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## Conditions for effective macroprudential policy interventions

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# CONDITIONS FOR EFFECTIVE MACROPRUDENTIAL POLICY INTERVENTIONS

*Fahad Khan, Arief Ramayandi, and Marcel Schröder*

**NO. 609**

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## Conditions for Effective Macroprudential Policy Interventions

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## ABSTRACT

This paper aims at identifying effective macroprudential policy (MPP) interventions and analysing the macroeconomic conditions that promote them. We define effective MPP interventions as those that stabilize its underlying target variable, such as credit growth, house price growth, etc. For our analysis, we construct a new database that documents the use of a large number of MPP instruments for 61 advanced and emerging market economies from 2000 to 2016. The new feature of the database is that it maps every recorded MPP intervention in these economies and over this period to stabilize a specific target variable category for banking, health, domestic loans, the exchange rate, foreign capital movements, and house prices. Using this dataset, we introduce a practical way for defining the macroprudential policy effectiveness. We find that MPP interventions are more likely to be effective when several prudential measures are taken together, but at the same time avoid the diminishing returns of repeated MPP tightening. Monetary tightening seems to override the effectiveness of MPP instruments. The output gap, credit cycle, external debt, current account, and global risk appetite also count for the likelihood of MPP successes. The paper provides a guideline for the effective conduct of MPPs.

*Keywords:* effectiveness, financial stability, macroprudential policy, probabilistic analysis

*JEL codes:* E32, E58, G15, G28

## I. INTRODUCTION

Advanced and emerging market economies (EMEs) increasingly rely on macroprudential policy (MPP) interventions to safeguard financial stability jeopardized by volatile asset prices and credit cycles. Instruments in the MPP toolkit include loan-to-value (LTV) ratios on mortgage loans, capital requirements, and limits on credit or credit growth.

The use of these instruments has intensified since the 2008 global financial crisis. But their effectiveness is still under debate. Our contribution to this debate is threefold. First, we document the frequency of which MPP instruments were applied to stabilize their target variables and introduce a practical definition for effective MPP interventions. Second, we analyze the macroeconomic conditions that promote the effectiveness of MPP interventions in stabilizing their target variable. And third, we assemble a new dataset that records the use of MPP instruments for 61 economies—21 advanced economies and 40 emerging EMEs—during 2000–2016. The novel feature of our database is that it maps the 14 different types of recorded MPP interventions to the stabilization of a specific target variable in five categories—banking health, domestic loans, the exchange rate, foreign capital movements, and house prices. The third contribution is elemental to our study as the specific knowledge about the target indicator for each macroprudential intervention is required here. To our knowledge, no attempt has yet been made to shed light on this issue.

To compile our dataset, we extend the works of Lim et al. (2011, 2013); Shim et al. (2013); Lee, Asuncion, and Kim (2016); Cerutti et al. (2017); and Budnik and Kleibl (2018) by using International Monetary Fund (IMF) Article IV consultations, country reports, and annual reports on exchange arrangements and exchange restrictions. These datasets only reported the incidence of MPP interventions by instruments, without specifically identifying the exact variables that they are targeting. We then use official documents from national sources to identify the actual target variable for each recorded MPP intervention and created a new dataset that matches MPP interventions to their actual target. To simplify the analysis, we group these target indicators into the five categories. Our dataset documents 1,379 MPP interventions, along with their specific targets.

We conduct a logit regression analysis to gain insights into which macroeconomic conditions are conducive to effective MPP interventions. We group the conditioning factors into three categories. First, factors that are related to the existing macroprudential policy stance; this gives information on how the previous stance may have affected the effectiveness of the succeeding one. Second, factors related to the internal and external balance conditions of the economy. These factors show the role of these conditions in promoting effective MPP interventions. Third, global factors, which were used to assess their role in influencing the likelihood of MPP interventions being effective. For our analysis, we introduce a practical definition of an effective MPP intervention as being one that manages to bring down the volatility of its target variable by a certain threshold relative to its condition before the intervention. More specifically, we consider the average volatility of the target variable 6 months before and after the date of intervention.

The main findings are as follows: (i) Changes in reserve requirements (RRs) are by far the most frequently used MPP instrument, followed by capital requirements, limits on credit or credit growth, and LTV ratios. (ii) In terms of targets, most MPP interventions in our sample are aimed at stabilizing domestic loans, house prices, and banking health. The other two targets (the exchange rate and capital movements) appear only one-sixth of the time. (iii) We also find that most MPP instruments tend to concentrate on two targets. For example, LTV, debt-to-income and debt-service-to-income ratios



typically target house prices or domestic loans, while limits on net open positions target the exchange rate or foreign capital movements. But there are exceptions, such as RRs and limits on credit or credit growth that are used to target the full spectrum of target indicators. (iv) As documented by others, we confirm that the use of MPP instruments greatly intensified after the global financial crisis across all countries. (v) Asian economies seem to have relied more proactively on MPP instruments than others to promote financial stability; MPPs averaged 34 a year in Asia, compared with 16 in Europe.

This paper uses a logit model to investigate which macroeconomic conditions promote effective MPP interventions. The regression results suggest these are more likely to be effective when several measures are implemented in the same quarter, and when a country has avoided excessive MPP tightening in the past. This suggests that repeated tightening could create a credibility issue that may erode the effectiveness of future macroprudential policies. We find evidence that monetary tightening overrides the effectiveness of MPP interventions. Other eroding factors seem to be a positive output gap, a slowing credit cycle, a large current account deficit relative to the historical average, and an increase in the risk aversion of global investors. Our results are robust to alternative definitions of MPP success and probabilistic models. We also find that MPP interventions have become more effective since the global financial crisis, and that there are behavioral differences between advanced economies and EMEs in how they promoted effective MPPs.

The rest of the paper is organized as follows. Section II reviews the literature on MPPs. Section III describes the construction of the dataset and discusses the descriptive statistics, trends, and patterns in the use of MPPs. Section IV discusses the empirical strategy for conducting the probabilistic analysis. Section V presents the regression results, and section VI draws conclusions.

## II. LITERATURE REVIEW

This paper is part of a rapidly growing empirical literature studying the effectiveness of MPP instruments. The typical approach is to estimate through regression analysis whether MPP interventions on average affect a specific target indicator, such as house prices or credit growth. To do so, many of these papers rely on cross-country data and dynamic panel data models using either the fixed effects or the generalized method of moments estimator, the latter typically done in an attempt to deal with biases arising from endogeneity of regressors. This is the first time that an attempt has been made to analyze the macroeconomic determinants that promote the effectiveness of a particular MPP intervention. One goal of this paper is to enhance the understanding of these determinants.

Lim et al. (2011) is one of the early studies on the effectiveness of MPP instruments. The authors use 2011 IMF survey data to study the effectiveness of several MPP interventions. They find that most of them are successful in reducing the procyclicality between credit and gross domestic product (GDP) growth. Ahuja and Nabar (2011) study the effects of LTV and debt-to-income ratios on property prices and lending growth for 49 advanced economies and EMEs from 2000 to 2010. They find that LTV caps have a decelerating effect on the growth of property prices, whereas both debt-to-income and LTV ratios slow the growth on lending to the property sector. Bakker et al. (2012) and Dell’Ariccia et al. (2016) show that MPPs help reduce the incidence of credit booms and decrease the likelihood of a credit boom turning into a financial crisis.

Zhang and Zoli (2016) extended the database of Lim et al. (2013) to assess the effectiveness of a large set of MPP instruments for slowing growth in real credit and house prices for 46 advanced

economies and EMEs over 2000–2013. They conclude that especially housing-related MPP measures are successful in bringing down house price inflation and credit growth, particularly in Asia. Cerutti, Claessens, and Laeven (2017) constructed a comprehensive dataset documenting the use of MPP interventions for 119 countries over 2000–2013 on the basis of the IMF’s Global Macroprudential Policy Instrument Survey conducted in 2013 and 2014.<sup>1</sup> The authors conclude that the policy measures are successful in reducing credit and house price growth, although less for the latter. They also find that MPP instruments are more effective in the financially open economies and the less developed ones.

Kuttner and Shim (2016) report similar results on the basis of data going back to 1980 for 57 countries. Akinci and Olmstead-Rumsey (2018) combine the datasets of Lim et al. (2011), Shim et al. (2013), and the IMF’s Global Macroprudential Policy Instrument Survey in a sample of 57 countries from 2001 to 2013. The authors show that macroprudential policy instruments have been used more actively since the global financial crisis in both advanced economies and EMEs, and that they tend to be used in tandem with changes in RRs, capital flow restrictions, and monetary policy. Distinguishing between housing (LTV and debt-to-income ratios) and nonhousing measures (provisions, capital requirements, credit growth ceilings), their regression results suggest both types of instruments limit bank credit growth, but only housing instruments restrain growth in house prices and house credit.

Some papers are focused on specific regions. Bruno, Shim, and Shin (2017) and Lee, Asuncion, and Kim (2016) study countries in Asia and the Pacific; Tovar, Garcia-Escribano, and Vera Martin (2012) Latin America; and Vandenbussche, Vogel, and Detragiache (2015) emerging Europe. Case studies on individual countries include Argentina (Aguirre and Repetto 2016); the People’s Republic of China (Wang and Sun 2013); and Hong Kong, China (Wong et al. 2011, Craig and Hua 2011). Overall, these papers suggest that MPPs can promote financial stability in the sense of reducing the growth of a specified target variables, although there are differences in which instruments are the most effective and the magnitude of their effect.<sup>2</sup>

Finally, most papers on the effectiveness of MPP instruments are empirical, but there are also theoretical contributions. For instance, Arregui et al. (2013) develop a framework for assessing the net benefits of MPPs; that is, reducing the probability of a crisis versus reducing GDP growth, while Mendicino and Punzi (2014) study the stabilizing effects of MPPs in the context of current account deficits and domestic financial vulnerabilities. Other contributions are those of Rubio and Carrasco-Gallego (2014); Brzoza-Brzezina, Kolasa, and Makarski (2017); and Agénor et al. (2017).

### III. THE DATASET

We compile a dataset that comprehensively records each MPP intervention for 61 advanced economies and EMEs during 2000–2016.<sup>3</sup> The central novel feature of this database is that every MPP intervention is matched with its underlying target variable (e.g., domestic banking loans or house prices). This section briefly describes the approach to constructing the dataset.<sup>4</sup>

<sup>1</sup> See IMF (2013) for details of the survey.

<sup>2</sup> Bruno, Shim, and Shin (2017) is an exception to these findings. The authors, using Shim et al.’s (2013) database of policy actions on housing markets, argue that MPP instruments have an insignificant effect on total credit—although they find evidence that these instruments are effective when complemented with monetary policy.

<sup>3</sup> See Appendix 1 for the list and classification of the advanced economies and EMEs used in the sample.

<sup>4</sup> A more detailed explanation is available upon request to the authors.

The dataset builds on several MPP databases. Lim et al. (2011, 2013) use data from the 2010 IMF Survey on Financial Stability and Macprudential Policy to document the MPP interventions of 39 economies.<sup>5</sup> Shim et al. (2013) construct a database of real estate exposure-related MPP interventions for 60 countries. Cerutti et al. (2017) record MPP interventions for 64 countries using the IMF's 2013 Global Macprudential Policy Instruments Survey. Lee, Asuncion, and Kim (2016) document the use of MPP instruments in 10 Asian economies. Budnik and Kleibl (2018) record the MPP interventions of the 28 European Union member states.

We extended the sample period of these databases, which end in 2014 or earlier, to 2016 by using various sources of information, including IMF Article IV consultations, country reports, and annual reports on exchange arrangements and exchange restrictions, as well as official documents from national sources. Since the dataset is drawn on official sources and surveys, it allows us to cross-check the consistency between the survey data, official publications, and the media releases of central banks and financial authorities.

### **A. Coverage of Macprudential Policy Instruments**

The dataset covers a broad set of MPPs, which fall into one of four categories: credit-related measures, liquidity-related measures, capital-related measures, and other measures. These categories are further subdivided into 14 classifications: LTV, debt-to-income, and debt-service-to-income ratios, caps on foreign currency lending, limits on credit or credit growth, limits on net open positions and currency mismatches, limits on maturity mismatches, changes in RRs, loan-to-deposit limits, capital requirements, provisioning requirements, restrictions on profit distribution and dividend restrictions, exposure limits, levies and taxes on financial institutions and activities, and other restrictions on lending standards. We include general, sectoral, and targeted MPPs, as well as those that are microprudential in nature but are likely to have a significant impact on the aggregate financial system. Regulatory interventions, such as Basel requirements, are excluded from the sample.

We distinguish between changes in RRs and nonreserve-requirement measures (NRRs), where the latter refer to LTV, debt-to-income, and debt-service-to-income ratios, and other MPP instruments. We also record whether an MPP action was a tightening or easing. This can be directly determined from the available information. For instance, an increase in reserve or capital requirements is considered a tightening measure, whereas a reduction in the LTV ratio or exposure limits are easing ones.

### **B. Identifying the Target Variables**

To identify the target variable for each recorded MPP intervention, we mainly rely on official documents published by central banks and financial supervision bodies. We therefore revisit the official sources for each MPP intervention recorded in the databases and map each one to its target or targets on the basis of official country sources. The following are three examples that illustrate this process taken during the data compilation:

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<sup>5</sup> See IMF (2011) for details of the survey.

- (i) The Hong Kong Monetary Authority, in its Circular B1/15C, clearly stipulates that the 70% guideline on residential mortgage lending is intended to limit the risk exposure of authorized institutions to a maximum of 70% of the property value. The circular therefore suggests that residential mortgage loans were the identified target variable.
- (ii) In 2004, the China Banking Regulatory Commission imposed the maximum LTV ratio of 80% for loans for purchasing homes. The objective was to control the housing market through countercyclical adjustment specifically to curb credit growth and house price inflation. Hence, this policy targeted credit growth to curb house price inflation.
- (iii) In 2014, the National Bank of Kazakhstan imposed a 30% limit on credit growth to mitigate systemic risks in consumer lending. Risk weights of consumer loans when calculating banks' capital adequacy were tightened from 75% to 100%. The identified target was consumer loans.

In cases where the target variable cannot be determined from official documents, we chose the target indicator on the basis of the MPP framework practice guide by Krishnamurti and Lee (2014), which provides practical guidance for emerging economies in their shift toward a formal MPP framework. Their handbook developed a taxonomy of the most common MPP instruments and their typical targets and objectives.

Occasionally, official documents identify more than one target for MPP interventions. For example, the China Banking Regulatory Commission identifies reducing both credit growth and house price inflation as its target variables. In these types of cases, we identify the ultimate target variable by identifying the final objective of the policy intervention, which in this example is to control house price inflation. This gives us a straightforward way of quantifying the effectiveness of each MPP intervention. Those MPP observations for which we cannot reliably deduce the target indicator were dropped from the sample.

Overall, there is a surprisingly large set of target indicators of MPP interventions (over 30), as shown in Figure 1. To keep the analysis tractable, we group these target indicators into the five broad categories (banking health, domestic loans, the exchange rate, foreign capital movements, and house prices).<sup>6</sup>

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<sup>6</sup> We excluded about 90 MPP interventions that have incomplete information; for example, absence of quantifiable policy measure, missing date of enforcement, and unavailability of data on the target indicator.

**Figure 1: Macroprudential Policy Target Variables**

Banking	Domestic Loans	Exchange Rate	Foreign Capital Movement	House Prices
Bank assets	Automobile demand	Nominal exchange rate	External debt	Housing prices
Bank capital	Automobile sales		Foreign currency deposits	
Bank reserves	Automobile loans		Foreign currency liabilities	
Capital adequacy ratio	Consumer loans		Foreign currency loans	
Credit card purchases	Credit-to-GDP ratio		Foreign direct investment	
Deposits	Domestic credit		Foreign exchange reserves	
Interbank rate	Household debt		Foreign portfolio investment	Residential property prices
Lending rate	Housing loans		Net foreign assets	
Liquid assets ratio	Mortgage loans		Net open positions in foreign exchange	
Loan-to-deposit ratio	Real estate loans		Net open positions to regulatory capital	
Nonperforming loans	Total credit			
Rural and thrift bank profits	Total loans			

GDP = gross domestic product.  
Source: Authors.

### C. Descriptive Statistics

Our database collected 1,379 MPP interventions across the 61 economies (21 advanced, 40 emerging) over 2000–2016. Figure 2 shows the frequency of each instrument used in the recorded MPP interventions based on the 14 classifications defined earlier. Reserve requirement interventions are by far the most widely used (486 policy actions), followed by capital requirements (189), limits on credit or credit growth (149), and LTV ratios (132). The least popular measures were exposure limits, limits on maturity mismatches, and other restrictions on lending standards; each had fewer than 20 observations.

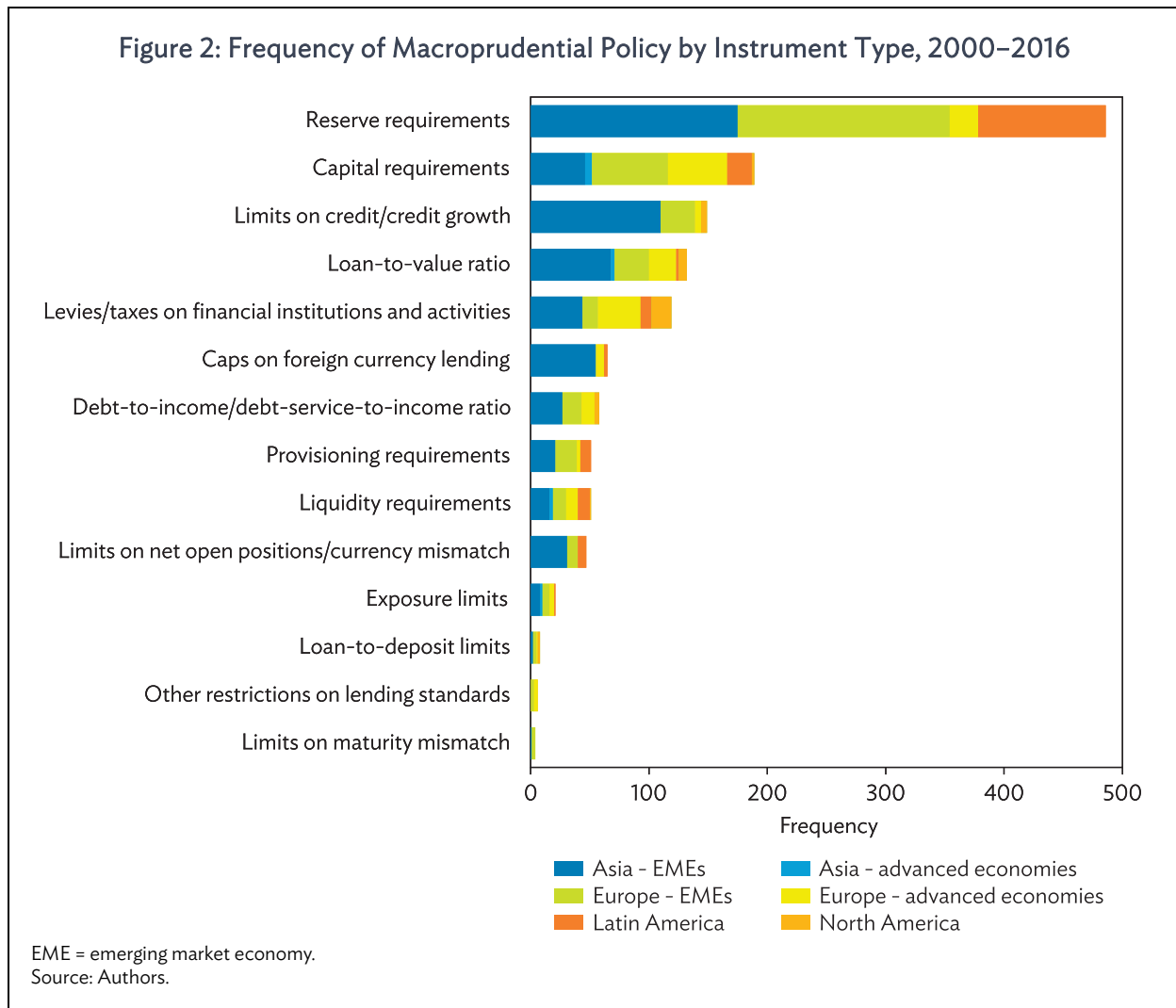
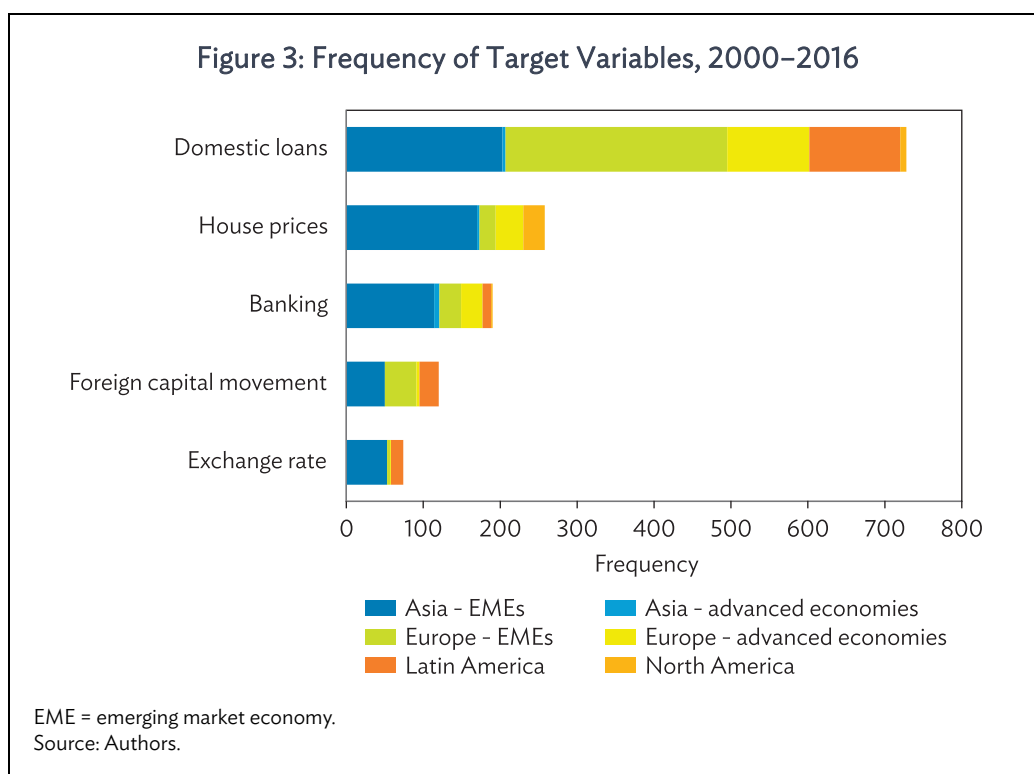


Figure 3 shows the frequency of MPP interventions in terms of the five categories of their target variables. Most MPP interventions (52.6% or 725 policy actions) are aimed at controlling domestic loans, followed by house prices (258) and banking (190). The exchange rate was targeted 74 times and capital movements 120 times. It is important to note that about 20% of the measures to control domestic lending are directed at housing-related loans. This said, the number of MPP interventions directed to controlling housing-related issues, either directly by controlling prices or indirectly by controlling lending to the sector, is quite substantial (almost 30% of recorded interventions), making MPPs a popular instrument to deal with housing sector issues.



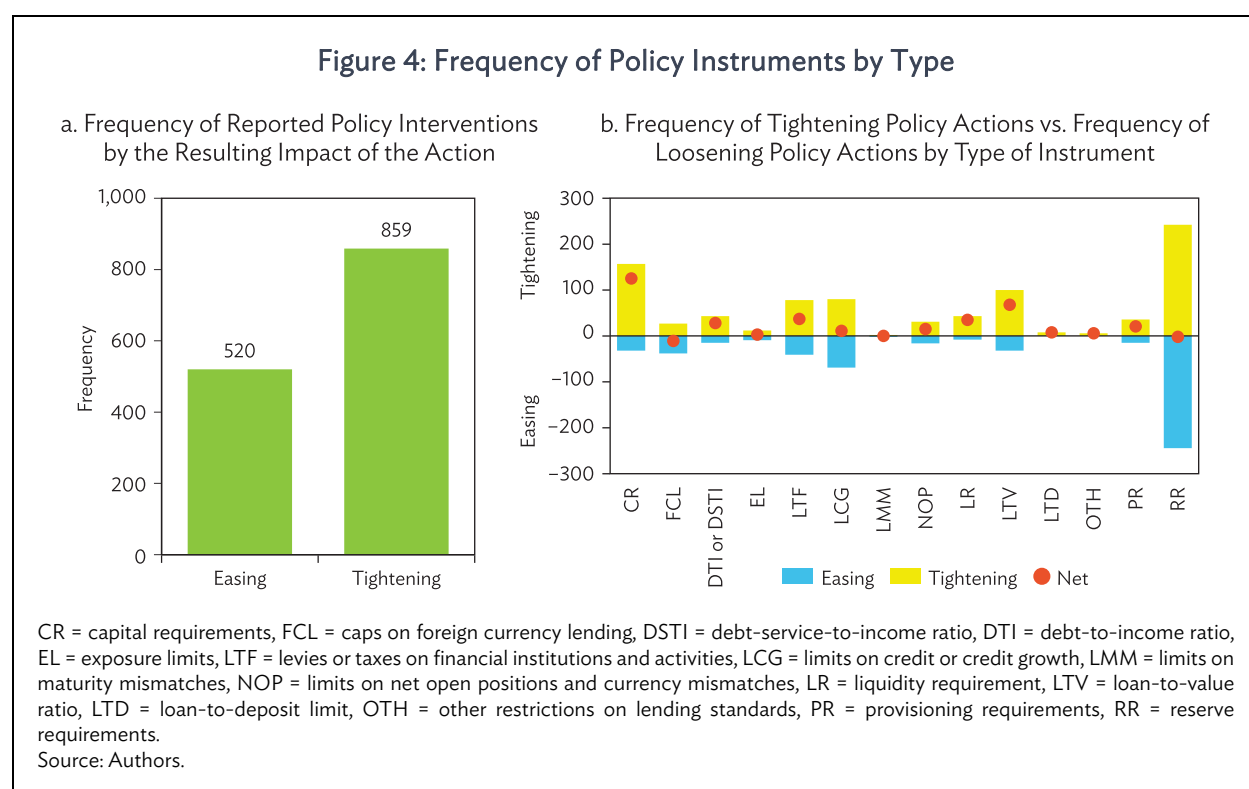
**Table 1: Frequency of Reported Policy Interventions by Instrument Category and Policy Measure Objective**

Instrument	Banking	Domestic Loans	Exchange Rate	Foreign Capital Movement	House Prices
Capital requirements	65	106	0	6	12
Caps on foreign currency lending	0	12	24	27	2
Debt-to-income or debt-service-to-income ratio	1	23	0	1	33
Exposure limits	7	11	0	1	2
Levies or taxes on financial institutions and activities	7	38	9	1	64
Limits on credit or credit growth	6	84	5	14	37
Limits on maturity mismatches	0	1	0	3	0
Limits on net open positions or currency mismatches	0	4	24	19	0
Liquidity requirements	10	34	3	4	0
Loan-to-value ratio	0	45	0	2	83
Loan-to-deposit limits	3	5	0	0	0
Other restrictions on lending standards	0	6	0	0	0
Provisioning requirements	7	36	0	2	6
Reserve requirements	84	323	10	40	20

Note: Frequencies in bold indicate the most often used instrument type for each specific target group.  
Source: Authors.

Table 1 shows the frequency of MPP instruments and target variables. The general inference is that each of the MPP instruments tends to concentrate on only two target indicators. LTV, debt-to-income, and debt-service-to-income ratios typically target house prices or domestic loans, whereas limits on net open positions mostly focus on the exchange rate and foreign capital movements. There are exceptions: reserve requirements are the most prominent, as they target all five categories even though they are concentrated on domestic loans. Limits on credit or credit growth are also used across the spectrum of target indicators. These findings highlight the need to consult official documents to correctly identify the target indicators of MPP interventions rather than inferring them from MPP instrument types alone. For example, assuming that LTV ratios are always used to target house prices is incorrect, since this approach could result in misleading conclusions.

Panel (a) of Figure 4 shows that authorities have conducted far more tightening than easing MPP interventions (859 versus 520 times). Capital requirements, LTV ratios, and levies and taxes are mostly tightened. While changes in RRs are used very frequently, there is no tendency toward either tightening or easing. Caps on foreign currency lending is the only MPP instrument that displays a net easing stance during the sample period.



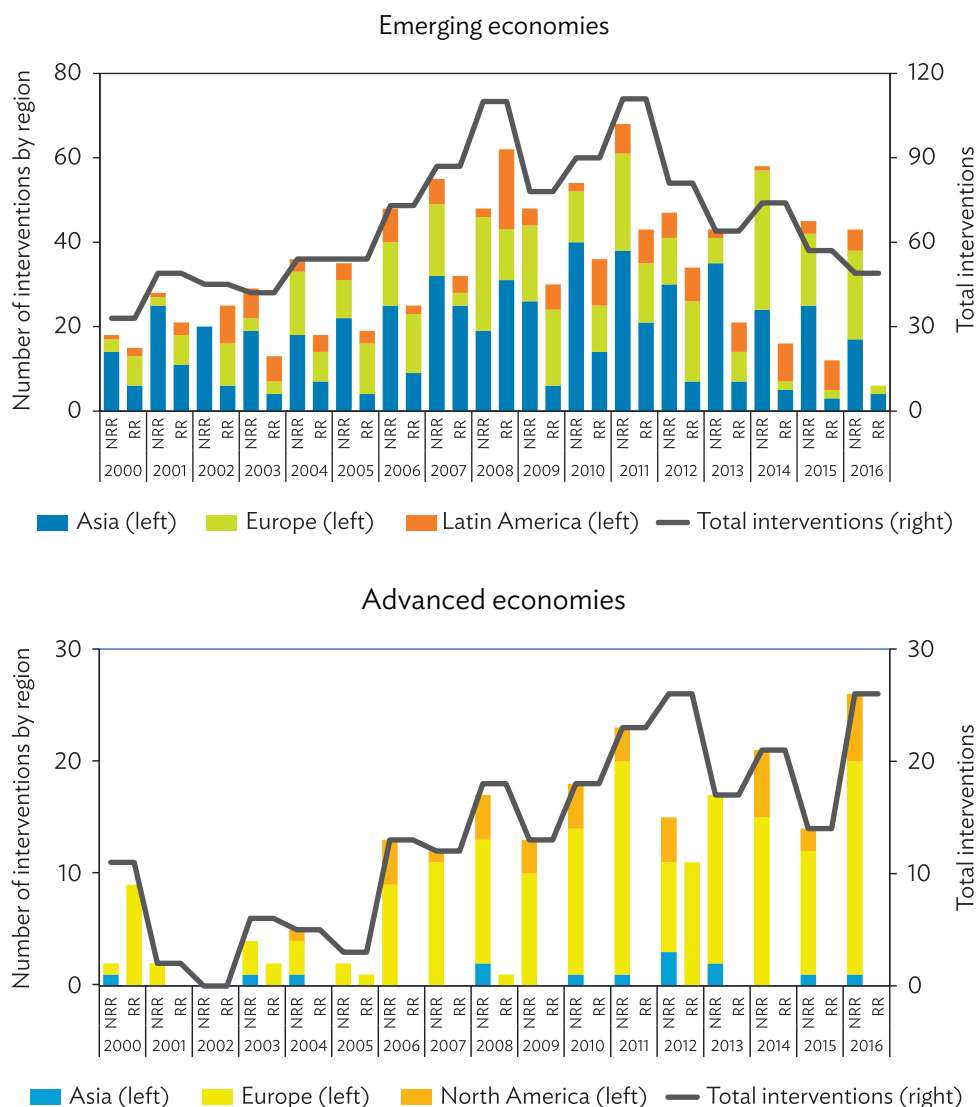
#### D. Trends and Patterns in the Use of Macroprudential Policy Interventions

Here, we present the trends and patterns in the use of our sample. Figure 5 shows the frequency of MPP interventions by year for advanced economies and EMEs. Both groups show a clear pattern of increasing reliance on the MPP toolkit, as shown by the increased frequency of use over the sample period. In the early 2000s, advanced economies conducted fewer than 50 MPP interventions a year, and EMEs fewer than 10. In the 2010s, the number of yearly MPP interventions was rarely below 20 in advanced



economies and 50 in EMEs. Perhaps not surprisingly, the economies in the sample implement MPP interventions especially during crisis years. The number of MPP interventions increased to over 100 in EMEs during the 2008 global financial crisis and during the 2011 euro crisis. A similar pattern is observable in the advanced economy group.

**Figure 5: Macroprudential Policy Interventions by Year and Classification**



NRR = nonreserve requirement, RR = reserve requirement.

Notes: Advanced Asia includes Australia and New Zealand. Advanced Europe includes Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway, Spain, Sweden, Switzerland, and United Kingdom. North America includes Canada and the United States. Emerging Asia includes Georgia; Hong Kong, China; India; Indonesia; Kazakhstan; Malaysia; Mongolia; Pakistan; the People's Republic of China; the Philippines; the Republic of Korea; Singapore; Sri Lanka; Taipei, China; Thailand; and Viet Nam. Emerging Europe includes Bulgaria, Croatia, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Portugal, Romania, the Russian Federation, Serbia, Slovakia, Slovenia, Turkey, and Ukraine. Emerging Latin America includes Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Uruguay.

Source: Authors.

But important differences also exist. Advanced economies rely almost exclusively on NRR measures; EMEs, however, often use RRs, although with an increasing tendency toward NRR measures since the global financial crisis. For EMEs in particular, the ratio between the use of RRs and NRRs has fallen significantly; that is, the NRR component seems to have gained considerably in popularity over time.

Figure 6 shows the number of MPPs before and after the global financial crisis and distinguishes between RRs and NRRs. It confirms that MPP instruments were used far more frequently after the crisis than before, at a ratio of almost 2 to 1 (890 versus 489 out of 1,379 times). The same ratio applies to the breakdown between RR and NRR instruments. In fact, almost half of all MPP measures after 2008 are NRRs, corroborating the idea that central banks nowadays mostly rely on these types of MPPs.

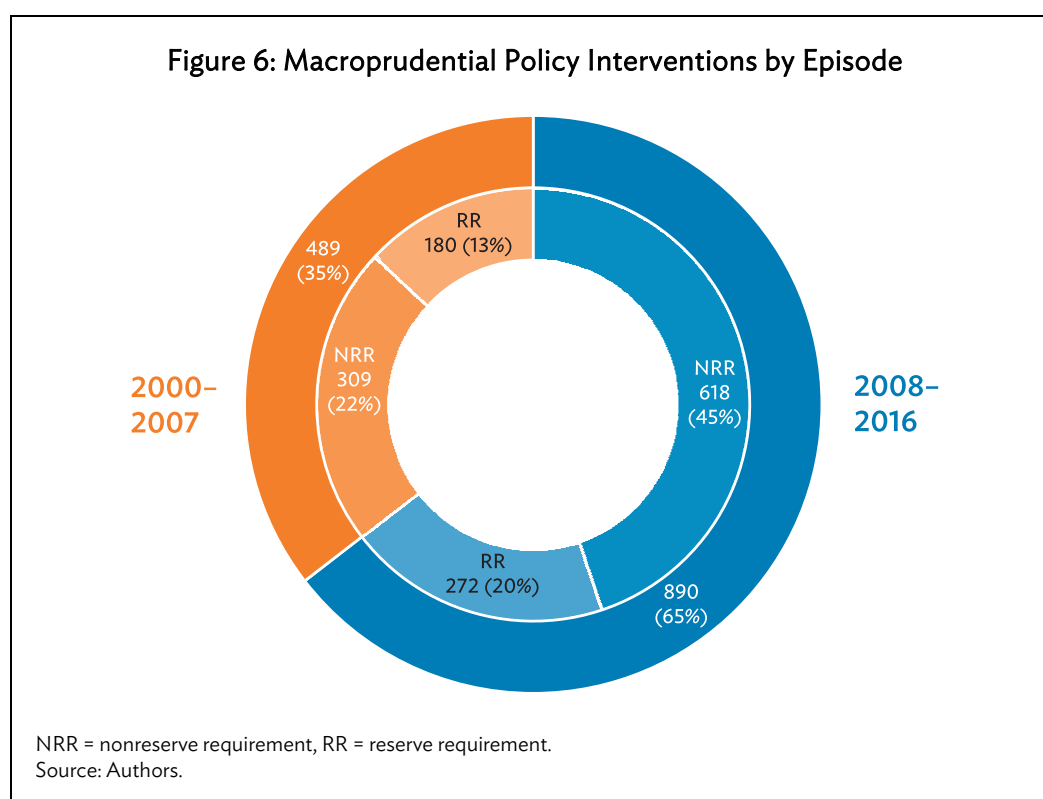
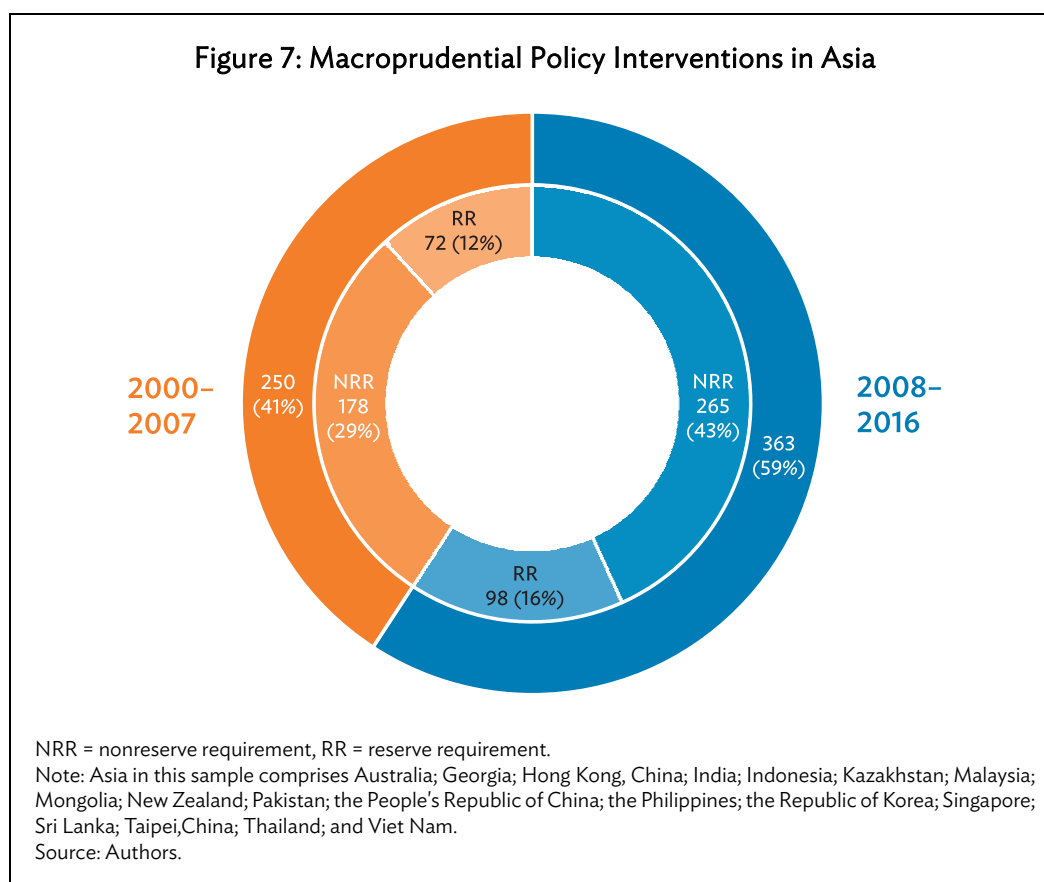


Figure 7 shows these instruments, by region, are particularly popular in the sample's 18 Asian economies. Almost half of all MPP interventions were in Asia (613 actions or 45% of interventions). That is about 34 MPP actions per economy on average. Compared with other regions, Asia also seems to rely more heavily on NRRs than RRs, with NRRs almost three times more likely to be used. The sample of 34 European countries implemented 558 MPP actions, or 16 per country on average. The nine economies in Latin and North America used 208 MPP interventions, an average of 23 per country. The use of MPP instruments in Asia intensified after the global financial crisis, especially NRR instruments. The shocks that mostly affected segments of the asset and credit markets since the crisis seem to have prompted authorities across Asia to rely more on these finely targeted types of policy instruments to stabilize their economies.



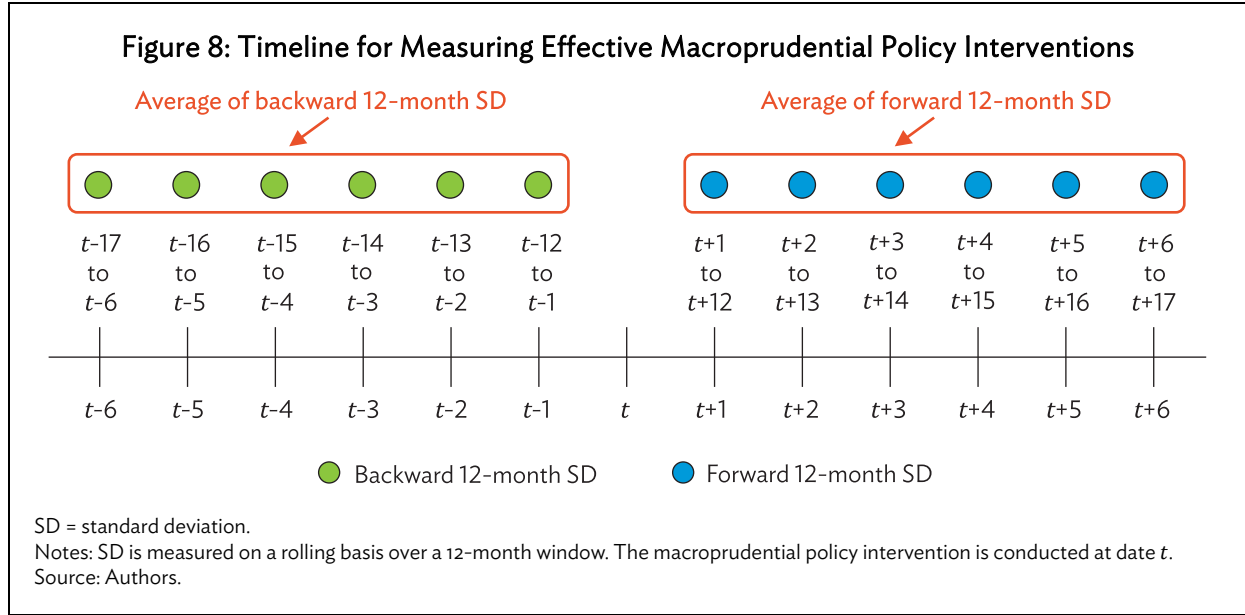
#### IV. EMPIRICAL STUDY

This section lays out the empirical strategy for learning about the macroeconomic conditioning factors for effective MPP interventions. The first step is to introduce the definition of effective MPP interventions. As there is currently no well-established definition for this and theoretical foundations also do not provide much guidance, the approach followed is necessarily heuristic.

##### A. Defining Effective Macroprudential Policy Interventions

It is widely accepted that MPP tools are used primarily to limit systemic risks (BIS 2010; FSB, IMF, and BIS 2011; IMF 2013). In other words, the goal of MPP interventions is to promote financial stability. Therefore, an effective MPP intervention should stabilize its underlying target variable (e.g., credit growth or house price growth, etc.), which, among others, can be reflected by a decline in the volatility of the target variable. To keep our analysis general and tractable, we consider this to be the case when the 6-month average of the target variable's rolling standard deviation (measured over 12-month windows) after the intervention date (forward 12-months standard deviation in Figure 8) declines relative to the 6-month average standard deviations (backward 12-months standard deviation) before the intervention.<sup>7</sup> Figure 8 illustrates this approach.

<sup>7</sup> We calculate the standard deviation of the detailed target indicators that are listed in Figure 1.



In particular, for each MPP intervention  $i$ , we calculate the ratio of the rolling average standard deviations (RRSD) as follows:

$$RRSD_i = \frac{\text{6-month average of forward 12-months } SD_i}{\text{6-month average of backward 12-months } SD_i} \quad (1)$$

RRSD captures the implied stabilization of the target indicator regardless of its units of measurement (e.g., house price index, credit growth, etc.) or whether an easing or tightening measure was used. It indicates how much more stable the target variable was after compared to before the MPP intervention.

Table 2 shows the bottom quartile, median, and top quartile of RRSD based on the 1,379 MPP interventions in our dataset. For the whole sample, the median RRSD is 0.87 which translates to an approximately 13% decline in the average standard deviation after the intervention relative to before. The relative decline in the standard deviation after an MPP intervention at the top quartile is almost 50%, while volatility of the target variable increases by about 40% postintervention at the bottom quartile. At the median, the relative decline in the post intervention volatility varies across region. It is slightly higher for developing Asia (about 15%), lowest in the emerging Europe (about 4%), and highest in the advanced economies (about 18%).

**Table 2: Distribution of RRSD**

	Bottom Quartile	Median	Top Quartile
All	1.40	0.87	0.53
Developing Asia	1.33	0.85	0.53
Emerging Europe	1.49	0.96	0.59
Latin America	1.45	0.87	0.41
Advanced countries	1.43	0.82	0.52

Note: RRSD refers to the ratio of the rolling average standard deviations as specified in equation (1)  
Source: Authors' calculations.

For our empirical analysis, we define MPP interventions effective under the condition that  $RRSD \leq 0.80$ , which implies a decline in the average standard deviation forward of at least 20%; and ineffective otherwise. We chose a ratio that is slightly higher than the median observed in advanced economies to set a relatively high but commonly achievable standard for an MPP intervention to be considered effective. To ensure the robustness of the results, we also consider alternative cutoff points that range from below to above 0.80.<sup>8</sup>

Table 3 shows that the unconditional probability of an effective MPP under our baseline threshold is about 45%. We conjecture that the state of the business cycle influences the probability of success; and because of this, we also report the conditional probabilities on both positive and negative output gaps. In fact, the probability of success conditional on the output gaps are virtually the same. Interestingly, there is no marked difference in the likelihood of success between RR and NRR instruments. And there is little difference in the unconditional probability that the MPP intervention is effective between tightening and easing measures. But when conditioned on a negative output gap, easing instruments seem to be substantially more likely to succeed (52.4%) than when the output gap is positive (42.3%). For tightening measures, the probability of success is similar for both positive (46%) and negative output gaps (43.3%). Either way, these are only first-pass results and are best supplemented with our regression results reported in the next section.

**Table 3: Percentage of Success Conditional on Output Gap**

Item	Overall	Positive Output Gap	Negative Output Gap
All	44.9	44.5	46.5
Nonreserve requirement	45.9	45.3	46.5
Reserve requirement	44.4	42.9	46.5
Tightening	44.7	46	43.3
Easing	46.7	42.3	52.4

Source: Authors' calculations.

<sup>8</sup> Some target variables react faster to MPP interventions than others. For example, we expect exchange rates and foreign capital movements to respond rather quickly, while effects on house prices might take longer to materialize. We argue that fast responses are captured within the 6-month average. While some targets might take longer to react, we nevertheless only consider averages over a 6-month horizon in order to limit capturing effects other than that of the MPP intervention. The robustness tests using thresholds other than  $RRSD = 0.80$  addresses this concern.

## B. Model

To conduct a probabilistic analysis to learn about the conditioning factors that are influencing the effectiveness of MPP interventions, we rely on the estimation of the following logit model:

$$P(effective_i = 1|x_i) = \theta(x'_i\beta).$$

The left side of this equation is a binary variable that takes a value of 1 if an MPP intervention is effective according to the definition outlined in the last section, and 0 otherwise. We maintain our definition of an effective MPP intervention; that is, if the average of the rolling standard deviation decreases by at least 20% in the 6 months after the MPP intervention. The vector  $x_i$  contains a constant and the conditioning factors that may govern the probability of effective MPP interventions;  $\beta$  is a conformable vector of coefficients for  $x_i$ , and  $\theta(\cdot)$  is a logistic function.

Given the lack of theoretical priors for our analysis, there are no strong hypotheses as to which variables should be included in the model or what their respective probabilistic impacts are. We take an agnostic ad hoc approach by considering various macroeconomic factors related to domestic economic conditions, external balance, the global environment, and policy variables that reflect a country's MPP stance. Our aim is to test which of these variables influence the effectiveness of MPP interventions and to what extent.

The baseline specification includes regressors that are used, although in a different context, in other empirical studies, including Kuttner and Shim (2016); Cerutti, Claessens, and Laeven (2017); and Akinci and Olmstead-Rumsey (2018). These variables include

- (i) the number of MPP interventions in the current quarter,
- (ii) a cumulative MPP tightening index,
- (iii) the output gap (measured as the output deviation from its Hodrick–Prescott-filtered trend),
- (iv) a measure of the domestic credit cycle (defined as the deviation of the domestic-credit-to-GDP ratio from its trend),
- (v) the change in the external-debt-to-GDP ratio,
- (vi) the current account deviation from its long-term average, and
- (vii) changes in the Chicago Board Options Exchange's Volatility Index.

The output gap and domestic credit cycle are assumed to capture the current domestic economic environment. The change in external debt and the deviation of the current account from its long-term average are included to represent the external balance variables. The Volatility Index represents a measure of risk aversion through which we aim to capture current global conditions. The MPP variables are the number of MPP interventions in the current quarter and a cumulative MPP tightening index.

To construct the cumulative MPP tightening index, we add 1 to the index value when country  $i$  implements a tightening MPP and deduct 1 for easing measures (Kuttner and Shim 2016; Zhang and Zoli 2016; Cerutti, Claessens, and Laeven 2017; Akinci and Olmstead-Rumsey 2018). We get the output gap through trend-cycle decomposition using the Hodrick–Prescott filter (Hodrick and Prescott 1997).<sup>9</sup>

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<sup>9</sup> We set the smoothing parameter at  $\lambda = 1,600$ .

The domestic credit cycle is measured as the deviation of the ratio of domestic credit to GDP from its linear trend. A sustainable current account balance implies that the series should be stationary (Taylor 2002, Clower and Ito 2012). Therefore, for the current account, we include deviations from its long-term average in the regression.

The explanatory variables are measured at a quarterly frequency. Some of these variables are not available at quarterly frequency for Chile, Colombia, Pakistan, and Viet Nam, which slightly reduces the sample size for our baseline regression. We include contemporaneous values and up to 2 lags of the macroeconomic variables in our baseline specification. The results section below reports the most parsimonious specification. Since our dependent variable is constructed based on the value of RRSD, which is a ratio of future to past volatility, we assume that all the explanatory variables are exogenous.

## V. RESULTS

Table 4 shows the logit estimates of vector  $\beta$ . We first estimate a model that only includes the two policy variables by exploiting all available observations covering the sample's 61 economies (Table 4, column 1). The results suggest that the more MPP interventions a country implements in the current quarter, the higher are the chances that the intervention is successful at a particular point in time. Table 5, column 1, shows the average marginal effects of the two regressors.<sup>10</sup> Holding all other variables constant, an additional MPP intervention during the same quarter is expected to increase the probability of success by about 3%, which is a statistically significant effect at the 10% level. This suggests that applying multiple MPP interventions in the same quarter—for example, five or more, as was done by Singapore in the first quarter of 2013 and the Republic of Korea in the fourth quarter of 2006—would significantly raise the chances of an effective intervention.

In contrast, a cumulative MPP tightening index tends to reduce the probability of an effective MPP intervention. A country that has repeatedly used tightening measures seems to be less successful in its next MPP intervention, because the returns to MPP interventions diminish because of arising credibility issues. The estimated marginal effect is actually quite substantial in that a tightening of MPP by 10 times (about 1 standard deviation) reduces the likelihood of an effective intervention by 10%, other things being equal. This is not necessarily at odds with previous findings, such as Akinci and Olmstead-Rumsey (2018), which suggest that an increase in the cumulative MPP tightening index leads to lower credit growth. This may not be accompanied by a reduction in its volatility, and hence does not necessarily imply improvements in its stability.

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<sup>10</sup> In the subsequent discussion, we only report average marginal effects. For  $x$ , the average marginal effect is calculated on the basis of actual values of the variables and then averaged over each observation.

Table 4: Main Logit Regression Results

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of interventions	0.136* (0.0760)	0.146* (0.0833)	0.148* (0.0849)	0.148* (0.0837)	0.147* (0.0842)	0.150* (0.0820)
Cumulative intervention index	-0.0441** (0.0207)	-0.0422* (0.0231)	-0.0405* (0.0228)	-0.0420* (0.0233)	-0.0474** (0.0224)	-0.0640*** (0.0245)
Output gap lag		-2.322* (1.335)	-2.581* (1.382)	-2.807** (1.329)	-2.314* (1.396)	-1.638 (1.317)
Credit cycle lag		1.840*** (0.612)	1.766*** (0.600)	1.736*** (0.623)	1.953*** (0.624)	1.613*** (0.613)
Δ External debt		0.00893*** (0.00238)	0.00826*** (0.00234)	0.00860*** (0.00231)	0.00860*** (0.00219)	0.00832*** (0.00237)
CA deviation		0.0560*** (0.0217)	0.0532** (0.0212)	0.0535* (0.0219)	0.0576*** (0.0220)	0.0490** (0.0225)
Δ VIX		-0.0065*** (0.00242)	-0.00638*** (0.00241)	-0.00573** (0.00243)	-0.00659*** (0.00240)	-0.00429* (0.00255)
Δ Policy rate			-0.154* (0.0850)			
Fiscal policy gap				-0.0370 (0.0271)		
Exchange rate regime					0.449 (0.342)	
Pre-GFC dummy						-0.679*** (0.239)
Constant	-0.551*** (0.198)	-1.186*** (0.263)	-1.023*** (0.277)	-1.193*** (0.268)	-2.267*** (0.855)	-0.858*** (0.299)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,379	1,137	1,128	1,118	1,137	1,137
Pseudo R <sup>2</sup>	0.063	0.104	0.111	0.102	0.107	0.107

CA = current account, GFC = global financial crisis, VIX = Chicago Board Options Exchange Volatility Index.

Notes: Robust standard errors in parentheses. \*\*\*  $p < 0.01$  \*\*  $p < 0.05$  \*  $p < 0.1$ .

Source: Authors' calculations.

Column 2 of Table 4 shows the regression results for the baseline specification discussed in the previous section of the model. The output gap and the domestic credit cycle influence the probability of an effective MPP intervention through their past values, while the other factors do so contemporaneously. All explanatory variables enter the regression significant, at least at a 90% level of confidence, and the marginal effects of the two MPP variables remain virtually unchanged when the other regressors are included. A positive output gap is estimated to negatively affect the likelihood of an effective MPP intervention. In the context of a destabilizing trend in the property sector, for example, it is more difficult to slow down and stabilize movements in house price growth through LTV ratios during an economic boom than otherwise. The same applies to easing measures, as they are unlikely to generate enough impetus to, say, house prices during an economic expansion. But the marginal probabilistic effect is relatively small, such that a substantially positive output gap of 5 percentage points reduces the probability of an effective intervention only by 2.5%, other things being equal (Table 5, column 2).



The coefficient on the credit cycle is positive and highly significant at the 1% level. Consistent with Cerutti, Claessens, and Laeven (2017), MPP interventions seem to be less effective during a credit cycle bust, or when the credit-to-GDP ratio falls below its trend. Intuitively, there should be more scope for MPP interventions, regardless of whether they are tightening or easing measures, to exert an influence on their target variable during a credit cycle expansion than when the demand for credit falls below its trend. In contrast to the output gap, the marginal effect of the credit cycle is sizable, in that a 20 percentage point deviation from the trend (about 1 standard deviation) raises the likelihood of the MPP intervention to be effective by about 8%, other things being equal (Table 5, column 2).

Variables representing the external balance condition are also important drivers. Effective MPP interventions are more likely when the ratio of external debt to GDP is larger. Similar to domestic credit cycles, larger external debt also provides more leeway for MPP instruments to affect their respective target variables because this is also associated with credit expansion. This result further suggests that for the effectiveness of MPP interventions, it does not matter whether credit is sourced domestically or internationally. The marginal effect, however, is smaller for external debt, with the likelihood of success increasing by only about 0.4% for a nontrivial addition of 2 percentage points in the external-debt-to-GDP ratio, other things being equal.

**Table 5: Average Marginal Effects of the Logit Estimates**

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of interventions	0.0308* (0.0172)	0.0314* (0.0178)	0.0316* (0.0179)	0.0319* (0.0179)	0.0314* (0.0178)	0.0318* (0.0173)
Cumulative intervention index	-0.0100** (0.00462)	-0.00908* (0.00491)	-0.00863* (0.00482)	-0.00907* (0.00495)	-0.0102** (0.00471)	-0.0136*** (0.00509)
Output gap lag		-0.500* (0.286)	-0.550* (0.293)	-0.605** (0.286)	-0.495* (0.296)	-0.347 (0.278)
Credit cycle lag		0.396*** (0.128)	0.376*** (0.124)	0.374*** (0.131)	0.418*** (0.129)	0.342*** (0.126)
Δ External debt		0.00192*** (0.000504)	0.00176*** (0.000492)	0.00186*** (0.000491)	0.00184*** (0.000462)	0.00176*** (0.000502)
CA deviation		0.0121*** (0.00456)	0.0113** (0.00442)	0.0115** (0.00461)	0.0123*** (0.00458)	0.0104** (0.00469)
Δ VIX		-0.0014*** (0.000514)	-0.0014*** (0.000507)	-0.0012** (0.000520)	-0.0014*** (0.000501)	-0.0009* (0.000539)
Δ Policy rate			-0.0329* (0.0180)			
Fiscal policy gap				-0.00798 (0.00586)		
Exchange rate regime					0.0962 (0.0719)	
Pre-GFC dummy						-0.144*** (0.0499)
Observations	1,379	1,137	1,128	1,118	1,137	1,137

CA = current account, GFC = global financial crisis, VIX = Chicago Board Options Exchange Volatility Index.

Notes: Robust standard errors in parentheses. The average marginal effect for  $x_i$  is calculated on the basis of actual observed values of the variables and then averaged over each observation. \*\*\*  $p < 0.01$  \*\*  $p < 0.05$  \*  $p < 0.1$ .

Source: Authors' calculations.

Current account deviations from long-term averages also matter for the effectiveness of MPP interventions in the sense that unusually large deficits tend to make MPP less effective. The magnitude of this effect is more substantial than that of external debt. Other things being equal, a current account balance that is 5 percentage points below the long-term average (about 1 standard deviation) decreases an MPP intervention's probability of success by 6%, which is statistically significant at the 1% level. Unusually large current account deficits create uncertainty for the sustainability of a country's external position, which may counteract the stabilizing effects of MPPs.

Changes in global risk aversion as proxied by the Volatility Index also affect the likelihood that countries can conduct MPP interventions effectively. Heightening risks in the global financial condition may entail spillovers of uncertainty in sentiment to the domestic economy (e.g., for capital movements), which in turn may erode the potential for effective MPP impacts. The marginal effect of the Volatility Index suggests that a 50% increase in the index (about 1 standard deviation), other things being equal, decreases the chances for an effective MPP intervention by about 7%, which is statistically significant at a 99% level of confidence.

Columns 3–5 in Table 4 show to what extent other macroeconomic policy variables affect the likelihood of an effective MPP intervention. To this end, we augment the baseline model (column 2) with the change in the policy interest rate, the fiscal policy gap, and a variable capturing the exchange rate regime. Out of these three policy variables, only changes in the policy interest rate seem to affect the effectiveness of MPP interventions at a 90% level of confidence, while the other two variables enter the baseline model with an estimated coefficient that is statistically indistinguishable from zero.

The average marginal effect analysis suggests that a 1 percentage point increase in the policy rate decreases the likelihood of an effective MPP intervention by 3.3%, other things being equal (Table 5, column 3). This significance of the policy rate effect echoes other studies that discuss empirical interactions between monetary and macroprudential policy, which often highlight the need for coordination. Our finding suggests the effectiveness of MPP interventions is reduced when they are coupled by a monetary tightening. As argued in Malovana and Frait (2017), more accommodative monetary policy tends to boost the credit cycle, at least in expectation, and hence provides better scope for effective MPP interventions. Conversely, monetary tightening seems to create a less effective environment for MPP interventions, perhaps due to the dominating effects of the former over the latter.

These results suggest that a certain combination of macroeconomic conditions can seriously hamper the likelihood of effective MPP interventions. For example, a hypothetical country that goes through a boom financed through large current account deficits but faces a slowing credit cycle amid heightened global financial market uncertainty, may have a difficulty pushing through an effective MPP intervention. A 1 standard deviation from the mean of these variables implies that the likelihood for an effective MPP intervention would be significantly reduced by 23.5%. If the country were to make up for the downside from the macroeconomic environment, the policy implications of our findings suggest that MPP interventions should be countercyclical, as is also argued in IMF (2015), by making several MPP interventions work together at the same time to increase their effectiveness, and to avoid diminishing credibility from having to go through repeated interventions. It would also be necessary for the country to ensure that MPP interventions are coordinated with monetary policy.

Because advanced economies and EMEs used MPP interventions far more frequently after than before the global financial crisis, we also examine whether there are any differences in the likelihood of effective interventions between the two periods. To this end, we augment the baseline model with a dummy for before the global financial crisis, which takes the value of 1 before 2008, and 0 otherwise (Table 4, column 6). The coefficient on the global financial crisis dummy is negative and significant at a 99% level of confidence, with the marginal effects analysis suggesting that MPP interventions were 15% less likely to be effective during the period before the global financial crisis.

We then extend our analysis to check whether there is a significant difference in the likelihood of success of MPP interventions between tightening and easing, or between measures for RRs versus NRRs. We added indicator variables for both measures to the baseline model, but there is no indication that they have a significant effect on the probability for effective MPP interventions at conventional levels of confidence (Appendix 2). Thus, there is no difference in how these types of instruments affect the performance of MPPs.

## A. Robustness

This section performs a number of robustness checks. Because our definition of a successful MPP intervention is arguably arbitrary, we check whether our main results change if different cutoffs for RRSD are chosen. For this, we experiment with the following set of RRSD values: {0.91, 0.67, 0.50}, which corresponds to, respectively, a roughly, 9%, 33%, and 50% lower standard deviation in the 6 months after the MPP intervention compared to the 6 months before.

Table 6 shows the regression results for different cutoffs to define the effective MPP interventions using two specifications: the baseline model and the one augmented with the change in the policy rate. Overall, the results are reassuring in that they are not substantially different from the ones discussed earlier. The sign of the coefficients and their statistical significance and magnitudes are quite similar, implying that the marginal effects of the variables do not change much under the set of different RRSD cutoffs {0.91, 0.67, 0.5}. There is one important exception, however. The coefficient on the variable “number of MPP interventions in the current quarter” gets smaller and reduced into a magnitude that is not statistically different from zero as the cutoffs exceed our baseline value. To an extent, policy makers can stabilize the underlying target variable by implementing several MPP interventions at the same time. But whether the stabilization occurs in a real and significant way—that is, a 34% or 50% decline in the standard deviation—seems to entirely depend on the current macroeconomic environment characterized by the output gap, state of the credit cycle, and other indicators. Interestingly, the negative marginal effect stemming from repeated MPP tightening also seems to be larger for the 50% cutoff compared with the baseline results (Table 5, columns 3 and 6). This suggests that the credible conduct of MPPs becomes more important the more ambitious the authority’s stabilization goals are.

**Table 6: Robustness of Main Results to Alternative Definitions of Effective Macprudential Policy**

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of interventions	0.202** (0.0869)	0.151* (0.0895)	-0.0568 (0.0985)	0.219** (0.0870)	0.144 (0.0902)	-0.0935 (0.0970)
Cumulative intervention index	-0.0278 (0.0226)	-0.0426** (0.0214)	-0.0821*** (0.0209)	-0.0268 (0.0225)	-0.0415* (0.0212)	-0.0800*** (0.0213)
Output gap lag	-3.678*** (1.271)	-2.736* (1.550)	-4.210** (1.884)	-3.593*** (1.374)	-2.802 (1.705)	-4.982** (1.986)
Credit cycle lag	2.124*** (0.605)	1.707*** (0.539)	2.110** (0.880)	2.046*** (0.599)	1.610*** (0.527)	1.951** (0.889)
Δ External debt	0.00833*** (0.00214)	0.0103*** (0.00347)	0.00674*** (0.00194)	0.00805*** (0.00222)	0.00942*** (0.00320)	0.00613*** (0.00206)
CA deviation	0.0611*** (0.0235)	0.0499** (0.0200)	0.0561*** (0.0214)	0.0583** (0.0230)	0.0458** (0.0192)	0.0535** (0.0215)
Δ VIX	-0.0076*** (0.00229)	-0.00569** (0.00271)	-0.00317 (0.00217)	-0.0074*** (0.00228)	-0.00547** (0.00272)	-0.00281 (0.00196)
Δ Policy rate				-0.140* (0.0726)	-0.181** (0.0912)	-0.155* (0.0802)
Constant	-1.206*** (0.241)	-1.193*** (0.272)	-1.849*** (0.282)	-1.085*** (0.254)	-0.986*** (0.274)	-1.623*** (0.309)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,134	1,123	1,105	1,125	1,114	1,096
Pseudo $R^2$	0.106	0.111	0.175	0.113	0.119	0.186

CA = current account, VIX = Chicago Board Options Exchange Volatility Index.

Notes: Robust standard errors in parentheses. The RRSD threshold is 0.91 in Columns 1 and 4, 0.67 in Columns 2 and 5, and 0.5 in Columns 3 and 6. \*\*\*  $p < 0.01$  \*\*  $p < 0.05$  \*  $p < 0.1$ .

Source: Authors' calculations.

We also conducted a robustness check on the average marginal effects estimates over different functional specifications of our regression model. This is to check for the possibility that our results may suffer from an “incidental parameter problem,” as discussed in Neyman and Scott (1948), Greene (2004), and Arellano and Hahn (2007). We argue, however, that the incidental parameter problem is not applicable in our setup. The country dummies do not constitute the classical fixed effects since our data structure is not a panel dataset. Even so, for robustness, we compare the logit average marginal effects to the ones we would get from a probit model and a linear probability model. Table 7 reports the estimated average marginal effects for the baseline specification obtained from the three functional specifications. It shows that the marginal effects implied across the three models are virtually the same. The results are taken as evidence in favor of the notion that our main results do not suffer the inconsistencies from an incidental parameter problem, and they are independent for the implicit assumption of the functional form used for the estimation.

**Table 7: Average Marginal Effects of Probit, Logit, and Linear Probability Model**

Variables	(1) Probit	(2) Logit	(3) LPM
Number of interventions	0.0306* (0.0179)	0.0314* (0.0178)	0.0294 (0.0184)
Cumulative intervention index	-0.00902* (0.00471)	-0.00908* (0.00491)	-0.00874* (0.00485)
Output gap lag	-0.489* (0.287)	-0.500* (0.286)	-0.524* (0.301)
Credit cycle lag	0.395*** (0.123)	0.396*** (0.128)	0.405*** (0.132)
Δ External debt	0.00189*** (0.000453)	0.00192*** (0.000504)	0.000895*** (0.000158)
CA deviation	0.0121*** (0.00444)	0.0121*** (0.00456)	0.0118*** (0.00437)
Δ VIX	-0.00142*** (0.000515)	-0.00140*** (0.000514)	-0.00142*** (0.000529)
Observations	1,137	1,137	1,137

CA = current account, LPM = linear probability model, VIX = Chicago Board Options Exchange Volatility Index.

Notes: Robust standard errors in parentheses. The average marginal effect for  $x_i$  is calculated on the basis of actual observed values of the variables and then averaged over each observation. \*\*\*  $p < 0.01$  \*\*  $p < 0.05$  \*  $p < 0.1$ .

Source: Authors' calculations.

## B. Do Advanced Economies Differ from Emerging Market Economies?

Our dataset is also rich enough to allow us to test for behavioral differences between the advanced economies and EMEs for the macroeconomic conditions for effective MPP interventions. We use a dummy variable that takes a value of 1 for advanced economies and 0 for EMEs and add it to the baseline specification. Column 1 of Table 8 shows the regression results. The coefficient on the dummy for advanced economies is positive and significant at a 99% level of confidence, with a relatively large magnitude. This implies that, other things being equal, advanced economies are 32% more likely to conduct an effective MPP intervention than EMEs.<sup>11</sup>

We interact each of the explanatory variables of the baseline specification with the dummy for advanced economies. Column 2 of Table 8 shows the results, which include only variables that are statistically significant. Three of the variables seem to affect the probability of effective MPP interventions differently between advanced economies and EMEs: domestic credit cycle, changes in external debt, and the Volatility Index. Because the magnitude of the coefficients on these variables tend to nullify their estimated effect, their marginal effects are essentially very close to zero for advanced economies. This implies that the credit cycle, both domestic and external, and global risk aversion (Volatility Index), do not seem to matter in determining the effectiveness of MPP interventions in advanced economies.

<sup>11</sup> Note that the unconditional probability of effective MPP interventions is virtually the same for advanced and emerging economies (47% versus 45%).

**Table 8: Logit Results for Advanced versus Emerging Market Economies**

Variables	(1)	(2)	(3)
Number of interventions	0.146* (0.0833)	0.149* (0.0855)	0.154* (0.0869)
Cumulative intervention index	-0.0422* (0.0231)	-0.0429* (0.0232)	-0.0413* (0.0230)
Output gap lag	-2.322* (1.335)	-2.731* (1.408)	-2.917** (1.453)
Credit cycle lag	1.840*** (0.612)	2.235*** (0.782)	2.145*** (0.780)
Δ External debt	0.00893*** (0.00238)	0.0385** (0.0170)	0.0358** (0.0169)
CA deviation	0.0560*** (0.0217)	0.0527*** (0.0204)	0.0505** (0.0202)
Δ VIX	-0.00649*** (0.00242)	-0.00833*** (0.00265)	-0.00817*** (0.00260)
Advanced dummy	1.780*** (0.221)	1.640*** (0.245)	1.490*** (0.262)
Advanced × credit cycle lag		-1.736* (1.007)	-1.603 (1.022)
Advanced × Δ external debt		-0.0319* (0.0170)	-0.0296* (0.0170)
Advanced × Δ VIX		0.00979** (0.00487)	0.00958* (0.00501)
Δ Policy rate			-0.146* (0.0874)
Advanced × Δ policy rate			-0.00683 (0.309)
Constant	-1.186*** (0.263)	-1.023*** (0.278)	-0.880*** (0.288)
Country dummies	Yes	Yes	Yes
Observations	1,137	1,137	1,128
Pseudo R <sup>2</sup>	0.104	0.11	0.117

CA = current account, VIX = Chicago Board Options Exchange Volatility Index.

Notes: Robust standard errors in parentheses. \*\*\*  $p < 0.01$  \*\*  $p < 0.05$  \*  $p < 0.1$ .

Source: Authors' calculations.

Indeed, on the contrary, the effect of conventional monetary policy on the probability for effective MPP interventions does not seem to differ between advanced economies and EMEs. The coefficient on the interaction between a change in the policy rate and the advanced economies' dummy is not statistically different from zero, suggesting there is no difference between advanced economies and emerging markets in how monetary policy affects the probability of an MPP intervention being successful. Thus, coordination between MPP and conventional monetary policy is equally important to ensure the effectiveness of MPPs in both advanced and emerging markets.

## VI. CONCLUSION

We constructed a new dataset on the use of MPP instruments for 61 advanced economies and EMEs from 2000 to 2016. The novelty of our database is that it maps every documented use of an MPP instrument in the sample over this period to a specific target indicator for banking health, domestic loans, the exchange rate, foreign capital movements, and house prices. We assembled a new database on the use of MPP instruments by using IMF Article IV consultations, country reports, and annual reports on exchange arrangements and exchange restrictions, and official documents from national sources.

From our dataset, we were able to introduce a practical definition for an effective MPP intervention. We did this by defining effective MPP interventions as those that bring down the 6-month average of the target variable's rolling forward standard deviation after the intervention date by at least 20% relative to the 6-month's average of rolling back standard deviations before the intervention. Under this definition, out of the 1,379 recorded MPP interventions, only about 45% were considered effective.

This paper showed that changes in RRs are by far the most frequently used MPP instrument, followed by capital requirements, limits on credit or credit growth, and LTV ratios. Most MPP interventions in our sample target stabilizing domestic lending, the housing sector, and the health of the banking system. Stabilizing exchange rates and capital movements accounted for only one-sixth of interventions. Most MPP instruments tended to concentrate on two target indicators, but there were exceptions, including reserve requirements and limits on credit or credit growth, which were used to target all five categories of the target indicators. Our findings confirm that the use of MPP instruments greatly intensified after the global financial crisis. We also found that MPP instruments were used more proactively in Asia to promote financial stability than in other regions, with these instruments used on average 34 times a year in the review period in Asia, compared with 16 in Europe.

Our regression results suggest that multiple MPP interventions conducted in the same quarter tend to improve the likelihood of these measures being effective. On average, economies conducted two policy interventions in a quarter, but this could go to as high as six interventions in a quarter when conditions required, as was the case in Singapore in 2013. Conversely, repeatedly tightening MPP seems to reduce the chances for an effective intervention, because it may undermine the policy credibility in stabilizing the target variable.

Internal and external balance conditions contribute to the chances for effective policy interventions. For internal balance, MPP interventions tend to be more effective when an economy is in recession rather than when it is overheated. Consistent with Cerutti, Claessens, and Laeven (2017), MPP interventions tend to be less effective during the bust of a credit cycle when the credit-to-GDP ratio falls below its trend.

For the external balance, economies with rapid increases in their external-debt-to-GDP ratio tend to have a higher chance of effective MPP interventions. This has a similar effect to domestic credit conditions, suggesting that the effectiveness of MPP interventions is affected by credit conditions regardless of whether they are sourced domestically or internationally. MPPs tend to have less of a chance to be effective in economies with larger current account deficits; this is because larger external dependency reduces domestic policy independence, which in turn affects policy effectiveness.

Changes in global financial risk conditions also affected economies using MPP interventions. Heightened risk, as captured by increases in the Chicago Board Option Exchange's Volatility Index,

reduces the likelihood for effective MPP interventions. In an increasingly integrated world, volatility in global financial market entails spillover effects to the domestic economy; for example, through uncertainty in capital movements, which in turn could erode the potential for effective MPPs. But while the Volatility Index and credit conditions count for the effectiveness of MPP interventions in EMEs, advanced economies seem to be somewhat shielded from the same effect.

An extended analysis to look at the possible impact of other macroeconomic policy interventions on the likelihood for effective MPP interventions suggests that only an economy's monetary policy stance matters and not the stance of fiscal policy or the choice of exchange rate regime. This finding suggests the effectiveness of an MPP intervention is reduced when coupled with monetary tightening. As argued in Malovana and Frait (2017), more accommodative monetary policy tends to boost the credit cycle, hence providing better scope for effective MPP interventions. Conversely, monetary tightening seems to create a less effective environment for MPP interventions, perhaps due to the dominating effects of monetary tightening over MPP interventions. Lastly, we find the increasing reliance on MPP interventions since the global financial crisis also coincides with better chances of the policy becoming effective in stabilizing its respective target indicator.

In sum, certain macroeconomic environments can seriously hamper the likelihood for MPP interventions to be effective. For example, consider a hypothetical case of a country that is experiencing a boom financed through large current account deficits, but accompanied by a slowing credit cycle and heightened global financial market uncertainty. Under such an unfortunate combination of events, a 1 standard deviation from the mean of the three variables implies that the likelihood for an effective MPP intervention would be significantly reduced by 23.5%. The country then needs to enact countercyclical MPP interventions, as also argued by IMF (2015), by adequately enforcing several MPP measures to work together at the same period to increase their effectiveness and avoid the potential diminishing credibility from having to go through repeated interventions. It would also be necessary for the country to ensure that MPP interventions are appropriately coordinated with monetary policy.



## APPENDIXES

Table A.1: List of the 61 Economies Used in the Sample

### Advanced economies (21)

Asia	Europe	North America
Australia, New Zealand	Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom	Canada, United States

### Emerging economies (40)

Asia	Europe	Latin America
Georgia; Hong Kong, China; India; Indonesia; Kazakhstan; Malaysia; Mongolia; Pakistan; People's Republic of China; Philippines; Republic of Korea; Singapore; Sri Lanka; Taipei, China; Thailand; Viet Nam	Bulgaria, Croatia, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Portugal, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Turkey, Ukraine	Argentina, Brazil, Chile, Colombia, Mexico, Peru, Uruguay

Table A.2: Logit Results for Different Types of Macroprudential Policies

Variables	(1)	(2)
Number of interventions	0.147* (0.0823)	0.147* (0.0830)
Cumulative intervention index	-0.0419* (0.0226)	-0.0418* (0.0227)
Output gap lag	-2.274* (1.294)	-2.316* (1.335)
Credit cycle lag	1.832*** (0.610)	1.837*** (0.611)
Δ External debt	0.00896*** (0.00236)	0.00895*** (0.00240)
CA deviation	0.0560*** (0.0217)	0.0559*** (0.0215)
Δ VIX	-0.00660*** (0.00244)	-0.00653*** (0.00242)
Tightening	-0.0551 (0.164)	
RR dummy		0.0965 (0.199)
Constant	-1.161*** (0.261)	-1.215*** (0.269)
Country dummies	Yes	Yes
Observations	1,137	1,137
Pseudo $R^2$	0.114	0.104

CA = current account, RR = reserve requirements, VIX = Chicago Board Options Exchange Volatility Index.

Notes: Robust standard errors in parentheses. \*\*\*  $p < 0.01$  \*\*  $p < 0.05$  \*  $p < 0.1$ .

Source: Authors' calculations.

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## Conditions for Effective Macroprudential Policy Interventions

This paper constructs a new database that documents the use of a large number of macroprudential policy (MPP) instruments for 61 economies over 2000–2016. The dataset is used to introduce a practical way of defining effective MPP interventions on the basis of the observed stability implications in their target indicators and for analyzing macroeconomic conditions that promote effective MPP interventions. These are more likely to happen if several measures are implemented credibly and in tandem. The paper finds that monetary tightening overrides the effectiveness of MPP instruments. Output gap, credit cycle, external debt, current account, and global risk appetite also count for the likelihood of the effectiveness of MPP interventions.

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