (2017) who studied the effects of the Spanish dynamic provisioning mechanism and Richter, Schularick, and Shim (2019) who used a narrative identification strategy to measure the intensity of LTV changes.

Often times, papers use a composite measure of MPM's. For example, Kuttner and Shim (2016), Cerutti, Claessens, and Laeven (2017), Claessens, Ghosh, and Mihet (2013) look at borrower targeted measures and construct a composite of LTV and DSTI limits, and Akinci and Olmstead-Rumsey (2018) and Vandenbussche, Vogel, and Detragiache (2015) construct a composite MPM measures based on broad-based, liquidity, housing and other measures. All composite MPM measures are also categorized into: (i) housing, (ii) non-housing (broad-based, liquidity and other), and (iii) general, which includes both housing and non-housing measures.

E. Standardization

The literature does not have a standard definition of the variables used to measure the effects of macroprudential policy. Therefore, they vary widely in terms of economic meaning (e.g. house prices, credit), their measurement (e.g. log-levels, real or nominal growth rates, ratios, etc.), the time horizon of the analysis (e.g. over one quarter, one year), or their underlying

distribution (e.g. micro data vs. macro data, or EM countries vs. advanced). Enhancing comparability of effects across studies requires normalizing the $\hat{\beta}$ coefficients and their standard errors by the standard deviation of the corresponding outcome variable.[11]

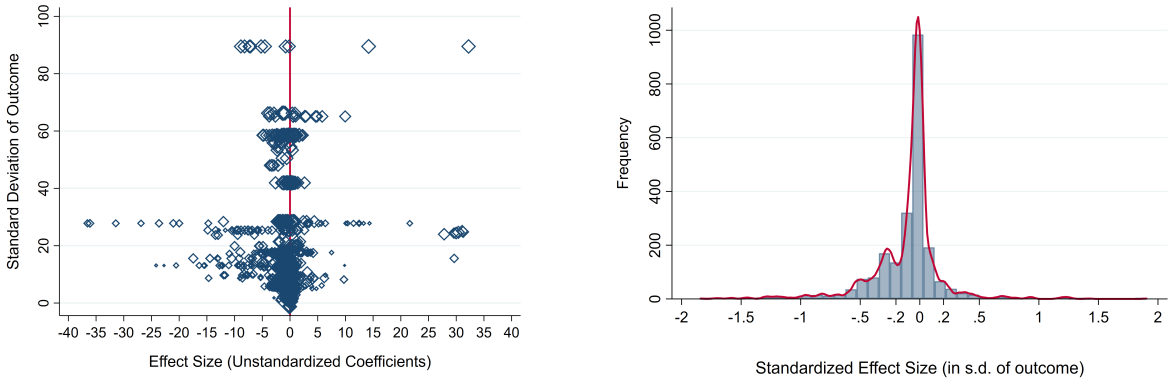
Where MPM's are measured discretely (either as a dummy variable indicating whether a policy is in place or in terms of a change to tightening or loosening), the effect size is interpreted as a standard deviation change to the outcome variable in response to a change in the policy either in the direction of tightening or adoption of the tool.

When the MPM's are measured considering the intensive margin, the effect is still standardized using the standard deviation of the outcome variable, but the database includes also the standard deviation of the MPM change when available. In this case, the effect size is interpreted as a standard deviation change to the outcome variable in response to unit change in the policy variable, which in most cases corresponds to a one percentage point change in the corresponding tool.

When available, the standardization approach used the summary statistics specific to the sample that produced the selected $\hat{\beta}$ coefficient. Regression-specific summary statistics were requested from the authors if not available in the paper. If not provided, the standardization used the summary statistics available in the paper for the specific outcome variable considered.

Figure 2. Effect Sizes

(a) Raw Effects and Outcome Standard Deviation **(b) Distribution of Standardized Effects**



Note: Each diamond in the figure represents a coefficient; size is proportional to its precision.

[11] Yuan and Chan (2011) show that dividing the standard error by the outcome's standard deviation is a good approximation of the standardized standard error and under certain conditions, it is close to being consistent in the case of multiple regressions. See also Nieminen and others (2013) and Peterson and Brown (2005) for a similar approach.

Figure 2a shows that the range of unstandardized effects is wide and dispersed, which may be explained by the aforementioned heterogeneity in outcome variables but also in MPM tools in our dataset. In contrast, Figure 2b shows that once coefficients are standardized, the distribution is approximately normal, allowing us to draw comparisons more easily, with effect sizes concentrated in the 0 to -0.2 standard-deviations region.

Our standardization procedure ensures that all effects can be comparable and interpreted similarly, regardless of how the outcome variables are measured, the time-horizon over which they are measured, the unit of analysis, or the sample. The importance of the standardization of coefficients in enhancing comparability of results can be visually inferred through Figure 2 which plots the distribution of raw and standardized effects.

III. Descriptive Statistics

A. Database Overview

Figure 3. Focus of Studies: MPMs and Outcome Variables

	household credit	house price	credit	bank balance sheet fragility	economic activity	capital flows	corporate credit	bank default risk	non bank credit	other	Total Number of Distinct Papers
Index	13	11	14	2	7	7	4	3	1	4	33
LTV (limits to loan-to-value ratio)	15	15	4	3	3	2	1	1	1	4	23
RR (reserve requirements)	5	6	8	5	2	4	2	2		2	18
DSTI (limits to debt-service-to-income ratio)	10	11	4	3	2	1	1			1	15
LLP (loan loss provisions)	6	8	7	3	3	1	1			1	14
CR (capital requirements)	8	7	3	3	2	3	1	1	1	1	17
OTHER (other measures)	4	3	3	2	1	1	1			1	9
LCG (limits on credit growth)	4	2	4	2	1	1	1				8
TAX (taxes and levies)	4	5	1		2		1				6
LFC (limits on foreign currency loans)	2	3	2	2	1	1	1			1	7
LIQ (liquidity coverage)	1	2	2	1		1		1	1	2	5
CCB (countercyclical capital buffer)	2	1	3	2	1			1		1	7
LVR (leverage limits)	1	1	1		1	1	1			1	3
SIFI (measures on systemically important financial institutions)	2	1	1		1		1				3
LR (loan restrictions)	2	2		1	1						3
LFX (limits on FX positions)			1			1		1			2
CON (conservation buffer)											0
Total Number of Distinct Papers	23	19	27	8	9	11	5	7	2	14	58

Figure 3, provides a broad overview of all instruments and outcome variables studied in the papers in our database. Each cell includes the number of papers studying the effect of an

MPM tool (shown on the first column) on an outcome variable (shown on the top row). The darker shade indicates an increased number of papers associated with that pair. The upper left corner of the matrix concentrates the most widely studied pairs, notably those related to the housing sector such as borrower-based housing measures and their impact on house prices and household credit. The first row of the matrix groups studies where macroprudential policy is measured as a composite index of multiple tools.

Most studies examine economy-wide impacts using typically cross-country datasets, but a growing number of studies exploit also the availability of micro-level data to assess the effects of macroprudential policy. For example, Jiménez and others (2017) use bank-firm-level data on loans from the Spanish credit registry to study the effects of dynamic provisioning on bank credit provision and other outcome variables. Overall, 43 percent of studies are cross-country using macro-level data, 10 percent of studies are cross-country using micro-level data, 12 percent of studies are country studies using macro-level data and 34 percent of studies are country studies using micro-level data.

The set of control variables used also varies and typically include other MPM's (61 percent of results), interest rates (77 percent of results), other macroeconomic variables (61 percent of results), cross-sectional fixed effects (80 percent of results), and time fixed effects (35 percent of results).

There is also significant variation across papers in their empirical approaches, in particular with regards to dealing with the endogeneity of macroprudential policy actions. Many of the studies use panel-data techniques and deal with reverse causality concerns through timing assumptions and focus on the lagged effect of macroprudential policy changes (e.g. Richter, Schularick, and Shim, 2019). A few other studies use GMM or instrumental variables (e.g. Cizel and others, 2019; Zhang and Zoli, 2016), instrumenting macroprudential policy with the vector of exogenous covariates. Several other studies, typically using micro-level data make use of an event-study or difference in difference methodology to identify the effects of macroprudential policy often looking specifically at entities around the binding constraint or applicability thresholds (e.g. Aiyar, Calomiris, and Wieladek, 2014; Jiménez and others, 2017). [12]

Most studies focus on effects of up to a year, but some use VAR's (e.g. Carreras, Davis, and Piggott, 2018) or local projection methods (Richter, Schularick, and Shim, 2019) to understand the effects of macroprudential policy at various horizons, but also to allow the exogenous covariates to be inter-related (e.g. Kim and Mehrotra (2018)). [13]

[12]Overall, half of the studies present at least one result using OLS estimation, one quarter of the studies present at least one result using GMM estimation, 15 percent of the studies present at least one result using difference-in-difference estimation while half of the papers present at least one result based on some other method (e.g. Panel VAR, Quantile Regression, etc).

[13]Nearly all papers present results for horizons of up to one year while one quarter of studies also present results for over one-year horizons.

B. Statistical Significance

This subsection presents a first cut of the database focusing on statistical significance. Macroprudential tools are grouped into the four types described in Section II: (i) Broad-based tools; (ii) Liquidity tools; (iii) Housing tools; and (iv) Other tools.

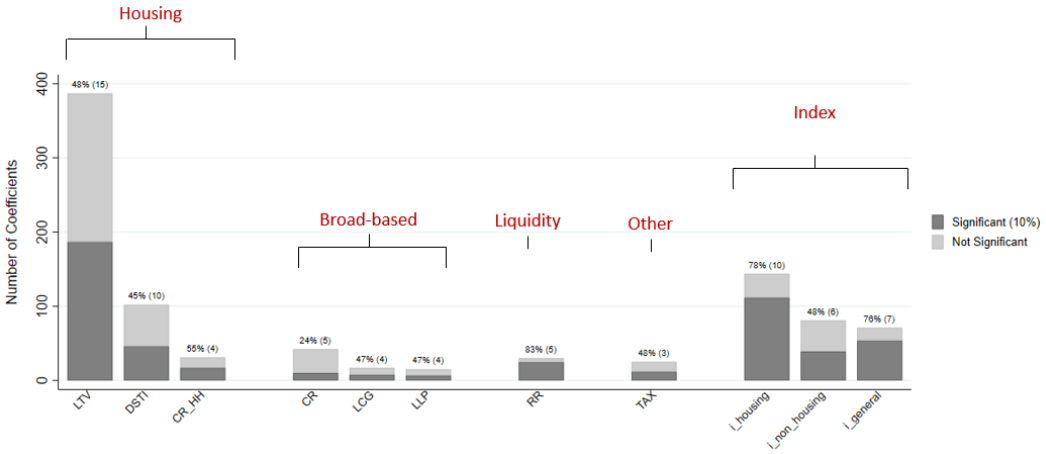
Figure 4 shows the number of statistically significant coefficients, at least at the 10 percent level, and the total number of coefficients on the vertical axis and the analyzed MPM tool on the X-axis. The figure focuses on the three most widely studied outcome variables: household credit (panel a), house prices (panel b), and total credit (panel c) displaying about half of the 6627 coefficients in our database. The sample includes coefficients estimated using all types of policy change measurement, for tightening and loosening episodes, for all time horizons, and whether or not statistics could be collected for standardization. At the top of each bar, the figure shows the percent of significant results and the number of papers, in parenthesis, from which these coefficients were collected. Consistent with Figure 3, Figure 4 shows that limits on loan-to-value ratio and on debt-service-to-income ratio stand out as the most studied measures, when looking at household credit or house prices as outcome variables. But the coefficients are not always statistically significant. And this pattern seems to hold for individual MPP measures or composite ones. Finally, turning to total credit growth, measures such as loan loss provision, reserve requirements and composite measures seem to be the more widely studied, with also a large fraction of statistically significant coefficients. In sum, a very heterogeneous picture which makes it difficult to extract a clear common ground. To make progress, meta-analysis techniques come in handy by allowing summarizing these findings to extract a bottom line.

C. Magnitudes

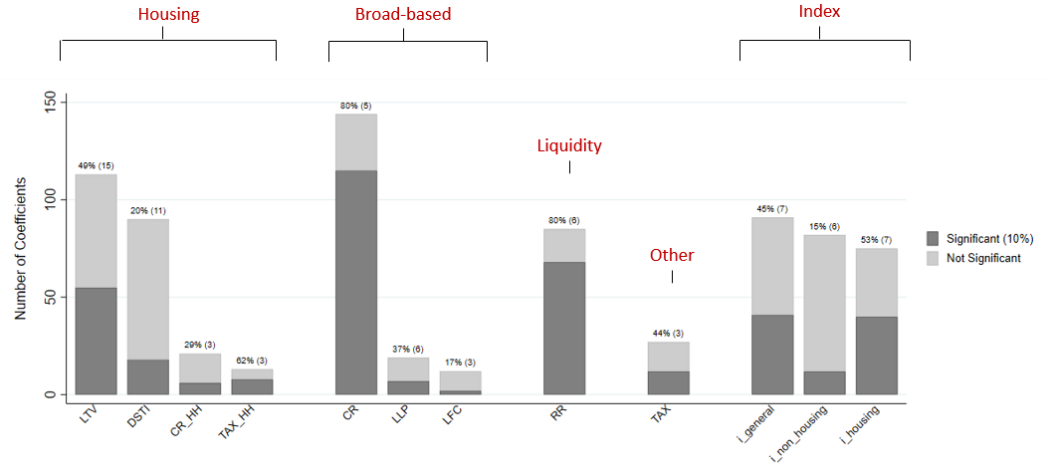
Table 1 presents summary statistics of standardized effects for the broad outcome buckets described in Section II. For the statistics to be comparable, only results that could be standardized and that measure effects for a horizon of up to one year (henceforth short-term horizon) are used to produce the table. These filters imply that Table 1 summarizes approximately 50 percent of all coefficients in the database.[14]

[14] Approximately 60 percent of the results in the database correspond to effects within a one-year horizon, but in constructing Table 1 about 10 percent of results are lost due to the lack of summary statistics to normalize coefficients.

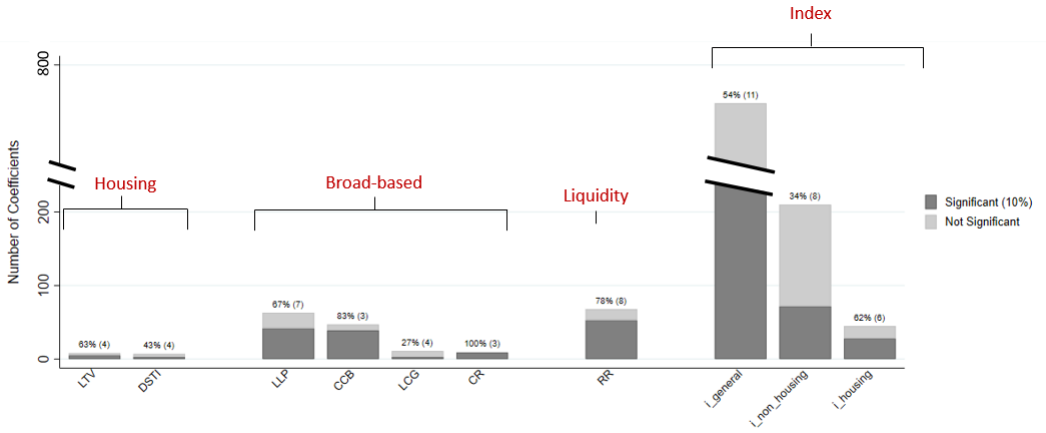
Figure 4. Fraction of Coefficients Statistically Significant at 10% level or higher



(a) MPM Effects on Household Credit



(b) MPM Effects on Housing Prices



(c) MPM Effects on Credit

The The numbers on top of each bar are the percentage of significant results and (in parenthesis) the number of papers. The "i_general" bar in chart (c) is not shown in full,the total number of coefficients for "i_general" index on the outcome category "credit" is 696. Details of each MPP tools and outcome categories can be found in Table A1 and Table A2, respectively.

Table 1. Summary of Standardized Macroprudential Policy Effects

	Obs.	Mean	Std. Dev.	Min	Max
MPM in place (0,1):					
Balance sheet fragility	249	-0.02	0.09	-0.94	0.21
Capital inflow	78	0.05	0.19	-0.83	0.77
Corporate credit	51	-0.01	0.54	-1.69	2.24
Credit	190	-0.38	0.71	-3.52	1.90
Economic activity	30	0.13	0.55	-1.67	0.95
House price	157	-0.09	0.39	-2.06	1.19
Household credit	176	-0.15	0.29	-1.23	0.93
All Outcomes	931	-0.12	0.44	-3.52	2.24
MPM change (-1,0,1 in the direction of tightening:)					
Balance sheet fragility	5	-0.02	0.03	-0.05	0.01
Bank default risk	38	-0.31	0.62	-3.35	0.40
Capital inflow	116	0.00	0.10	-0.37	0.34
Corporate credit	37	0.08	0.07	-0.11	0.34
Credit	168	-0.07	0.45	-2.21	2.40
Economic activity	392	-0.08	0.51	-5.36	1.57
House price	353	-0.01	0.31	-1.44	2.69
Household credit	411	-0.14	0.32	-1.59	1.02
Non bank credit	18	0.02	0.04	-0.01	0.14
All Outcomes	1538	-0.07	0.38	-5.36	2.68
MPM intensity (level or change in levels):					
Balance sheet fragility	14	-0.25	0.23	-0.66	-0.01
Credit	55	-1.21	1.14	-5.91	-0.06
Economic activity	150	0.00	0.01	-0.04	0.05
House price	238	-0.28	0.20	-0.94	0.40
Household credit	168	0.01	0.04	-0.22	0.20
All Outcomes	625	-0.21	0.50	-5.91	0.40

The table reports the summary statistics for standardized macroprudential policy effects for each outcome category by different types of macroprudential policy measurements. The signs of effects for some outcomes have been reversed to fit the direction of the overall outcome category; see Appendix Table A2 provides details on the outcomes within each categorization and the sign transformations. It should be noted that the summary statistics bundle together the effects of all types of macroprudential instruments. The sign is reversed for loosening only episodes for ease of interpretation.

The summary stats are presented separately by the way in which macroprudential policy is measured. The first panel summarizes the effects of the availability of macroprudential tools on the corresponding outcomes, which comprises 30 percent of the short-term horizon results

in our database; the summary statistics in this cell, therefore represent the standard deviation change in the outcome variable from having the macroprudential policy in place. The second panel shows outcomes from studies that measure adjustments in the tool through -1, 0, and 1, dummies indicating policy episodes of loosening, no change, and tightening, respectively, and comprises 50 percent of the short-term horizon results; the summary statistics in this cell, therefore represent the standard deviation change in the outcome variable from changing the macroprudential policy, in the direction of tightening. The third panel includes outcomes from papers using either the actual value of the tool (e.g. reserve requirements) or some transformation of it (e.g. a step function of LTV limits) that considers intensity of use; the summary statistics in this cell, therefore represent the standard deviation change in the outcome variable from a unit change in the intensity of macroprudential policy use.

Taking up first the case of results in the first panel, it can be seen that effects encompass both positive and negative values across all outcomes. As noted before, the results are concentrated around measuring effects on credit (including household credit) and house prices. The effects reported for several outcome variables are highly variable, with the standard deviations most exceeding the mean.

A similar pattern was found for the second set of results which measure discrete macroprudential policy changes in the direction of tightening. In this set, the results are similarly focused on examining credit and housing outcomes. For the third set of results, which include information on intensity in the change of macroprudential policy, there are fewer outcomes as there are also fewer papers. They focus on credit (including household credit), house prices and indicators of economic activity (e.g. real GDP growth, employment, and firms sales). The distribution of effect sizes in this set are not easily comparable, because the actual level or change of macroprudential policy varies substantially across studies and the coefficients (effect sizes) are not estimated as elasticities. Nonetheless, both negative and positive effects are reported.

Finally, Appendix Table A11 provides a more dissagregated version of Table 1 by breaking down the summary statistics by sectoral MPM measures.

D. Symmetry

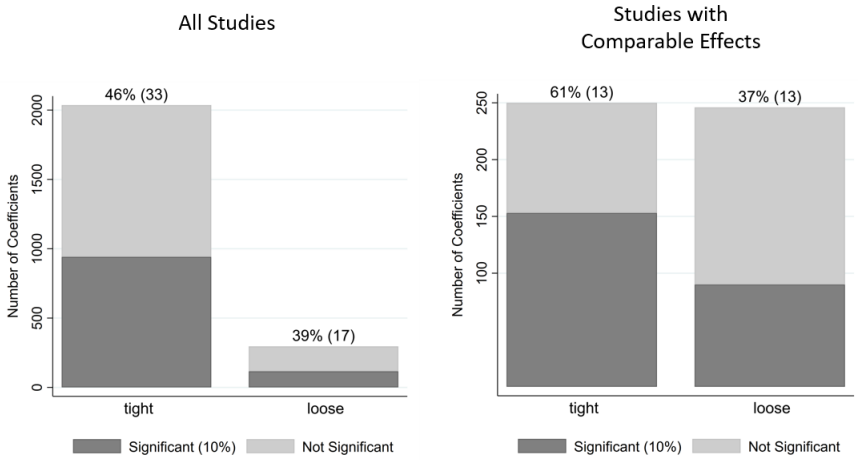
As noted in Table 1, the bulk of our database includes papers looking at changes in macroprudential policy in the direction of tightening or loosening. But these effects need not be the same in absolute value. The rationale for the possibility of asymmetric effects lies in that tightening measures are generally employed in expansionary phases of the cycle, when incentives to leverage up can be stronger than in the correction phase. In this context, introducing macro-prudential measures are more likely to impose *binding constraints*. Loosening measures, on the other hand, tend to be implemented during the correction phase, with the intention of releasing buffers and provide a boost to agents' borrowing capacity. However, it is not necessarily the case that agents can or would want to take advantage of it, for example

due to a reduction in income or increased uncertainty.[15] The presence of leakages can also influence symmetry of effects if the incentives to circumvent regulation are stronger in the buildup phase of the financial cycle, when constraints bind.

About sixty percent of the studies in our database discuss effects of either tightening or loosening macro-prudential policies, with examples including McDonald (2015), Kuttner and Shim (2016), Jiménez and others (2017), and Richter, Schularick, and Shim (2019). However, more than a quarter of these papers study only tightening actions, a few (4) of them study easing actions alone, and about 20 percent of them study both. Overall, there is more evidence about the effects of tightening than loosening macro-prudential policies, largely by virtue of the developments in the past decade which constitute the largest parts of the samples. A large proportion of these findings pertains to housing market tools.

Overall, the estimated effects of tightening are more often statistically significant than those of loosening (see Figure 5, left-hand-side chart).[16] Among papers looking at the effects of tightening and/or loosening, 46 percent of results find tightening coefficients to be statistically significantly different from zero at the 10 percent level, versus 36 percent for easing actions. When restricting the analysis to within paper comparisons, that is, looking only at the 13 papers analyzing both tightening and loosening effects in comparable regressions (i.e. same specification, tools, and sample), tightening coefficients are significant in 61 percent of cases, and easing coefficients in only 37 percent of them (see Figure 5, right-hand-side chart).

Figure 5. Results on Asymmetries

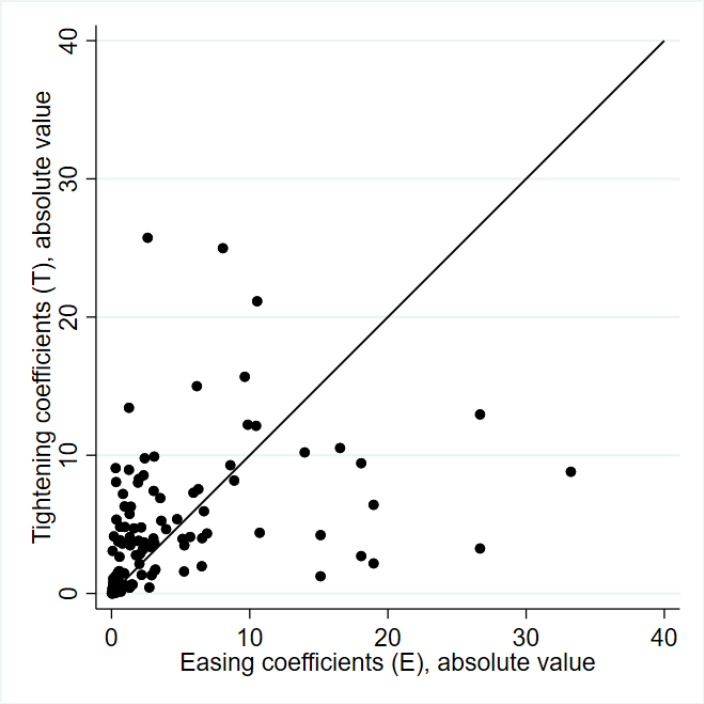


[15]Increased uncertainty about economic outcomes during the correction phase can intensify a precautionary motive under which agents become "too cautious" and may wish to reduce leverage.

[16]The figure focuses only on statistical significance of tightening/easing coefficients without differentiating tools or outcome variables.

These results largely mirror the conclusions from papers looking at the effects during different phases of the financial cycle.[17] More specifically, macroprudential measures employed during the expansionary phase are statistically significant at the 10 percent level in 70 percent of cases (and 65 percent of the results which directly compare boom and bust periods). At the same time, measures implemented during the correction phase, are statistically significant in 56 percent of cases.

Figure 6. Result on Asymmetries between Tightening and Easing



Turning to magnitudes, and fixing the sample on those 13 papers studying both directions[18] Figure 6 shows a direct comparison (in absolute value) of tightening and easing coefficients. In general, the figure shows that there is more mass above the 45-degree line, suggesting that the magnitude of tightening coefficients tends to be more often than not larger than the comparable easing coefficient. More specifically, we find that in about 57 percent of cases, the estimated coefficients for tightening measures are larger in absolute value than those for easing. Moreover, when restricting our attention to the tightening coefficients which are statistically significant and negative (about 40 percent), they overwhelmingly exceed the

[17]The financial cycle is defined somewhat differently in each paper in terms of the specific metric or methodology to identify the cyclical position, for simplicity these phases are refered to as "expansionary" and "correction." Examples include Claessens, Ghosh, and Mihet (2013), Lim and others (2011), McDonald (2015), Vandenbussche, Vogel, and Detragiache (2015).

[18]For this analysis we also include non-standardized results in our database to cover a broader sample. Since we are making comparisons within papers, standardization becomes less critical.

effects of easing actions. But it is important to note that in about 20 percent of cases, the effects of easing are either stronger than tightening (e.g. Barroso, Gonzalez, and Doornik, 2017, on reserve requirements) or the two are too close to make a call.

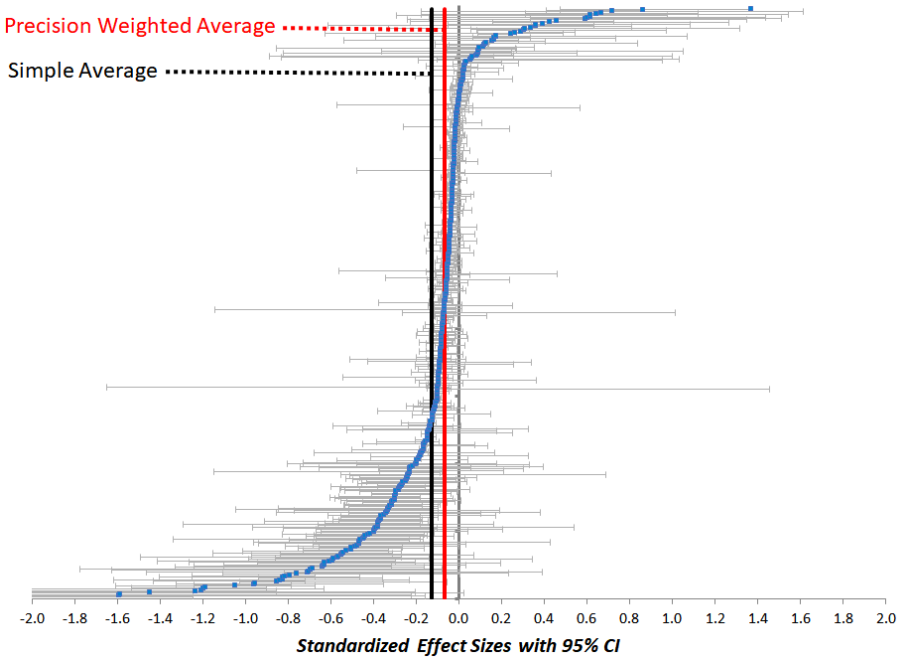
In general, the evidence suggests that the effect of tightening has a larger quantitative impact and is more often statistically significant than the effect of easing. Beyond any economic rationale for these results, there is also a statistical reason which is that the larger number of observations for tightening actions allows more power in identifying their effects.

IV. Meta-Regressions

A. Methodology

The previous section illustrated significant variation in the statistical significance and magnitude of coefficients. However, extracting a summary view requires combining information about precision and magnitudes of estimates to arrive at an "average" effect. To this end, this paper uses a meta-analysis framework to quantitatively synthesize estimated effects and ultimately examine how they vary with some studies or results characteristics.

Figure 7. Forest Plots: Effects of Tightening Macroprudential Tools on Credit



To illustrate how a meta-analysis works, let us assume that the standardized true average effect of macroprudential policy on credit is denoted by β. The database includes the estimated

effect size for result j from the k^{th} study, $\hat{\beta}_{jk} \sim N(\beta, \sigma^2_{jk})$,[19] which incorporates some error around the true effect (typically from sampling variability) with variance given by σ^2_{jk}. This variance of the estimated effect is given by the square of the effect's standard error, which is included in the database. The meta-analysis framework then allows us to recover β by taking a weighted average of $\hat{\beta}_{jk}$ across studies, with the weights inversely proportional to the standard error of each estimated effect, implicitly giving higher weights to more precise results as is typically done in meta-analyses (e.g. Bruns, 2017; Sutton and Higgins, 2008). As an illustration, Figure 7 shows the elements of the meta-analysis described above - the estimated effects sizes, its variance, and our measure of the true average effect - focusing on the short-term effects for credit from tightening macroprudential policies (without differentiating tools for now). Each row of this figure plots the standardized effect from each of the studies together with its 95th percent confidence intervals. The vertical red line shows the precision weighted average of these effects, while the black line shows the simple average of all the effects. As shown in the figure, there is substantial heterogeneity in the precision of estimates, with the distribution of effects slightly negatively skewed, as expected.

In estimating average effects, however, the β above is likely to differ across tools, outcome variables, and other determinants. In what follows, this heterogeneity is exploited through a meta-regression, which includes covariates that help explain how the true effects may vary (Greenland, 1987). The meta-regression framework is thus given by:

$$\hat{\beta}_{jk} = \sum_m \theta_m \cdot MPM^m_{jk} + \gamma \mathbf{X}_{jk} + \delta \cdot SE^2(\beta_{jt}) + \varepsilon_{jk} \tag{1}$$

where $\hat{\beta}_{jk}$ corresponds to some outcome variable of interest and is regressed on a set of dummies, MPM^m_{jk}, each taking the value of 1 when the effect corresponds to MPM measure m, which could be category of tools (e.g. broad based) or an specific tool (e.g. LTV limits). Therefore, the coefficients θ_m denote the average effect of MPM m, on the outcome variable in question, controlling for attributes of the estimate $\hat{\beta}_{jk}$ collected in $\mathbf{X}_{jk}$. These attributes include a dummy variable to identify estimates taken from papers published in a peer-reviewed journal and a dummy variable that identifies estimates taken from the most complete specification within a study. The inclusion of the latter variable is motivated by the possibility that inferior specifications could bias our average effects.[20] Finally, the term $SE^2(\beta_{jt})$ is a publication bias selection correction based on the standard error of $\hat{\beta}_{jk}$, in line with the standard practice in the meta-analysis literature.

The publication bias may arise if researchers select their results based either on its statistical significance or on a prior expected direction of the effects (Havranek, 2015). As proposed by

[19] The assumption that all effect sizes are the the same and equal to the true effect size average effect, β, is typically referred to as the common-effect meta-analysis model, as suggested by Rice, Higgins, and Lumley (2018).

[20] An alternative would have been to identify estimates taken from a best-practice regression specification in the literature (Bruns, 2017), but lacking such benchmark, as mentioned in Section II, this issue is instead addressed by identifying estimates from regressions that have the most exhaustive set of controls, within each study.

Stanley and Doucouliagos (2014),[21] This selection bias problem is addressed by including as control the square of the estimate's standard error, $SE^2(\beta_{jt})$. Appendix *VII* shows that the bias is significant even among published paper, but considerably smaller and statistically insignificant in micro-based studies.

The sample for the meta-regressions comprises all effects estimated within the one-year horizon i.e., short-term effects and excludes results that could not be standardized. The sample also excludes a very small fraction of outliers, those effects that exceed -3 or +3 standard deviation, when the MPP is analyzed in terms of existence or changes. Note that the error in equation (1), $\varepsilon_{jk} \sim N(0, \sigma^2_{jk})$, is heteroskedatic, with the degree of heteroskedasticity given by the estimate's standard error. This is accounted for by using a weighted least squares estimation procedure with the inverse of standard errors as weights, which yields efficient estimates.

B. Baseline Results

Table 2 reports the baseline results from estimating equation (1) focusing on the short-term effects of MPP changes (in the direction of tightening) on credit, including household credit. The sample comprises the results where the change of macroprudential policy (most typically tightening episodes) through -1,0,1 dummies, as described in Section II.[22] The sample excludes results from (i) loosening actions to ensure a comparable interpretation of the effects, although these are still few; and (ii) MPM indices, which combine instruments across different categories to ensure that the MPM categories in the regressions are mutually exclusive, but provide separately results on these later in this section. The classification of macroprudential tools follow the broad categories described in Section II.

Column (1) reports results from a simple specification without adding any controls and shows that liquidity and other tools tend to have relatively larger effects, when tightened, on total credit. On average, a tightening of these tools is associated with a 0.12 standard deviation reduction in total credit compared to the 0.04 standard deviation effect on reducing credit obtained from tightening housing and broad-based tools. Liquidity and other tools are bundled together because of the fewer observations on the latter but Table 3 show their effects separately. One caveat to note is that a comparison of average effect sizes across the different categories of macroprudential policies or even tools within a category, is valid to the extent

[21] Stanley and Doucouliagos (2014) show that in the presence of a selection bias, the reported effects may be regarded as incidentally truncated (the truncation is based on the z-value or t-value of the coefficient). They show that including the square of the estimate's standard error as a control performs well in reducing the bias. Andrews and Kasy (2019) propose bias-corrected estimators based on (non-parametrically) identifying the conditional selection-related publication probabilities up to scale. While the regressions in the main text rely mainly on the correction proposed by Stanley and Doucouliagos (2014), the appendix also shows results based on the selection correction procedure outlined by Andrews and Kasy (2019).

[22] The sample consists of non-cumulative effects up to one year. For studies that reported only cumulative effects, the per-period effect was backed out by dividing the former by the corresponding horizon in order to standardize coefficients. This step was necessary as summary statistics typically corresponded to the one-period effect. Over 80 percent of the results in the sample correspond to quarterly frequency and the rest to monthly frequency.

that the average tightening of macroprudential tools in the corresponding sample is approximately equivalent, which does not need to be the case. In other words, the stronger impact from liquidity tools may just be driven by much more intense tightening of these tools compared to others. This caveat applies to the literature in general as most studies do not measure the intensive margin in the use of macroprudential tools.[23]

Table 2. Average Effects of Tightening Macroprudential Tools on Credit

	Dep. Var.- Standardized effects on Credit				
	(1)	(2)	(3)	(4)	(5)
Broad based	-0.045***	-0.037***	-0.037***	-0.053	-0.056***
	(0.002)	(0.010)	(0.010)	(0.034)	(0.007)
Housing	-0.041***	-0.051***	-0.050***	-0.058**	-0.045***
	(0.007)	(0.012)	(0.012)	(0.026)	(0.011)
Liquidity & Other	-0.118***	-0.118***	-0.118***	-0.135***	-0.129***
	(0.005)	(0.005)	(0.005)	(0.030)	(0.009)
SE sq. (Pub. Bias Correction)			-0.780	-0.759	-2.314**
			(1.268)	(1.281)	(0.837)
Specification with incomplete controls				0.013	0.024***
				(0.015)	(0.008)
Non-Published Papers				0.011	
				(0.026)	
Study over-weighting adjustment		X	X	X	
Journal quality weighting					X
Observations	438	438	438	438	438
r2	0.695	0.607	0.608	0.613	0.704

The table reports the average effects of tightening macroprudential measures on credit (including credit to households) . All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result. Columns (2)-(3) additionally apply weights proportional to the number of results observed per study to avoid for any one study to drive the results. To account for possible dependence across results/observations for the same study, standard errors are clustered at the study level and reported in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

[23] As described in Section III.C, a few studies in the database do consider the intensity of use of macroprudential tools, not just the direction of change, but are too few to be summarized through metaregressions.

Accounting for result quality and robustness checks: Columns (2)-(4) successively check for the robustness of these results with a view also to control for the varying quality of results and papers, to find that the pattern and magnitude of the baseline results remains largely unchanged:

- First, some studies report many more results than others and therefore the regressions in Columns (2)-(4) use sampling weights proportional to the inverse of the number of estimates reported by each study. The results are not overly influenced by a single study.
- Second, Columns (3)-(5) show the results after adding the selection bias correction term as explained in the previous subsection. Even though the selection term is statistically significant in Column 5, the overall pattern of results are only slightly affected by it.
- Third, two dummy variables were added to control for results coming from unpublished papers (Column 4) and from specifications which are not the most complete ones within a paper (Columns 4 and 5), which allows controlling for quality of papers and results. The rationale behind the publication dummy is that the refereeing process would help ensure the proper use of estimation methodology, calculation of standard errors, and other quality control elements; whereas the incomplete specification dummy would control for quality of specifications within a paper. Both dummies are set up such that the baseline results correspond to the average effects among published papers and among the most complete specifications within papers.[24] The results are robust to the inclusion of these controls, although the effect on broad-based tools loses precision.
- Fourth, to account more comprehensively for paper quality, the regression in Column (5) introduces an additional weighting scheme that ranks papers according to the journal where they are published. [25] The magnitude of the average effects continues to be robust and stable with the broad-based measure now regaining its precision.
- Finally, Appendix Table A6 shows that the results presented in Table 2 are also robust to dropping observations where standardized effects were calculated using imputed summary statistics, and to sequentially excluding a specific study from the analysis.

Results from other MPM measurements: As a third of the database also consists of results from studies that measure whether the macroprudential policy is in place or not, Appendix

[24]While some meta-analysis studies include only published papers, the inclusion of unpublished papers follows from the relatively young age of the research on macroprudential policy effects.

[25]The weighting assigns a value of 4 to 'world-leading' journals, 3 for 'internationally excellent', 2 for 'recognised internationally' and 1 for other journals. The categorization of journals into the ranks 4-2 is obtained from Hole (2017), the most recent list (incorporating the relatively new American Economic Association and Econometric Society journals) that has been published in a peer-reviewed journal. All non-published papers were assigned a value of 0.5, thereby ranking them the lowest but still included in the regression. The specification for Column (5) excludes the weighting for study over-adjustment for simplicity, but the results are stable to its exclusion.

Table A4 reports average effects from these studies. The table shows an effect of 0.2, 0.1 and 0.09 standard deviation reduction in credit from having broad-based, housing sector, and liquidity/other tools respectively. These average effects are relatively larger than those reported in Table 2, which may possibly be capturing cumulative effects of several tightening actions over time. An alternative explanation is that they may simply reflect differences in economic circumstances across countries since these studies mainly exploit cross-country variation in the toolkit.

C. Heterogeneity of Average Effects

The next results explore how the average effects vary, looking first at the effects of individual instruments, followed by examining the effects on two additional outcome variables: household credit and house prices. Table 3 shows the average effects for the most widely studied instruments in the literature as identified in Section II.C. The average effect across all other tools is captured by the "other MPP" variable.

Tighter limits to LTV and DSTI are found to have similar impacts on total credit or household credit, reducing both by about 0.05-0.065 standard deviations, but their average effect on house prices is statistically insignificant. Liquidity tools - mainly reserve requirements and limits to the net FX open position- have relatively larger effects on credit as before. However, loan loss provisioning is statistically insignificant across the three outcome variables. Capital requirements[26] appear to affect total credit and house prices, but their average effect on household credit is less precise. On the other hand, tightening loan-loss provisions has a statistically insignificant effect on all outcomes, but the coefficient is of the order of 0.03 standard deviations.

Next, effects are disaggregated by country setting and examined whether the effects of macroprudential policy are different in emerging market economies. This is done by sub-sampling results based exclusively on emerging market countries (*EM*); and samples consisting of advanced, emerging, and low-income countries or exclusively advanced countries (*Mixed*), with results shown in Columns (1) and (2) of Table 4[27] which shows evidence of relatively larger average effects in EM's for housing and liquidity (and other) measures. However, the reported results for emerging markets have wider confidence intervals.

[26]In this specification, capital requirements includes sectoral capital requirements (such as capital requirements on housing sector credit).

[27]Table 4 omits the control variable for non-published papers because of the very few published (at most two) in the EM vs. Mixed split sample. For robustness, Appendix Table A10 presents results slightly differently, with the micro vs macro split including the publication dummy, where it is feasible to include because of enough published papers. The conclusions are similar to those in Table 4.

Table 3. Average Effects of Tightening Macroprudential Policy by Instrument

	Dep. Var - Standardized Effects on:		
	Credit	Household Credit	House Price
	(1)	(2)	(3)
LTV	-0.065**	-0.061**	-0.007
	(0.031)	(0.027)	(0.015)
DSTI	-0.063**	-0.052**	0.001
	(0.025)	(0.018)	(0.011)
Capital Req.	-0.065**	-0.030	-0.042**
	(0.030)	(0.022)	(0.018)
Loan Loss Prov.	-0.030	-0.033	0.016
	(0.030)	(0.021)	(0.010)
Liquidity	-0.139***		
	(0.030)		
Other	-0.035	-0.034	-0.002
	(0.029)	(0.020)	(0.010)
SE sq. (Pub. Bias Correction)	-0.687	-1.332	-1.909
	(1.372)	(2.145)	(1.537)
Specification with incomplete controls	0.018	-0.037	-0.038
	(0.012)	(0.027)	(0.035)
Non-Published Papers	0.011	0.010	-0.023*
	(0.029)	(0.022)	(0.012)
Observations	366	228	214
r2	0.666	0.269	0.222

The table reports the average effects of tightening specific macroprudential tools on credit, household credit and house prices. All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result and additionally apply weights proportional to the number of results observed per study to avoid for any one study to drive the results. To account for possible dependence across results/observations for the same study, standard errors are clustered at the study level and reported in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

Table 4. Average Effects of Tightening Macroprudential Policy on Credit

	Dep. Var.- Standardized Effects on Credit			
	EM	Mixed	Micro	Macro
	(1)	(2)	(3)	(4)
Broad based	-0.044**	-0.033**	-0.045**	-0.032*
	(0.018)	(0.011)	(0.018)	(0.015)
Housing	-0.153***	-0.034***	-0.192***	-0.039***
	(0.042)	(0.007)	(0.009)	(0.009)
Liquidity & Other	-0.126***	-0.030***	-0.130***	-0.030***
	(0.011)	(0.008)	(0.007)	(0.009)
SE sq. (Pub. Bias Correction)	0.380	-3.176***	-2.393***	1.159
	(2.400)	(1.017)	(0.325)	(2.295)
Specification with incomplete controls	0.015	-0.019**	0.018	-0.020
	(0.016)	(0.008)	(0.014)	(0.012)
Observations	198	239	176	261
r2	0.660	0.388	0.694	0.229

The table reports the average effects of macroprudential measures on credit (including household credit). *Mixed* refers to studies which use samples consisting of advanced, emerging and low-income countries or exclusively advanced country samples. All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result and additionally apply weights proportional to the number of results observed per study to avoid for any one study to drive the results. To account for possible dependence across results/observations for the same study, standard errors are clustered at the study level and reported in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

The baseline results are also split according to the study's unit of analysis i.e., whether the results correspond to macro (country level) or micro (bank/firm level) analysis. For all measures, the findings show that the tightening of MPM's is associated with significantly larger effects in micro data. For instance, the tightening of housing tools reduce credit for banks or firms, on average, by 0.2 standard deviations relative to the 0.04 reduction in aggregate credit. This can be explained by i) the higher statistical and identification power in micro-level studies; ii) the focus of micro studies on the effects around binding constraints or on constrained agents, in contrast to the average effect across constrained and unconstrained agents in macro data; and/or iii) the existence of leakages/spillovers which reduce the transmission of micro effects to the aggregate. The results also confirm that the relatively larger effects for liquidity (and other) measures, in Table 2 derive mainly from micro results, which as seen in Figure 4 are substantially larger than the corresponding macro effects.[28]

[28]Appendix Table A8 shows that relatively larger effects found for EM (relative to the mixed samples) and micro-level studies (relative to macro-level studies) hold even when simultaneously controlling for micro-level and EM effects in the EM/Mixed regression (Columns (1)-(2)) and micro/macro regressions (Columns (2)-(3)) respectively. Appendix Table A9 also shows that the results are robust to using an alternative selection correction

Table 5. Mapping Standardized Effects (Tightening Macroprudential Policy)

	Average S.D. of Outcome	Std. Effect Size	Effect Size
Credit Growth:			
y-o-y quarterly Macro	13%	- 0.05	- 0.6 p.p.
q-o-q quarterly Micro	30%	- 0.15	- 4.5 p.p.

To gain further insight into the economic magnitude of the difference between the effects from macro and micro level analysis, the raw effects are reconstructed by multiplying the standardized effects by the average standard deviation of the corresponding outcome variable. In general, all the standardized effects reported in the paper can be converted into unstandardized magnitudes following this approach. Table 5 provides an illustrative mapping of standardized effect sizes for credit growth and shows that the average macro-level standardized effect of -0.05 found across various instruments, can correspond to a -0.6 percentage point reduction in year-on-year credit growth. This is based on the typical cross-country study with an average standard deviation for this measure of 13 percent. Similarly, when interpreting micro-level effects, the average standardized effect of -0.15 can be interpreted as a 4.5 percentage point reduction in quarter-on-quarter credit growth for banks or firms, based on a typical micro study.

D. Reconciling Macro and Micro Estimates: Statistical Power and Leakages and Spillovers

One possible reason for the large difference in micro vs. macro effects could be explained by more statistical and identification power in micro studies. Statistical power is a critical parameter in assessing the credibility of an empirical study as it indicates whether the empirical methods and data used in a study are able to detect an effect, should it be there. As explained in Ioannidis and others (2017), low power means not just high rates of false negatives (Type I errors) but also high rates of false positives, where non-existent effects are seemingly detected (Type II errors). Adopting the conventional 5% level of statistical significance and 80% power level,[29] and taking the average effects obtained in our meta-analysis as a lower-bound for the 'true effect', means that a result's standard error needs to be smaller than the absolute value of the 'true' effect divided by 2.8 for it to be adequately powered. Based on this calculation, almost 80% of the macro-level studies are under-powered to detect standardized effects below

proposed by Andrews and Kasy (2019) i.e., results from EM and micro studies are found to be relatively larger than mixed (sample) and macro studies respectively.

[29]This is the probability of a Type II error, which should be no larger than four times the probability of the conventional Type I error (0.05)

0.05 standard deviations. In contrast only 20% of the micro-level studies are under-powered implying that their results are much more precise, with point estimates more likely to be statistically significantly different from zero, relative to macro studies. Indeed, consistent with these results, the precision of effects in micro-level studies reported in our regressions is almost five times larger than that of macro studies. This also means lower precision weighted average effects for macro studies than micro-studies.

Table 6. Average Leakages and Spillover Effects from Tightening MPMs

	Dep. Var.- Standardized Effects on Cross-border and Non-bank Lending		
	(1)	(2)	(3)
Broad based	0.054**	0.049**	0.066**
	(0.015)	(0.017)	(0.024)
Housing	0.004*	0.005***	0.005***
	(0.002)	(0.001)	(0.000)
Liquidity & Other	0.060***	0.059***	0.077**
	(0.000)	(0.001)	(0.024)
SE sq. (Pub. Bias Correction)			-0.190
			(0.847)
Specification with incomplete controls			0.030*
			(0.014)
Non-Published Papers			-0.034
			(0.025)
Study over-weighting adjustment		X	X
Observations	59	59	59
r2	0.407	0.365	0.445

The table reports the average effects of tightening specific macroprudential tools on variables related to cross-border (spillovers) and non-bank (leakages) lending. All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result. Columns (2)-(3) additionally apply weights proportional to the number of results observed per study to avoid for any one study to drive the results. To account for possible dependence across results/observations for the same study, standard errors are clustered by study and reported in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

Another factor influencing the micro-macro discrepancy is the presence of spillover effects and/or leakages. The issue of spillovers and leakages is tied to both the compliance aspect of the policy as well as its uneven application. An example of compliance is when households take consumer loans to finance a home purchase to circumvent LTV limits. An example of

uneven application is when the activity migrates to institutions that are not covered by the macroprudential instrument, such as corporates borrowing externally instead of domestically (Aiyar, Calomiris, and Wieladek, 2014; Bengui and Bianchi, 2018; Reinhardt and Sowerbutts, 2015). Forbes (2019) distinguishes the two effects by referring to leakages as shifts in credit to other institutions in the same country, and spillovers as shifts in credit to other countries[30]

To shed light on the magnitude of leakages and spillovers, Table 6 uses the meta-regression framework to recover average effects, across different measures, on leakages and spillovers. The sample is limited to those studies in the database that explore this question. A positive sign means that tighter macroprudential policy increases cross-border and/or nonbank lending. The results show that all measures are associated with leakages and/or spillover effects, but that these effects are strongest for broad-based and liquidity measures. These results are consistent with the hypothesis that domestic constraints on lending and credit could create spillover effects internationally, implicitly shifting the portfolio of lending to other countries (Reinhardt and Sowerbutts, 2015).

A rough back-of-the-envelope calculation, subtracting the average effect of leakages/spillovers from the average micro-level effects could suggest still a net negative effect of tightening macroprudential policy on credit. For liquidity, this net effect of approximately -0.05 standard deviations is roughly equivalent to the average macro-effects of -0.03 standard deviations, reported in Table 4. This crude calculation delivers conclusions consistent with the few studies looking more carefully at the net effects (Ahnert and others, 2018; Aiyar, Calomiris, and Wieladek, 2014). These studies suggests that leakages might reduce the impact of macroprudential policy, but it would still constrain credit growth. Nonetheless, this is an area were more work is needed to reach firmer conclusions.

E. Impact on Economic Activity

Macroprudential policy can also have unintended consequences on economic activity. Studies in the database examine this question, but mostly with MPM's measured as indices combining instruments across different categories. Table 7 summarizes through the metaregression framework these results to show that macroprudential policy tightening has a negative and statistically significant effect–at the 1 percent level–on economic activity indicators. The coefficient, at -0.004 standard deviations, is about a third of the effect on credit reported in the same table.[31]

[30] A few papers also examine the spillovers of sector-specific macroprudential measures on other segments of bank lending (Acharya and others, 2019; Bennani and others, 2017), but the analysis in this paper focuses mainly on spillovers to the cross-border and non-bank sectors on which the bulk of this literature concentrates.

[31] These effects on credit cannot be directly compared to those reported in Table 2 as the composition of these indices tend to be fairly heterogeneous, but it is consistent in terms of sign and statistical significance with results shown earlier.

Table 7. Average Effects of Macroprudential Tools: Cross-Sector Effects

	Dep. Var - Standardized Effects on:		
	Credit	House Price	Economic Activity
	(1)	(2)	(3)
Cross-Sector Index	-0.011***	0.002	-0.004***
	(0.003)	(0.003)	(0.000)
SE sq. (Pub. Bias Correction)	-0.002	10.932	-0.130
	(0.070)	(19.355)	(0.099)
Specification with incomplete controls	0.001	-0.002	0.017*
	(0.003)	(0.004)	(0.006)
Observations	80	55	143
r2	0.643	0.216	0.095

The table reports the average effects of tightening cross-sectoral macroprudential tools on credit (including household credit), house prices and macro variables. All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result and additionally apply weights proportional to the number of results observed per study to avoid for any one study to drive the results. To account for possible dependence across results/observations for the same study, standard errors are clustered at the study level and reported in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

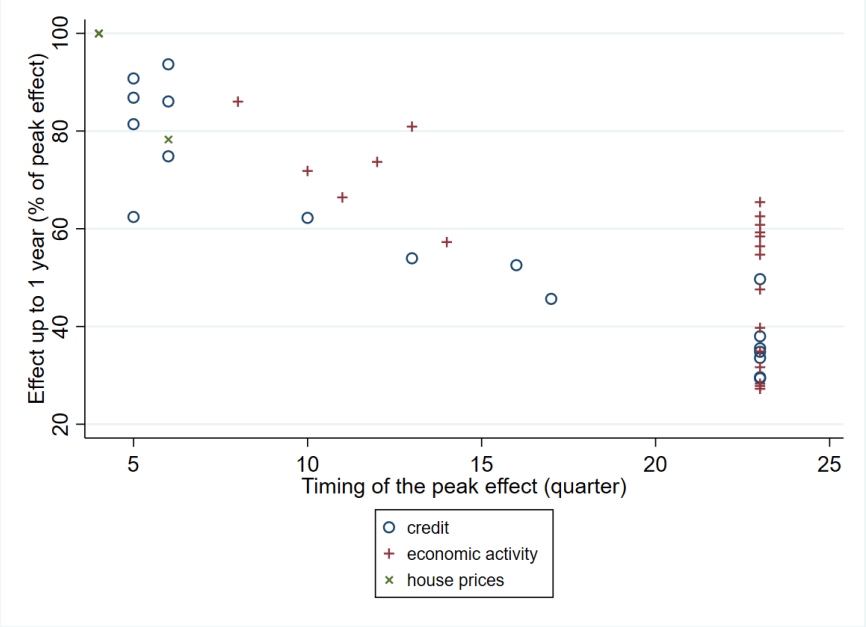
The economic activity category, however, includes many indicators, ranging from firm sales to real GDP growth, and the channels driving the effects from macroprudential actions may differ among them. Therefore, the next step involves looking specifically at papers exploring the effects on output and consumption within the "economic activity" bucket. The observations are too few to run metaregressions on these, but it is nonetheless worth reporting on their findings. For instance, Richter, Schularick, and Shim (2019) find a decline of 0.5 percent and 1.1 percent in real GDP after 2 and 4 years respectively, following a 10 percentage points reduction in LTV limits, an effect comparable in magnitude to that of a 25bps monetary policy tightening (the conclusion is similar when they present results looking at dummy indicators for tightening LTV limits). Alam and others (2019) find a 1.5 percent decline in real consumption growth in response to a tightening of up to 10 percentage points in LTV limits and a 1.1 percent decline for a tightening between 10-25 percentage points. Two related studies (Kim and Mehrotra, 2018, 2019) estimate the effects on real GDP, private consumption, and investment to find comparable effects between a one-standard-deviation shock to an index of macro-prudential measures and a one-standard deviation monetary policy tightening. Overall, the evidence suggests that by reducing credit flows through a variety of tools, macroprudential policy may reduce also economic activity. But this effect may be also consistent with macroprudential policy reducing the incidence of boom-bust cycles, ultimately reducing output volatility in the long term.

F. Dynamics

The full effects of macroprudential policy can take more than one year to fully materialize– the horizon examined until now. On the one hand, searching for a lender, a house, and processing a loan application may take some time. This implies that some of the effect from macroprudential policy actions may materialize with a delay. On the other hand, borrowers and/or lenders may find ways to circumvent regulation, and thus the effects of macroprudential policy may weaken over time. To examine this question, Appendix Table A10 compares the estimated average impact of macroprudential policy among papers looking at effects within the same period (i.e. contemporaneous) and those doing so one period after the policy action (i.e. lagged). For all the three buckets of tools, the table shows smaller lagged than contemporaneous effects. These results suggest a hump-shaped response of credit to macroprudential policy adjustments.

A number of papers in the database (e.g. Kim and Mehrotra, 2018; Richter, Schularick, and Shim, 2019; Zdzienicka and others, 2015) examine this question more specifically through VAR/VECM frameworks, or local projection methods. To summarize these findings, Figure 8 plots two attributes of each result taken from these papers: the timing of the peak effect and the fraction of the peak effect that is observed in the first year. The figure shows only responses which are significant at 10 percent confidence level.

Figure 8. Effects at various horizons, from studies focusing on long-run effects



The figure confirms that the response of various outcome variables to macro-prudential policies is often hump-shaped, with persistent but declining effects over time. The chart also

shows some mass of peak results at 24 quarters, which simply reflects a truncation in the horizon reported by authors, as well as some very persistent responses. The effects on credit peak at a 1-2 year horizon, while those for macroeconomic variables (GDP, consumption, prices) after 2-3 years. The first year effect is in most cases between 20 percent and 80 percent of the peak effect.

Dynamic effects are also corroborated by studies conducting dynamic panel data analysis (e.g. Alam and others, 2019; Claessens, Ghosh, and Mihet, 2013), which allow also some inference on the dynamic effects of MPMs (about 30 percent of the studies in the database). To some extent the finding of persistent effects is not a total surprise given that the studies focus on variables that are inherently persistent. But they highlight that in considering the total effects of macroprudential policy, there may be a non-trivial fraction of the effects beyond the first year.

V. Conclusion

Since the Global Financial Crisis policymakers have increasingly used macroprudential policy recognizing its potential to be an important tool to preserve financial stability. Until recently, most of its use was directed to containing the buildup of vulnerabilities through tightening actions. However, as countries grapple with the effects from the COVID-19 pandemic, many are now easing macroprudential policy in an effort to ensure the flow of credit to the real economy. Yet, there is still no consensus on how effective macroprudential policy is and what instruments work best. To make further progress in this direction, this paper presented a novel database to take stock of what is known about the effects of macroprudential policy.

Focusing on the most widely studied outcomes in the literature, and relying on meta-analysis techniques, this paper finds that on average, macroprudential policy tools have statistically significant effects on credit. These effects are relatively larger among studies using micro-level data than those using macro level data. This is in part explained by stronger identification and statistical power in micro level studies; the presence of leakages and spillovers; and the fact macro-level studies capture averages across constrained and unconstrained agents. The paper finds significant heterogeneity in the effects across country settings and instruments, with effects appearing stronger among emerging markets, albeit with larger confidence intervals. The paper also finds suggestive evidence of stronger effects from tightening than loosening actions. This follows in part from a larger number of tightening than loosening actions until recently, which allow for stronger statistical power to detect their effects. Finally, the paper finds evidence of a negative impact on economic activity in the near term from tightening macroprudential policy, which may be consistent with reducing the incidence of boom-bust cycles and ultimately generating lower output volatility in the long term.

Overall, the paper's findings provide encouraging evidence supporting macroprudential policy' role in containing the buildup of credit vulnerabilities ex ante, helping build financial sector resilience to shocks. However, more work is needed to fully understand how effective macroprudential policy is. Future work in this area should consider improving measurement

of macroprudential policy actions to better capture the intensive margin; increasing research on micro-level data which seems more adequately powered; expanding our knowledge on the effects of easing macroprudential policy taking advantage of actions in response to COVID-19, to better understand the effects of macroprudential policy in downturns; and further exploring nonlinearities, including interactions with other policies.

REFERENCES

Acharya, Viral V., Katharina Bergant, Matteo Crosignani, Tim Eisert, and Fergal J. McCann, 2019, "The anatomy of the transmission of macroprudential policies," Available at ssrn 3388963, NYU Stern School of Business.

Afanasieff, Tarsila, Fabiana L. C. A. Carvalho, Eduardo C. de Castro, Rodrigo Coelho, and Jaime Gregório, 2015, "Implementing loan-to-value ratios: The case of auto loans in brazil (2010-11)," Working Paper 380, Central Bank of Brazil.

Agénor, Pierre-Richard, 2019, "Growth and Welfare Effects of Macroprudential Regulation," *Macroeconomic Dynamics*, Vol. 23, No. 8, pp. 3140–3162.

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.

Ahnert, Toni, Kristin Forbes, Christian Friedrich, and Dennis Reinhardt, 2018, "Macroprudential FX regulations: shifting the snowbanks of FX vulnerability?" Working Paper 2018-55, Bank of Canada.

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*, Vol. 46, No. s1, pp. 181–214.

Akinci, Ozge, and Jane Olmstead-Rumsey, 2018, "How effective are macroprudential policies? An empirical investigation," *Journal of Financial Intermediation*, Vol. 33, pp. 33–57.

Alam, Zohair, Adrian Alter, Jesse Elseman, 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.

Alfon, Isaac, Isabel Argimon, and Patricia Bascuñana-Ambrós, 2005, "How individual capital requirements affect capital ratios in UK banks and building societies," Working Paper 0515, Banco de España.

Altunbas, Yener, Mahir Binici, and Leonardo Gambacorta, 2018, "Macroprudential policy and bank risk," *Journal of International Money and Finance*, Vol. 81, pp. 203–220.

Andrews, Isaiah, and Maximilian Kasy, 2019, "Identification of and correction for publication bias," *American Economic Review*, Vol. 109, No. 8, pp. 2766–94.

Arregui, Nicolas, Jaromír Beneš, Ivo Krznar, Srobona Mitra, and Andre O. Santos, 2013, "Evaluating the net benefits of macroprudential policy: A cookbook," IMF Working Paper 13/167, International Monetary Fund.

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.

Banerjee, Ryan N., and Hitoshi Mio, 2018, "The impact of liquidity regulation on banks," *Journal of Financial intermediation*, Vol. 35, pp. 30–44.

Barroso, João Barata R. B., Rodrigo Barbone Gonzalez, and Bernardus F. Nazar Van Doornik, 2017, "Credit Supply Responses to Reserve Requirement: loan-level evidence from macroprudential policy," Working Paper 467, Central Bank of Brazil.

Baskaya, Yusuf Soner, Turalay Kenç, Ilhyock Shim, and Philip Turner, 2016, "Financial development and the effectiveness of macroprudential measures," BIS Paper 86, Bank for International Settlements.

Basten, Christoph Carl, and Catherine Koch, 2015, "Higher bank capital requirements and mortgage pricing: evidence from the Countercyclical Capital Buffer (CCB)," BIS Working Paper 511, Bank for International Settlements.

Benediktsdóttir, Sigríður, Greg Feldberg, and Nellie Liang, 2020, "What macroprudential policies are countries using to help their economies through the COVID-19 crisis?" *Brookings Upfront*.

Bengui, Julien, and Javier Bianchi, 2018, "Macroprudential Policy with Leakages," Working Paper w25048, National Bureau of Economic Research.

Bennani, T, C Couaillier, A Devulder, Silvia Gabrieli, J Idier, P Lopez, T Piquard, and V Scalone, 2017, "An analytical framework to calibrate macroprudential policy," Working Paper 648, Banque de France.

Bonner, Clemens, and Sylvester CW Eijffinger, 2016, "The impact of liquidity regulation on bank intermediation," *Review of Finance*, Vol. 20, No. 5, pp. 1945–1979.

Bruns, Stephan B, 2017, "Meta-Regression Models and Observational Research," *Oxford Bulletin of Economics and Statistics*, Vol. 79, No. 5, pp. 637–653.

Campbell, John Y, Tarun Ramadorai, and Benjamin Ranish, 2015, "The impact of regulation on mortgage risk: Evidence from India," *American Economic Journal: Economic Policy*, Vol. 7, No. 4, pp. 71–102.

Carreras, Oriol, E Philip Davis, and Rebecca Piggott, 2018, "Assessing macroprudential tools in OECD countries within a cointegration framework," *Journal of Financial Stability*, Vol. 37, pp. 112–130.

Cerutti, Eugenio, Stijn Claessens, and Luc Laeven, 2017, "The use and effectiveness of macroprudential policies: New evidence," *Journal of Financial Stability*, Vol. 28, pp. 203–224.

Cerutti, Eugenio, and Haonan Zhou, 2018, "Cross-border banking and the circumvention of macroprudential and capital control measures," IMF Working Paper 18/217, International Monetary Fund.

Cipollina, Maria, and Luca Salvatici, 2010, "The trade impact of European Union agricultural preferences," *Journal of Economic Policy Reform*, Vol. 13, No. 1, pp. 87–106.

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*, Vol. 51, No. 5, pp. 1209–1235.

Claessens, Stijn, Swati R Ghosh, and Roxana Mihet, 2013, "Macro-prudential policies to mitigate financial system vulnerabilities," *Journal of International Money and Finance*, Vol. 39, pp. 153–185.

Craig, R Sean, and Changchun Hua, 2011, "Determinants of Property Prices in Hong Kong Sar: Implications for Policy," IMF Working Paper 11/27, International Monetary Fund.

Crowe, Christopher, Giovanni Dell'Ariccia, Deniz Igan, and Pau Rabanal, 2012, "Policies for macrofinancial stability: Managing real estate booms and busts," *International Monetary Fund*, pp. 1–25.

Danisewicz, Piotr, Dennis Reinhardt, and Rhiannon Sowerbutts, 2017, "On a tight leash: Does bank organizational structure matter for macroprudential spillovers?" *Journal of*

International Economics, Vol. 109, pp. 174–194.

Dassatti Camors, Cecilia, Jose-Luis Peydro, Francesc R-Tous, and Sergio Vicente, 2019, "Macroprudential and monetary policy: loan-level evidence from reserve requirements," Working Paper 1650, Universitat Pompeu Fabra.

de Araujo, Douglas Kiarelly Godoy, Joao Barata Ribeiro Blanco Barroso, and Rodrigo Barbone Gonzalez, 2019, "Loan-to-value policy and housing finance: effects on constrained borrowers," *Journal of Financial Intermediation*, p. 100830.

Dell'Ariccia, Giovanni, Deniz Igan, Luc Laeven, Hui Tong, Bas Bakker, and Jérôme Vandenbussche, 2012, "Policies for macrofinancial stability: How to deal with credit booms," IMF Staff Discussion Note 12/06, International Monetary Fund.

Disdier, Anne-Célia, and Keith Head, 2008, "The puzzling persistence of the distance effect on bilateral trade," *The Review of Economics and statistics*, Vol. 90, No. 1, pp. 37–48.

Doucouliagos, Hristos, and Tom D Stanley, 2009, "Publication selection bias in minimum-wage research? A meta-regression analysis," *British Journal of Industrial Relations*, Vol. 47, No. 2, pp. 406–428.

Epure, Mircea, Irina Mihai, Camelia Minoiu, and José-Luis Peydró, 2018, "Household credit, global financial cycle, and macroprudential policies: credit register evidence from an emerging country," IMF Working Paper 18/13, International Monetary Fund.

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

Gadatsch, Niklas, Lukas Mann, and Isabel Schnabel, 2018, "A new IV approach for estimating the efficacy of macroprudential measures," *Economics Letters*, Vol. 168, pp. 107–109.

Galac, Tomislav, 2010, "The Central Bank as Crisis-Manager in Croatia–A Counterfactual Analysis," Working Paper 27, Croatian National Bank.

Galati, Gabriele, and Richhild Moessner, 2013, "Macroprudential policy–a literature review," *Journal of Economic Surveys*, Vol. 27, No. 5, pp. 846–878.

———, 2018, "What do we know about the effects of macroprudential policy?" *Economica*, Vol. 85, No. 340, pp. 735–770.

Gambacorta, Leonardo, and Andrés Murcia, 2019, "The impact of macroprudential policies in Latin America: An empirical analysis using credit registry data," *Journal of Financial Intermediation*, p. 100828.

Gechert, Sebastian, 2015, "What fiscal policy is most effective? A meta-regression analysis," *Oxford Economic Papers*, Vol. 67, No. 3, pp. 553–580.

Gómez, Esteban, Angélica Lizarazo, Juan Mendoza, and Andrés Murcia, 2017, "Evaluating the impact of macroprudential policies on credit growth in Colombia," Bis working paper, Bank for International Settlements.

Greenland, Sander, 1987, "Quantitative methods in the review of epidemiologic literature," *Epidemiologic reviews*, Vol. 9, No. 1, pp. 1–30.

Havranek, Tomas, 2015, "Measuring intertemporal substitution: The importance of method choices and selective reporting," *Journal of the European Economic Association*, Vol. 13, No. 6, pp. 1180–1204.

Havranek, Tomas, and Zuzana Irsova, 2011, "Estimating vertical spillovers from FDI: Why results vary and what the true effect is," *Journal of International Economics*, Vol. 85, No. 2, pp. 234–244.

Havranek, Tomas, Marek Rusnak, and Anna Sokolova, 2017, "Habit formation in consumption: A meta-analysis," *European Economic Review*, Vol. 95, pp. 142–167.

Havranek, Tomas, and Anna Sokolova, 2020, "Do consumers really follow a rule of thumb? Three thousand estimates from 144 studies say "probably not"," *Review of Economic Dynamics*, Vol. 35, pp. 97–122.

Hole, Arne Risa, 2017, "Ranking economics journals using data from a national research evaluation exercise," *Oxford Bulletin of Economics and Statistics*, Vol. 79, No. 5, pp. 621–636.

Igan, Deniz, and Heedon Kang, 2011, "Do loan-to-value and debt-to-income limits work? Evidence from Korea," IMF Working Papers 11/297, International Monetary Fund.

IMF, 2014, "Staff Guidance Note on Macroprudential Policy - Detailed Guidance on Instruments," *IMF Staff Guidance Note*.

———, 2020, "Policy Responses to COVID-19," *International Monetary Fund*.

Ioannidis, John PA, TD Stanley, Hristos Doucouliagos, and others, 2017, "The Power of Bias in Economics Research," *Economic Journal*, Vol. 127, No. 605, pp. 236–265.

Jacome, Luis I., and Srobona Mitra, 2015, "LTV and DTI Limits—Going Granular," IMF Working Paper 15/154, International Monetary Fund.

Jasova, Martina, and A Gersl, 2012, "From credit boom to credit crunch: effectiveness of policy measures in Central and Eastern Europe," *International Journal of Business*, Vol. 1, pp. 58–66.

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*, Vol. 125, No. 6, pp. 2126–2177.

Kang, Heedon, Francis Vitek, Rina Bhattacharya, Phakawa Jeasakul, Sònia Muñoz, Naixi Wang, and Rasool Zandvakil, 2017, "Macroprudential policy spillovers: A quantitative analysis," IMF Working Paper 17/170, International Monetary Fund.

Kim, Soyoung, and Aaron Mehrotra, 2018, "Effects of Monetary and Macroprudential Policies—Evidence from Four Inflation Targeting Economies," *Journal of Money, Credit and Banking*, Vol. 50, No. 5, pp. 967–992.

———, 2019, "Examining macroprudential policy and its macroeconomic effects - some new evidence," BIS Working Papers 825, Bank for International Settlements.

Kraft, Evan, and Tomislav Galac, 2011, "Macroprudential regulation of credit booms and busts-The case of Croatia," Working Paper WPS5772, The World Bank.

Krznar, Ivo, and James Morsink, 2014, "With Great Power Comes Great Responsibility: Macroprudential Tools at Work in Canada," IMF Working Paper 14/83, International Monetary Fund.

Kuttner, Kenneth N, and Ilhyock Shim, 2016, "Can non-interest rate policies stabilize housing markets? Evidence from a panel of 57 economies," *Journal of Financial Stability*, Vol. 26, pp. 31–44.

Levin, Gabriel, Calixto López, and Fabrizio Lopez-Gallo, 2016, "The impact of expected losses provisioning on credit growth: the case of Mexico," Working paper, Bank of Mexico.

Lim, Cheng H., Francesco Columba, Alejo Costa, Piyabha Kongsamut, Akira Otani, Mustafa Saiyid, Torsten Wezel, and Xiaoyong Wu, 2011, "Macroprudential Policy: What Instru-

ments and How Are They Used? Lessons from Country Experiences," IMF Working Paper 11/238, International Monetary Fund.

Magud, Nicolas, Carmen Reinhart, and Kenneth Rogoff, 2011, "Capital Controls: A Meta-analysis Approach," Mpra paper, University Library of Munich, Germany.

Martins, Bruno, and Ricardo Schechtman, 2013, "Loan pricing following a macro prudential within-sector capital measure," Working Paper 323, Central Bank of Brazil.

McDonald, Chris, 2015, "When is macroprudential policy effective?" BIS Working Papers 496, Bank for International Settlements.

Minaya, Elinas, José Lupú, and Miguel Cabello, 2017, "Macroprudential policies in Peru: the effects of dynamic provisioning and conditional reserve requirements," BIS Working Paper 675, Bank for International Settlements.

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*, Vol. 37, pp. 89–103.

Neagu, Florian, Luminita Tatarici, and Irina Mihai, 2015, "Implementing Loan-to-value and Debt Service-to-income Measures: A Decade of Romanian Experience," MPRA Paper 65988, University Library of Munich, Germany.

Nieminen, Pentti, Heli Lehtiniemi, Kirsi Vähäkangas, Antti Huusko, and Arja Rautio, 2013, "Standardised regression coefficient as an effect size index in summarising findings in epidemiological studies," *Epidemiology, Biostatistics and Public Health*, Vol. 10, No. 4.

Nymoen, Ragnar, Kari Pedersen, and Jon Ivar Sjåberg, 2019, "Estimation of effects of recent macroprudential policies in a sample of advanced open economies," *International Journal of Financial Studies*, Vol. 7, No. 2, p. 23.

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*, Vol. 88, No. 2, pp. 407–421.

Peterson, Robert A, and Steven P Brown, 2005, "On the use of beta coefficients in meta-analysis." *Journal of Applied Psychology*, Vol. 90, No. 1, p. 175.

Reinhardt, Dennis, and Rhiannon Sowerbutts, 2015, "Regulatory arbitrage in action: evidence from banking flows and macroprudential policy," Working Paper 546, Bank of England.

Rice, Kenneth, Julian PT Higgins, and Thomas Lumley, 2018, "A re-evaluation of fixed effect (s) meta-analysis," *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, Vol. 181, No. 1, pp. 205–227.

Richter, Björn, Moritz Schularick, and Ilhyock Shim, 2019, "The costs of macroprudential policy," *Journal of International Economics*, Vol. 118, pp. 263–282.

Stanley, Tom D, 2001, "Wheat from chaff: Meta-analysis as quantitative literature review," *Journal of economic perspectives*, Vol. 15, No. 3, pp. 131–150.

Stanley, Tom D, and Hristos Doucouliagos, 2014, "Meta-regression approximations to reduce publication selection bias," *Research Synthesis Methods*, Vol. 5, No. 1, pp. 60–78.

Sutton, Alexander J, and Julian PT Higgins, 2008, "Recent developments in meta-analysis," *Statistics in medicine*, Vol. 27, No. 5, pp. 625–650.

Sánchez, Aida Caldera, and Oliver Röhn, 2016, "How do policies influence GDP tail risks?" OECD Working Papers 1339, OECD Publishing.

Tantasith, Chantawit, Nasha Ananchotikul, Chatlada Chotanakarn, Vorada Limjaroenrat, Runchana Pongsaparn, and others, 2018, "The Impact of LTV policy on Bank Lending:

Evidence from Disaggregate Housing Loan Data," PIER Discussion Paper 90, Puey Ungphakorn Institute for Economic Research.

Vandenbussche, Jérôme, Ursula Vogel, and Enrica Detragiache, 2015, "Macroprudential policies and housing prices: A new database and empirical evidence for Central, Eastern, and Southeastern Europe," *Journal of Money, Credit and Banking*, Vol. 47, No. S1, pp. 343–377.

Wang, Bin, and Tao Sun, 2013, "How effective are macroprudential policies in China?" IMF Working Papers 13-75, International Monetary Fund.

Wong, TC, Tom Fong, Ka-fai Li, and Henry Choi, 2011, "Loan-to-value ratio as a macroprudential tool-Hong Kong's experience and cross-country evidence," Working Paper 01/2011, Hong Kong Monetary Authority.

Yuan, Ke-Hai, and Wai Chan, 2011, "Biases and standard errors of standardized regression coefficients," *Psychometrika*, Vol. 76, No. 4, pp. 670–690.

Zdzienicka, Aleksandra, Sally Chen, Federico Diaz Kalan, Stefan Laseen, and Katsiaryna Svirydzenka, 2015, "Effects of Monetary and Macroprudential Policies on Financial Conditions; Evidence from the United States," IMF Working Paper 15/288, International Monetary Fund.

Zhang, Longmei, and Edda Zoli, 2016, "Leaning against the wind: Macroprudential policy in Asia," *Journal of Asian Economics*, Vol. 42, pp. 33–52.

Appendices

Table A1. List of Macroprudential Tools

Groups	Macroprudential Tools	Definition of Macroprudential Tools
broad_based	Countercyclical buffers (CCB)†	A requirement for banks to maintain a countercyclical capital buffer. Implementations at 0% are not considered as a tightening in dummy-type indicators.
	Conservation buffers (CON)	Requirements for banks to maintain a capital conservation buffer, including the one established under Basel III.
	Capital requirements (CR)*†§	Capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements. Countercyclical capital buffers and capital conservation buffers are captured in their sheets respectively and thus not included here.
	Leverage limits (LVR)	A limit on leverage of banks, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures (e.g., Basel III leverage ratio).
	Loan loss provisions (LLP)*†	Loan loss provision requirements for macroprudential purposes, which include dynamic provisioning and sectoral provisions (e.g. housing loans).
	Limits on credit growth (LCG)	Limits on growth or the volume of aggregate credit, the household-sector credit, or the corporate-sector credit by banks, and penalties for high credit growth.
	Loan restrictions (LR)*†	Loan restrictions, that are more tailored than those captured in "LCG". They include loan limits and prohibitions, which may be conditioned on loan characteristics (e.g., the maturity, the size, the LTV ratio and the type of interest rate of loans), bank characteristics (e.g., mortgage banks), and other factors. Restrictions on foreign currency lending are captured in "LFC".
	Limits on foreign currency loans (LFC)	Limits on foreign currency (FC) lending, and rules or recommendations on FC loans.
liquidity	Liquidity (LIQ)*	Measures taken to mitigate systemic liquidity and funding risks, including minimum requirements for liquidity coverage ratios, liquid asset ratios, net stable funding ratios, core funding ratios and external debt restrictions that do not distinguish currencies.
	Limits on loan-to-deposit ratio (LTD)	Limits to the loan-to-deposit (LTD) ratio and penalties for high LTD ratios.
	Limits on foreign exchange positions (LFX)	Limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mismatch regulations.
	Reserve Requirements (RR)*	Reserve requirements (domestic or foreign currency) for macroprudential purposes. Please note that this category may currently include those for monetary policy as distinguishing those for macroprudential or monetary policy purposes is often not clear-cut.
housing	Limits on loan-to-value ratio (LTV)*	Limits to the loan-to-value ratios, including those mostly targeted at housing loans, but also includes those targeted at automobile loans, and commercial real estate loans.
	Limits on the debt-service-to-income ratio (DSTI)*	Limits to the debt-service-to-income ratio and the loan-to-income ratio, which restrict the size of debt services or debt relative to income. They include those targeted at housing loans, consumer loans, and commercial real estate loans.
other	Systemically important financial institutions (SIFI)	Measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFIs), which includes capital and liquidity surcharges.
	Tax measures (TAX)*†	Taxes and levies applied to specified transactions, assets, or liabilities, which include stamp duties, capital gain taxes, and levies on banks' noncore funding.
	Other (OTHER)*†	Macroprudential measures not captured in the above categories—e.g., stress testing, restrictions on profit distribution, and structural measures (e.g., limits on exposures between financial institutions).
index	i_housing	Index measure constructed with housing tools only.
	i_non_housing	Index measure constructed without housing tools (broad_based, liquidity, other).
	i_general	Index measure constructed with both housing and non-housing tools.

* some papers also study FX targeted measures of this macroprudential tool (suffix: _FX), we classify these measures in the same group as the tools listed in the table

† some papers also study household or housing sector targeted measures of this macroprudential tool (suffix: _HH), we classify these measures in the "housing" group

§ some papers also study corporate sector targeted measures of this macroprudential tool (suffix: _CORP), we classify these measures in the same group as the tools listed in the table

Table A2. Categories of Outcome Variables

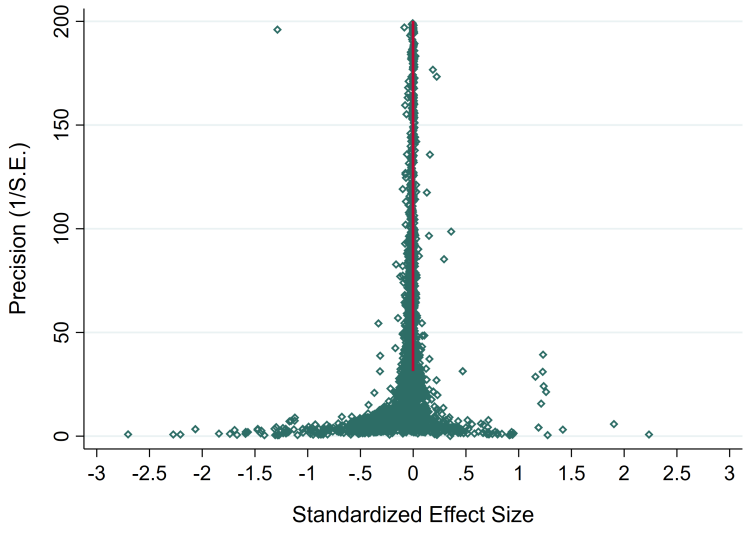
Outcome Categories	Examples of Variables Included in this Category
Balance sheet fragility	bank total asset; bank leverage ratio; bank liquidity ratio; bank non-core to core liability ratio; (-) bank capital
Bank default risk	non-performing loans; probability of areas; expected default frequency
Capital flows*	cross border credit to banks or non-banks; ratio of cross border credit to total credit
Corporate credit*	international and domestic debt by corporate; credit to corporate
Credit	bank credit (committed or drawn); total credit; credit to GDP ratio; debt-to-liability ratio; bank borrowing
House price	house price index
Household credit	household credit; mortgage loans; consumption loans; auto loans
Economic activity	GDP; consumption; investment; inflation; firm sales
Non bank credit*	non bank credit; non bank credit as a share of total assets or total liabilities
Other	number of housing transactions; house price expectation; mortgage rate; interest rate spread; stock price

* some of the outcome variables in these categories are identified as cross-boarder spillovers or domestic leakages.

VI. Testing for Selection bias

In this appendix section, we conduct formal tests to investigate presence of selective reporting bias. We examine whether the results we collect are subject to selective reporting, both graphically and statistically. Figure 9 shows a 'funnel-plot' which is often used in the meta-analysis literature to detect selection bias, and it plots each estimated standardized effect (horizontal axis) against its precision (vertical axis). We find that more precise results are clustered at the top and find smaller effects. Further, the estimated values tend to be larger on average for larger values of the standard error or less when precision is low.

Figure 9. Funnel Plot for Testing Selection Bias



Next we regress the estimated coefficient on its standard error; if all estimates have an equal probability of being reported then we should expect no correlation between the estimate and its standard error.[32] Table A3 presents results from statistically testing for the presence of selection bias. The results are based on all estimated coefficients across different macroprudential policy instruments and outcomes (up-to the one year horizon and excluding results from loosening episodes to ensure comparability). Column (1) shows that the estimates are significantly and negatively associated with their standard error, suggesting that the effects with smaller precision tend to be more negative and larger. Column (2) includes a fixed effect for each study in our data and finds a similar result. In column (3) and (4) we find the bias to be present even in published papers. Finally in column (5), we find the bias to be considerably small and statistically insignificant in micro-based studies, but to be present in macro studies.

Table A3. Selection Bias Test for All Effects

	(1) RE	(2) FE	(3) Published	(4) Macro	(5) Micro
Standard Error	-0.737***	-1.261**	-1.071***	-0.997***	-0.170
	(0.099)	(0.577)	(0.267)	(0.042)	(2.518)
Observations	2602	2602	1246	2110	492
Studies	30	30	12	16	14

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

VII. Additional Results

In this appendix section, we present additional results for total credit from studies that measure whether the macroprudential policy through indices which overlap across sectors, as well as results that measure macroprudential policies in terms of whether they are in place.

Next, in table A4 we find average effects for the existence of a macroprudential policy to be associated with a 0.2, 0.1 and 0.09 standard deviation reduction in credit for broad-based, housing sector, and liquidity/other tools respectively. These average effects are relatively larger than those reported in Table 2. However as these studies mainly exploit cross-country

[32]The underlying equation of this test is heteroskedatic and, as the degree of heteroskedasticity is given by the estimate's standard error, a weighted least squares procedure with the inverse of standard errors as weights yields efficient estimates.

variation as sources of identification, it is unclear whether the larger effects may just be picking up country specific economic differences. In addition, as these studies focus on whether MPP tools are in place, an existence of a tool could be capturing also a possible cumulative effect of several tightening episodes.

Table A4. Average Effects of Macroprudential Tools in Place on Credit

Dep. Var.- Standardized effects on Credit				
Broad based	-0.268*	-0.326**	-0.326**	-0.214*
	(0.125)	(0.108)	(0.109)	(0.110)
Housing	-0.106**	-0.102**	-0.102**	-0.099
	(0.041)	(0.034)	(0.034)	(0.052)
Liquidity & Other	-0.109***	-0.119***	-0.119***	-0.091***
	(0.019)	(0.027)	(0.027)	(0.020)
SE sq. (Pub. Bias Correction)			-0.012	-0.007
			(0.064)	(0.066)
Specification with incomplete controls				-0.004
				(0.060)
Non-Published Papers				-0.147*
				(0.062)
Study over-weighting adjustment		X	X	X
Observations	207	207	207	207
r2	0.197	0.267	0.267	0.282

The table reports the average effects of having in place sectoral macroprudential tools on credit (including credit to households) . All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result. Columns (2)-(3) additionally apply weights proportional to the number of results observed per study to avoid for any to influence the results. To account for possible dependence across results/observations for the same study, we cluster standard errors by study and reported these in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

Finally in Table A5 we report the effects of macroprudential measures on household credit and house prices. In this table we explore how tightening broad-based, housing and liquidity measures can affect housing sector outcomes. We find imprecise effects overall, but significant negative effects for housing macroprudential measures on household credit. These results should be interpreted with caution however, as Table 3 shows some heterogeneity across instruments; specifically, once disaggregated, we find broad-based measures such as capital requirements to reduce house prices, on average.

Table A5. Average Effects of Macroprudential Tools: Household Credit and House Price

	Household Credit	House Price
Broad based	-0.008	-0.009
	(0.028)	(0.010)
Housing	-0.038*	0.002
	(0.021)	(0.016)
Liquidity & Other	-0.012	-0.008
	(0.024)	(0.033)
SE sq. (Pub. Bias Correction)	-2.090	-2.012
	(1.942)	(1.509)
Specification with incomplete controls	-0.052	-0.045
	(0.036)	(0.041)
Non-Published Papers	-0.006	-0.027
	(0.023)	(0.017)
Observations	299	250
r2	0.225	0.180

The table reports the average effects of tightening sectoral macroprudential tools on household credit and house prices. All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result and additionally apply weights proportional to the number of results observed per study to avoid for any to influence the results. To account for possible dependence across results/observations for the same study, we cluster standard errors by study and reported these in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

VIII. Robustness

In this appendix section, we carry out robustness exercises to test the sensitivity of our baseline results. Table A6 shows that our results are robust to excluding results that were standardized based on imputing summary statistics; it also shows the results are fairly stable to excluding each study at a time and not unduly driven by a few studies. Next in Table A10 we add the dummy variable related to publication to ensure that our result on macro vs micro results are robust to its inclusion; we find that the pattern of our results remains fairly stable. Then , in Table A8 we show that relatively larger effects found for EM (relative to the mixed samples) and micro-level studies (relative to macro-level studies) hold even when simultaneously controlling for micro-level and EM effects in the EM/Mixed regression (Columns (1)-(2)) and micro/macro regressions (Columns (2)-(3)) respectively. Finally, Table A9 estimates the average effects for the EM vs. Mixed and Micro vs. Macro samples using the selection correction method proposed by Andrews and Kasy (2019); again we find that the pattern of our results is largely unchanged from the different estimation method used.

Table A6. Robustness to excluding single papers: MPM Tightening Effects on Credit

	Broad-based	Housing	Liquidity
Excluding:			
Imputed Summary Stats.	-0.028	-0.038**	-0.116***
	(0.033)	(0.017)	(0.028)
Excluding Paper:			
1	-0.052	-0.058**	-0.136***
	(0.035)	(0.026)	(0.030)
2	-0.052	-0.058**	-0.135***
	(0.035)	(0.026)	(0.031)
3	-0.051	-0.055**	-0.132***
	(0.033)	(0.025)	(0.030)
4	-0.053	-0.058**	-0.135***
	(0.034)	(0.026)	(0.030)
5	-0.053	-0.057**	-0.134***
	(0.034)	(0.026)	(0.030)
6	-0.066	-0.070	-0.147***
	(0.059)	(0.056)	(0.057)
7	-0.048	-0.052**	-0.129***
	(0.033)	(0.024)	(0.029)
8	-0.080*	-0.084**	-0.161***
	(0.042)	(0.036)	(0.039)
9	-0.009	-0.048**	-0.035
	(0.025)	(0.023)	(0.024)
10	-0.056*	-0.058**	-0.137***
	(0.034)	(0.026)	(0.030)
11	-0.054	-0.058**	-0.135***
	(0.035)	(0.026)	(0.031)
12	-0.054	-0.058**	-0.135***
	(0.034)	(0.026)	(0.030)
13	-0.054	-0.058**	-0.135***
	(0.034)	(0.026)	(0.030)
14	-0.056*	-0.058**	-0.137***
	(0.034)	(0.026)	(0.030)
15	-0.054	-0.058**	-0.135***
	(0.034)	(0.026)	(0.030)
16	-0.056*	-0.058**	-0.137***
	(0.034)	(0.026)	(0.030)
17	-0.053	-0.056**	-0.134***
	(0.034)	(0.025)	(0.030)
18	-0.054	-0.057**	-0.134***
	(0.034)	(0.026)	(0.030)
19	-0.070**	-0.061**	-0.142***
	(0.028)	(0.026)	(0.029)
20	-0.054	-0.059**	-0.135***
	(0.034)	(0.026)	(0.031)
21	-0.038	-0.041**	-0.119***
	(0.028)	(0.017)	(0.023)
22	-0.047	-0.058**	-0.128***
	(0.034)	(0.026)	(0.030)

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A7. Average Effects of Tightening Macroprudential Policy on Credit

	Dep. Var.- Standardized effects on Credit	
	Micro	Macro
	(1)	(2)
Broad based	-0.024	-0.025
	(0.028)	(0.024)
Housing	-0.188***	-0.035*
	(0.010)	(0.019)
Liquidity & Other	-0.110***	-0.023
	(0.019)	(0.021)
SE sq. (Pub. Bias Correction)	-2.383***	1.000
	(0.315)	(1.709)
Specification with incomplete controls	0.018	-0.024
	(0.014)	(0.021)
Non-Published Papers	-0.020	-0.007
	(0.016)	(0.020)
Observations	176	267
r2	0.694	0.178

The table reports the average effects of macroprudential measures on credit (including household credit). All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result and additionally apply weights proportional to the number of results observed per study to avoid for any to influence the results. To account for possible dependence across results/observations for the same study, we cluster standard errors by study and reported these in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

Table A8. Average Effects of Tightening Macroprudential Policy on Credit

	Dep. Var.- Standardized effects on Credit			
	EM	Mixed	Micro	Macro
	(1)	(2)	(3)	(4)
Broad based	0.038*	-0.039***	0.004	-0.037***
	(0.019)	(0.009)	(0.005)	(0.012)
Housing	-0.105***	-0.034***	-0.143***	-0.040***
	(0.012)	(0.007)	(0.009)	(0.009)
Liquidity & Other	-0.046**	-0.031***	-0.081***	-0.037**
	(0.017)	(0.009)	(0.008)	(0.013)
SE sq. (Pub. Bias Correction)	0.363	-3.282***	-2.523***	0.915
	(1.843)	(1.055)	(0.411)	(1.640)
Specification with incomplete controls	0.018	-0.022**	0.018	-0.018
	(0.014)	(0.009)	(0.014)	(0.012)
EM			-0.049***	0.032
			(0.014)	(0.045)
Micro	-0.084***	0.037**		
	(0.021)	(0.015)		
Observations	204	239	176	267
r2	0.660	0.397	0.695	0.185

The table reports the average effects of macroprudential measures on credit (including household credit). *Mixed* refers to studies which use samples consisting of advanced, emerging and low-income countries or exclusively advanced country samples. All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result and additionally apply weights proportional to the number of results observed per study to avoid for any to influence the results. To account for possible dependence across results/observations for the same study, we cluster standard errors by study and reported these in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

Table A9. Robustness: Selection Correction based on Andrews and Kasy (2019)

	Dep. Var.- Standardized effects on Credit			
	EM	Mixed	Micro	Macro
	(1)	(2)	(3)	(4)
Broad based	-0.037***	-0.015***	-0.028***	-0.034***
	(0.005)	(0.004)	(0.008)	(0.003)
Housing	-0.091***	-0.037***	-0.251***	-0.040***
	(0.006)	(0.003)	(0.043)	(0.003)
Liquidity & Other	-0.105***	-0.011	-0.121***	-0.014***
	(0.009)	(0.011)	(0.009)	(0.004)
Observations	204	239	176	267

The table reports the average effects of macroprudential measures on credit (including household credit). *Mixed* refers to studies which use samples consisting of advanced, emerging and low-income countries or exclusively advanced country samples. All columns report results from the methodology proposed by Andrews and Kasy (2019). Standard errors in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

Table A10. Average Effects of Tightening Macroprudential Policy on Credit

	Dep. Var.- Standardized effects on Credit	
	Contemporaneous	Lagged
	(1)	(2)
Broad based	-0.054***	0.004
	(0.008)	(0.005)
Housing	-0.066**	-0.035***
	(0.029)	(0.003)
Liquidity & Other	-0.131***	-0.020***
	(0.006)	(0.003)
SE sq. (Pub. Bias Correction)	-0.280	-2.004
	(1.535)	(1.472)
Specification with incomplete controls	0.023***	-0.015***
	(0.008)	(0.002)
Observations	245	198
r2	0.671	0.210

The table reports the average effects of macroprudential measures on credit (including household credit). All columns report results from a weighted least squares specification where the weights are proportional to the precision of each result and additionally apply weights proportional to the number of results observed per study to avoid for any to influence the results. To account for possible dependence across results/observations for the same study, we cluster standard errors by study and reported these in parentheses. * indicates significance at 10%; ** at 5%; *** at 1%.

Table A11. Summary of Standardized Macroprudential Policy Effects - by Group of Instruments

	Housing				Broad Based				Liquidity				Other				Index			
	Obs	Mean	Min	Max	Obs	Mean	Min	Max	Obs	Mean	Min	Max	Obs	Mean	Min	Max	Obs	Mean	Min	Max
MPP in place (0,1):																				
bank balance sheet fragility	46	-0.03	-0.94	0.15	93	-0.03	-0.42	0.08	31	0.00	-0.35	0.21	19	-0.01	-0.09	0.02	60	-0.01	-0.08	0.05
capital flows	14	0.04	-0.03	0.13	29	0.10	-0.26	0.77	2	-0.74	-0.83	-0.65	14	0.06	-0.20	0.22	19	0.04	-0.03	0.24
corporate credit	4	-0.37	-0.61	0.10	6	0.40	-0.99	2.24	1	-1.69	-1.69	-1.69	6	0.51	0.00	1.27	34	-0.09	-1.04	0.26
credit	11	-0.36	-1.84	1.40	25	-0.66	-3.52	0.52	4	-1.29	-3.27	-0.02	16	-0.61	-3.01	1.90	134	-0.28	-1.57	1.04
economic activity																	30	0.13	-1.67	0.95
house price	38	-0.17	-0.52	0.34	21	0.01	-0.53	0.36	2	1.19	1.19	1.19	39	-0.07	-2.06	0.91	57	-0.13	-0.97	0.42
household credit	73	-0.12	-1.21	0.51	22	-0.03	-0.45	0.93	1	-0.89	-0.89	-0.89	30	-0.16	-0.86	0.66	50	-0.23	-1.23	0.12
all outcomes	186	-0.11	-1.84	1.40	196	-0.07	-3.52	2.24	41	-0.17	-3.27	1.19	124	-0.11	-3.01	1.90	384	-0.15	-1.67	1.04
MPP change (-1, 0, 1 in the direction of tightening):																				
bank balance sheet fragility	2	-0.01	-0.04	0.01	2	-0.01	-0.02	0.00	1	-0.05	-0.05	-0.05								
bank default risk					6	-1.15	-3.35	0.40	8	-0.07	-0.71	0.31					24	-0.07	-0.31	0.12
capital flows	4	-0.07	-0.09	-0.04	21	-0.01	-0.37	0.18	18	0.06	-0.08	0.19					73	0.00	-0.15	0.34
corporate credit					2	0.19	0.03	0.34	1	-0.11	-0.11	-0.11					34	0.08	-0.08	0.18
credit	4	1.13	-0.07	2.40	78	0.00	-0.18	1.37	63	-0.19	-2.21	0.36					23	-0.15	-2.08	1.05
economic activity	50	-0.02	-0.20	0.10	98	-0.04	-0.33	0.23	2	-0.02	-0.23	0.19	24	-0.03	-0.13	0.14	218	-0.11	-5.36	1.57
house price	182	-0.01	-1.44	2.69	57	-0.04	-0.23	0.22	6	0.14	-0.09	0.36	14	-0.06	-0.25	0.20	94	-0.01	-0.14	0.20
household credit	193	-0.18	-1.58	1.02	63	-0.08	-1.59	0.86	6	-0.04	-0.64	0.43	14	-0.03	-0.44	0.17	135	-0.11	-1.19	0.64
non bank credit	1	0.00	0.00	0.00	2	0.00	0.00	0.00									15	0.03	-0.01	0.14
all outcomes	436	-0.08	-1.58	2.69	329	-0.06	-3.35	1.37	105	-0.11	-2.21	0.43	52	-0.04	-0.44	0.20	616	-0.07	-5.36	1.57
MPP quantitative (level or change in levels):																				
bank balance sheet fragility					9	-0.38	-0.66	-0.19	5	-0.01	-0.02	-0.01								
credit					6	-0.11	-0.12	-0.09	36	-1.69	-5.91	-0.20					13	-0.40	-1.03	-0.06
economic activity	150	0.00	-0.04	0.05																
house price	4	-0.26	-0.37	-0.12	119	-0.28	-0.92	0.40	104	-0.30	-0.94	0.26					11	-0.02	-0.35	0.11
household credit	151	0.01	-0.01	0.20	13	0.02	-0.12	0.14	4	-0.09	-0.22	0.02								
all outcomes	305	0.00	-0.37	0.20	147	-0.25	-0.92	0.40	149	-0.62	-5.91	0.26					24	-0.23	-1.03	0.11

Table A12. Papers in the Database

Paper	Citation
Afanasieff and others (2015)	Afanasieff, Tarsila, Fabiana L. C. A. Carvalho, Eduardo C. de Castro, Rodrigo Coelho, and Jaime Gregório, 2015, "Implementing loan-to-value ratios: The case of auto loans in brazil (2010-11)," Working Paper 380, Central Bank of Brazil.
Aguirre and Repetto (2017)	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.
Ahnert and others (2018)	Ahnert, Toni, Kristin Forbes, Christian Friedrich, and Dennis Reinhardt, 2018, "Macroprudential FX regulations: shifting the snowbanks of FX vulnerability?" Working Paper 2018-55, Bank of Canada.
Aiyar, Calomiris, and Wieladek (2014)	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, Vol. 46, No. s1, pp. 181–214.
Akinci and Olmstead-Rumsey (2018)	Akinci, Ozge, and Jane Olmstead-Rumsey, 2018, "How effective are macroprudential policies? An empirical investigation," Journal of Financial Intermediation, Vol. 33, pp. 33–57.
Alam and others (2019)	Alam, Zohair, Adrian Alter, Jesse Elseman, Gaston Gelos, Heedon Kang, Machiko Narita, Erlend Nier, and Naixi Wang, 2019, "Digging Deeper – Evidence on the Effects of Macro-prudential Policies from a New Database," IMF Working Paper 19/66, International Monetary Fund.
Alfon, Argimon, and Bascuñana-Ambrós (2005)	Alfon, Isaac, Isabel Argimon, and Patricia Bascuñana-Ambrós, 2005, "How individual capital requirements affect capital ratios in UK banks and building societies," Working Paper 0515, Banco de España.
Altunbas, Binici, and Gambacorta (2018)	Altunbas, Yener, Mahir Binici, and Leonardo Gambacorta, 2018, "Macroprudential policy and bank risk,"Journal of International Money and Finance, Vol. 81, pp. 203–220.
de Araujo, Barroso, and Gonzalez (2019)	de Araujo, Douglas Kiarelly Godoy, Joao Barata Ribeiro Blanco Barroso, and Rodrigo Bar-bone Gonzalez, 2019, "Loan-to-value policy and housing finance: effects on constrained borrowers,"Journal of Financial Intermediation, p. 100830.
Arregui and others (2013)	Arregui, Nicolas, Jaromír Beneš, Ivo Krznar, Srobona Mitra, and Andre O. Santos, 2013,"Evaluating the net benefits of macroprudential policy: A cookbook," IMF Working Paper13/167, International Monetary Fund.
Ayyagari, Beck, and Peria (2018)	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.
Banerjee and Mio (2018)	Banerjee, Ryan N., and Hitoshi Mio, 2018, "The impact of liquidity regulation on banks," Journal of Financial intermediation, Vol. 35, pp. 30–44.
Barroso, Gonzalez, and Doornik (2017)	Barroso, João Barata R. B., Rodrigo Barbone Gonzalez, and Bernardus F. Nazar Van Doornik,2017, "Credit Supply Responses to Reserve Requirement: loan-level evidence from macroprudential policy," Working Paper 467, Central Bank of Brazil.
Baskaya and others (2016)	Baskaya, Yusuf Soner, Turalay Kenç, Ilhyock Shim, and Philip Turner, 2016, "Financial development and the effectiveness of macroprudential measures," BIS Paper 86, Bank for International Settlements.
Basten and Koch (2015)	Basten, Christoph Carl, and Catherine Koch, 2015, "Higher bank capital requirements and mortgage pricing: evidence from the Countercyclical Capital Buffer (CCB)," BIS Working Paper 511, Bank for International Settlements.
Bonner and Eijffinger (2016)	Bonner, Clemens, and Sylvester CW Eijffinger, 2016, "The impact of liquidity regulation on bank intermediation," Review of Finance, Vol. 20, No. 5, pp. 1945–1979.
Dassatti Camors and others (2019)	Dassatti Camors, Cecilia, Jose-Luis Peydro, Francesc R-Tous, and Sergio Vicente, 2019, "Macroprudential and monetary policy: loan-level evidence from reserve requirements," Working Paper 1650, Universitat Pompeu Fabra.
Campbell, Ramadorai, and Ranish (2015)	Campbell, John Y, Tarun Ramadorai, and Benjamin Ranish, 2015, "The impact of regulation on mortgage risk: Evidence from India,"American Economic Journal: Economic Policy,Vol. 7, No. 4, pp. 71–102.
Carreras, Davis, and Piggott (2018)	Carreras, Oriol, E Philip Davis, and Rebecca Piggott, 2018, "Assessing macroprudential tools in OECD countries within a cointegration framework," Journal of Financial Stability,Vol. 37, pp. 112–130
Cerutti, Claessens, and Laeven (2017)	Cerutti, Eugenio, Stijn Claessens, and Luc Laeven, 2017, "The use and effectiveness of macroprudential policies: New evidence," Journal of Financial Stability, Vol. 28, pp.203–224
Cerutti and Zhou (2018)	Cerutti, Eugenio, and Haonan Zhou, 2018, "Cross-border banking and the circumvention of macroprudential and capital control measures," IMF Working Paper 18/217, International Monetary Fund.

For additional details on each paper, please see accompanying data file.

Papers in the Database (Continued)

Paper	Citation
Cizel and others (2019)	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, Vol. 51, No. 5, pp. 1209–1235.
Claessens, Ghosh, and Mihet (2013)	Claessens, Stijn, Swati R Ghosh, and Roxana Mihet, 2013, "Macro-prudential policies to mitigate financial system vulnerabilities," Journal of International Money and Finance,Vol. 39, pp. 153–185.
Craig and Hua (2011)	Craig, R. Sean, and Changchun Hua, 2011, "Determinants of Property Prices in Hong Kong SAR: Implications for Policy," IMF Working Paper 11/27, International Monetary Fund.
Danisewicz, Reinhardt, and Sowerbutts (2017)	Danisewicz, Piotr, Dennis Reinhardt, and Rhiannon Sowerbutts, 2017, "On a tight leash:Does bank organizational structure matter for macroprudential spillovers?" Journal of International Economics, Vol. 109, pp. 174–194.
Dell'Ariccia and others (2012)	Dell'Ariccia, Giovanni, Deniz Igan, Luc Laeven, Hui Tong, Bas Bakker, and Jérôme Vandenbussche, 2012, "Policies for macrofinancial stability: How to deal with credit booms," IMF Staff Discussion Note 12/06, International Monetary Fund.
Epure and others (2018)	Epure, Mircea, Irina Mihai, Camelia Minoiu, and José-Luis Peydró, 2018, "Household credit,global financial cycle, and macroprudential policies: credit register evidence from an emerging country," IMF Working Paper 18/13, International Monetary Fund.
Gadatsch, Mann, and Schnabel (2018)	Gadatsch, Niklas, Lukas Mann, and Isabel Schnabel, 2018, "A new IV approach for estimating the efficacy of macroprudential measures," Economics Letters, Vol. 168, pp. 107–109.
Galac (2010)	Galac, Tomislav, 2010, "The Central Bank as Crisis-Manager in Croatia–A Counterfactual Analysis," Working Paper 27, Croatian National Bank.
Gómez and others (2017)	Gómez, Esteban, Angélica Lizarazo, Juan Mendoza, and Andrés Murcia, 2017, "Evaluating the impact of macroprudential policies on credit growth in Colombia," BIS Working Paper, Bank for International Settlements.
Igan and Kang (2011)	Igan, Deniz, and Heedon Kang, 2011, "Do loan-to-value and debt-to-income limits work?Evidence from Korea," IMF Working Papers 11/297, International Monetary Fund.
Jacome and Mitra (2015)	Jacome, Luis I., and Srobona Mitra, 2015, "LTV and DTI Limits—Going Granular," IMF Working Paper 15/154, International Monetary Fund.
Jasova and Gersl (2012)	Jasova, Martina, and A Gersl, 2012, "From credit boom to credit crunch: effectiveness of policy measures in Central and Eastern Europe,"International Journal of Business, Vol. 1,pp. 58–66.
Jiménez and others (2017)	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, Vol. 125,No. 6, pp. 2126–2177.
Kang and others (2017)	Kang, Heedon, Francis Vitek, Rina Bhattacharya, Phakawa Jeasakul, Sònia Muñoz, NaixiWang, and Rasool Zandvakil, 2017, "Macroprudential policy spillovers: A quantitative analysis," IMF Working Paper 17/170, International Monetary Fund.
Kim and Mehrotra (2018)	Kim, Soyoung, and Aaron Mehrotra, 2018, "Effects of Monetary and Macroprudential Policies—Evidence from Four Inflation Targeting Economies,"Journal of Money, Credit and Banking, Vol. 50, No. 5, pp. 967–992.
Kim and Mehrotra (2019)	Kim, Soyoung, and Aaron Mehrotra, 2019, "Examining macroprudential policy and its macroeconomic effects - some new evidence," BIS Working Papers 825, Bank for International Settlements.
Kraft and Galac (2011)	Kraft, Evan, and Tomislav Galac, 2011, "Macroprudential regulation of credit booms and busts-The case of Croatia," Working Paper WPS5772, The World Bank.
Krznar and Morsink (2014)	Krznar, Ivo, and James Morsink, 2014, "With Great Power Comes Great Responsibility:Macroprudential Tools at Work in Canada," IMF Working Paper 14/83, International Monetary Fund.
Kuttner and Shim (2016)	Kuttner, Kenneth N, and Ilhyock Shim, 2016, "Can non-interest rate policies stabilize housing markets? Evidence from a panel of 57 economies," Journal of Financial Stability, Vol. 26,pp. 31–44.
Levin, López, and Lopez-Gallo (2016)	Levin, Gabriel, Calixto López, and Fabrizio Lopez-Gallo, 2016, "The impact of expected losses provisioning on credit growth: the case of Mexico," Working Paper, Bank of Mexico.
Lim and others (2011)	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.

For additional details on each paper, please see accompanying data file.

Papers in the Database (Continued)

Paper	Citation
Martins and Schechtman (2013)	Martins, Bruno, and Ricardo Schechtman, 2013, "Loan pricing following a macro prudential within-sector capital measure," Working Paper 323, Central Bank of Brazil.
McDonald (2015)	McDonald, Chris, 2015, "When is macroprudential policy effective?" BIS Working Papers 496, Bank for International Settlements.
Minaya, Lupú, and Cabello (2017)	Minaya, Elinas, José Lupú, and Miguel Cabello, 2017, "Macroprudential policies in Peru:the effects of dynamic provisioning and conditional reserve requirements," BIS Working Paper 675, Bank for International Settlements.
Morgan, Regis, and Salike (2019)	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, Vol. 37, pp. 89–103.
Neagu, Tatarici, and Mihai (2015)	Neagu, Florian, Luminita Tatarici, and Irina Mihai, 2015, "Implementing Loan-to-value and Debt Service-to-income Measures: A Decade of Romanian Experience," MPRA Paper 65988, University Library of Munich, Germany.
Nymoen, Pedersen, and Sjåberg (2019)	Nymoen, Ragnar, Kari Pedersen, and Jon Ivar Sjåberg, 2019, "Estimation of effects of recentmacroprudential policies in a sample of advanced open economies," International Journalof Financial Studies, Vol. 7, No. 2, p. 23.
Ostry and others (2012)	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, Vol. 88, No. 2, pp. 407–421.
Reinhardt and Sowerbutts (2015)	Reinhardt, Dennis, and Rhiannon Sowerbutts, 2015, "Regulatory arbitrage in action: evidence from banking flows and macroprudential policy," Working Paper 546, Bank of England.
Richter, Schularick, and Shim (2019)	Richter, Björn, Moritz Schularick, and Ilhyock Shim, 2019, "The costs of macroprudential policy,"Journal of International Economics, Vol. 118, pp. 263–282.
Sánchez and Röhn (2016)	Sánchez, Aida Caldera, and Oliver Röhn, 2016, "How do policies influence GDP tail risks?" OECD Working Papers 1339, OECD Publishing.
Tantasith and others (2018)	Tantasith, Chantawit, Nasha Ananchotikul, Chatlada Chotanakarn, Vorada Limjaroenrat, Runchana Pongsaparn, and others, 2018, "The Impact of LTV policy on Bank Lending: Evidence from Disaggregate Housing Loan Data," PIER Discussion Paper 90, Puey Ungphakorn Institute for Economic Research.
Vandenbussche, Vogel, and Detragiache (2015)	Vandenbussche, Jérôme, Ursula Vogel, and Enrica Detragiache, 2015, "Macroprudential policies and housing prices: A new database and empirical evidence for Central, Eastern,and Southeastern Europe," Journal of Money, Credit and Banking, Vol. 47, No. S1, pp.343–377.
Wang and Sun (2013)	Wang, Bin, and Tao Sun, 2013, "How effective are macroprudential policies in China?" IMF Working Papers 13-75, International Monetary Fund.
Wong and others (2011)	Wong, TC, Tom Fong, Ka-fai Li, and Henry Choi, 2011, "Loan-to-value ratio as a macro-prudential tool-Hong Kong's experience and cross-country evidence," Working Paper 01/2011, Hong Kong Monetary Authority.
Zdzienicka and others (2015)	Zdzienicka, Aleksandra, Sally Chen, Federico Diaz Kalan, Stefan Laseen, and Katsiaryna Svirydzenka, 2015, "Effects of Monetary and Macroprudential Policies on Financial Conditions; Evidence from the United States," IMF Working Papers 15/288, International Monetary Fund.
Zhang and Zoli (2016)	Zhang, Longmei, and Edda Zoli, 2016, "Leaning against the wind: Macroprudential policy in Asia," Journal of Asian Economics, Vol. 42, pp. 33–52.

For additional details on each paper, please see accompanying data file.