Macroprudential Policy Interactions: What has Changed Since the Global Financial Crisis? *

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Abstract

We study the empirical international policy interactions between macroprudential regulators to determine whether these react strategically to foreign policy dynamics. For that, we analyze the policy-to-policy effects for a panel of 65 economies using a local projection approach. Our findings suggest that domestic regulators can respond to foreign policy changes by changing their toolkit and on average will tighten their policies in response to stricter foreign regulations. We disentangle this effect by the type of country reacting, the origin of foreign policy change, and the type of instrument changing abroad. We obtain that the domestic reactions take place mainly in emerging economies and when reacting to policy developments in advanced economies. At the same time, the policies eliciting reactions are: The macroprudential tightenings (as opposed to loosenings), the changes in instruments that target financial institutions (as opposed to borrowers), and the policies involving capital requirements and liquidity risk tools. In contrast, we do not find strong evidence suggesting that advanced economies' regulators react to foreign policy developments. On the contrary, they seem to stick to "keeping their house in order" which aligns with the intuition that these countries would lose more by relinquishing their policy independence. Finally, implications for multilateral policy design—with regional policy recommendations—are mentioned.

JEL Codes: F38, F42, E44, G18

Key words: Macroprudential Policies, International Policy Interactions, Global Financial Cycle.

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1 Introduction

The macroeconomic effects of prudential regulations have been studied actively since the onset of the Global Financial Crisis. In that effort, a consensus has been reached suggesting these policies are effective on their targets but also imply unintended policy leakages and external effects that can be detrimental for agents outside the financial system.[1] Naturally, these external effects can extend to other economies (Buch and Goldberg, 2017; Forbes, Reinhardt, and Wieladek, 2017), and the associated prudential leakages may increase the vulnerability of financially integrated countries (Forbes, 2020). In light of that, it may be beneficial for a domestic regulator to adjust its own policies, not only in response to the local and global fundamentals, but also strategically as a function of foreign policy dynamics. We refer to such potential cross-border reactions—that are not based on the observed state of fundamentals— as international policy interactions. It seems relevant to determine whether these interactions exist and are sizable, to the point that countries adjust their macroprudential policies in presence of foreign regulations. We investigate whether this is the case for advanced and emerging economies, focusing on the change of these potential policy interactions after the Global Financial Crisis.

Verifying the presence of these policy-to-policy interactions can be relevant as these may constitute a critical feature for the design and evaluation of regulation. Such effects could imply important departures between the actual and intended outcome of policy and may become a source of economic inefficiency, for example, if an economy engages in international regulatory feedback loops—relative to other economies—that lead to excessive interventionism. With this in mind, we use a local projection approach to estimate the empirical domestic macroprudential dynamic response to changes in the prudential policies implemented in the rest of the world. In doing this, we exploit information about multiple macroprudential instruments at the cross-country level for a panel of 65 economies that include 23 advanced economies, 31 emerging economies, and 11 low income economies.

This methodology provides a flexible framework for separating the effects of a foreign policy that are intermediated by fluctuations in domestic fundamentals (policy-to-fundamentals effect) from the direct effects of changes in foreign regulations (policy-to-policy effects), and can be easily applied for a large number of specifications that vary in several dimensions such as the type of policies, of domestic economy (reacting), of origin of foreign regulation changes, and sample period. Furthermore, we complement our method with a narrative approach type of identification that seeks to isolate the prudential policy movements that are exogenous to domestic regulatory changes along similar lines to Richter, Schularick, and Shim (2019). This approach makes use of external global events that can prompt policy responses that are not dependent on the policy changes of other economies, namely the Basel (II and III) accords and the response to the COVID-19

[1] For example, see Cerutti, Claessens, and Laeven (2017), Akinci and Olmstead-Rumsey (2018), Claessens, Ghosh, and Mihet (2013), Aikman et al. (2019) for discussions on the direct effects of prudential policies, and Richter, Schularick, and Shim (2019), Boar et al. (2017), Aikman, Bush, and Davis (2016) for studies on the potential indented effects at the domestic level.

downturn, and allows us to assess the local policy reactions to foreign regulatory changes more comprehensively.

Our main results suggest that countries tend to adjust their policies in response to policy changes abroad beyond what could be explained by the direct spillover of these foreign regulations in observed fundamentals, that is, a policy-to-policy interaction takes place with domestic policymakers adjusting their regulations strategically and in anticipation to foreign policy leakages. The average reaction across the whole prudential toolkit (and for all countries) is positive —and has a scale of a quarter of an intervention—implying that a foreign policy tightening is followed by a partial local tightening adjustment—or total if the initial change is implemented across several instruments abroad. This effect changes with the type of economy reacting —with the core reactions taking place in emerging economies, with the type of foreign regulator enacting policy interventions, and with the type of policy change and instrument changing abroad. Besides the average positive reaction, we further state a number of facts related to this result to summarize this findings.

To begin, the interactions take place more saliently in emerging economies who also react more strongly to the policy changes in advanced economies. In contrast, the reactions by advanced economies is null in most of our estimations. In addition, when exploring the type of interventions we obtain that the interactions take place mainly when reacting to policy tightenings.These facts align closely with the findings of Richter et al. (2019) when studying the domestic macroeconomic cost of prudential interventions although here we verify them for international policy interactions instead. Furthermore, we also find that the type of tools generating policy interactions are those that target lenders (banks and financial institutions), while in contrast, the reaction to borrower-based tools' interventions is much weaker, null (or even inconsistent with the previous facts for some estimates). Finally, when splitting the toolkit into less aggregated policy classifications, we find that capital requirement related instruments explain the bulk of the interaction effects. However, there are still signs of policy interventions in other components of the prudential toolkit, for example with liquidity related tools. Finally, each of these stylized facts is present in the full sample period (1999-2021) and in the post great financial crisis (GFC) sample but not in the pre-crisis period. The latter implies that the cross-border policy linkages are a post-crisis phenomenon. Importantly, we should also mention that both the sporadic nature of the prudential interventions, and the loss of information implied in our identification approach will increase the uncertainty of the estimations at the specific instrument level, making difficult (and sometimes unfeasible) to analyze too disaggregated toolkit classifications. Thus, the estimations associated with the more aggregated instrument categories are more reliable. We mention this in more detail in our robustness exercises.

From these results we find evidence suggesting that country regulators react strategically to the policy changes in foreign economies. The policies implemented in advanced economies will be of particular interest for regulators engaging in policy cross-border policy interactions. The implications for emerging economies regulators can range from incentives to follow the lead of advanced economies that enjoy higher levels of financial stability to potential reactions aimed

at mitigating regulatory circumvention by financial intermediaries that may elicit after stricter regulations in foreign advanced economies are put in place. On the other hand, by construction, the strategic policy interactions we find are not prompted by observed changes in fundamentals —that principle could also imply additional prudential instruments adjustments. Thus, the regulatory reactions we obtain can be thought of as a lower bound of the total domestic policy response as they are are only related to the policy interdependence effect between regulators.

Finally, the fact that advanced economies are not reactive to prudential interventions abroad as other countries may suggest that the scope for welfare improving regional policy coordination (and cooperation) efforts between emerging economies may be substantial given that the former are not likely to face retaliatory responses by more their financial centers (or other developed economies). This is relevant policy implication of our results for multilateral institutions designing financial stability recommendations at the regional level.

These results are novel and improve our understanding of the policy considerations made by regulators that internalize the effect of global banking activities and foreign macroprudential policies in their domestic financial sector. Until now, the literature had documented direct and indirect effects of these policies, which in itself justifies domestic policy adjustments, but it was not as clear about the existence of additional features —rooted in a notion of policy-to-policy linkages— motivating policy interventions.

Related Literature. This paper is related to the empirical studies of the effects of macroprudential policies.[2] More specifically, it relates closely to articles that explore the external effects of the macroprudential toolkit. The policy externalities involved can affect the real and financial sector, and more importantly for this study, can have an international dimension. For example, Buch and Goldberg (2017) obtain that there are significant cross-border credit effects that spill over through the interbank lending, while Forbes, Reinhardt, and Wieladek (2017) find that the volume of foreign lending itself is affected by these prudential policies. As mentioned before, this can affect the intended outcome and effectiveness of these policy tools substantially.

Related studies also suggest that the cross-border impact on the financial stability could go in different directions, i.e., after a foreign policy change, a domestic country can import the financial instability of foreign economies or it can also import part of the intended, and stabilizing effects of the regulations. An example of a detrimental effect can be seen in Aiyar, Calomiris, and Wieladek (2014) for the UK case where in face of stricter British regulations, foreign banks —not affected by these regulations and with activities in the UK— would actually increase their financial intermediation, rendering less effective the regulation and also potentially increasing financial stability in the economies where these banks are based. On the other hand, positive effects have

[2]Another group of contributions touch these same topics from a theoretical standpoint, both in terms of the direct effects of these policies (Gertler and Kiyotaki, 2010; Aoki et al., 2018; Farhi and Werning, 2016), the interactions with other types of policies (Coimbra and Rey, 2017; De Paoli and Paustian, 2017), and the potential cross-border policy effects and international coordination of these instruments (Granados, 2021; Davis and Devereux, 2022; Korinek, 2020).

also been documented, for example Tripathy (2020) explains that in 2012 Mexico absorbed the financial stabilizing effects of policies targeting the Spanish real state sector through the activities of subsidiaries of BBVA in Mexico.

The evidence on the cross-border spillovers of these policies, as well as the potential policy interactions involving these instruments is what motivates this study, e.g., it may be reasonable to think the regulators internalize the external effects of foreign prudential policy changes in their economies and react in response by adjusting the domestic toolkit in anticipation of potential policy leakages stemming from abroad. Despite this, and in contrast with the study of foreign policies-to-local fundamental effects, the literature on the empirical strategic response between financial regulators (or lack thereof) in scarce, which is where our article represents a contribution.

On this front, Agénor, Kharroubi, Gambacorta, Lombardo, and da Silva (2017) study the static policy response to foreign policies based on data on the usage of macroprudential tools, i.e., they study whether a country would increase their extensive utilization of prudential tools in presence of an increased use abroad and obtain a negative relationship. We complement that study, by investigating the dynamic international policy interaction effects in terms of the policy stances (and not only the usage), i.e., we account for the type of policy change (tightening, loosening), while also considering an ample number of additional specifications by type of local and foreign country, sample period, and type of policy change abroad, and importantly, we carry out an identification scheme on the foreign policies to isolate exogenous interventions and thus remove sources of potential endogeneity in our estimates.

2 The Macroprudential policies in the last decades

The first half of the last two decades was characterized by a deregulation of the banking sector in the advanced economies (e.g. the termination of Glass-Steagal Act of 1933 in the US) and an increase in the scale of activities of these firms in the global financial markets. The latter was reflected in a steady increase of capital flows, initially to advanced, and after the Global Financial Crisis to the emerging economies. This increase has been largely explained by portfolio investments, the most volatile type of international capital flow. These partial change in the potential sources of risk, from advanced to emerging[3], was in part caused by a tightening in the financial regulation stance in the US, implemented in response to the global financial crisis experience (Frank Dodd Act of 2010) that prompted a subsequent flight of international investment flows to less regulated economies.

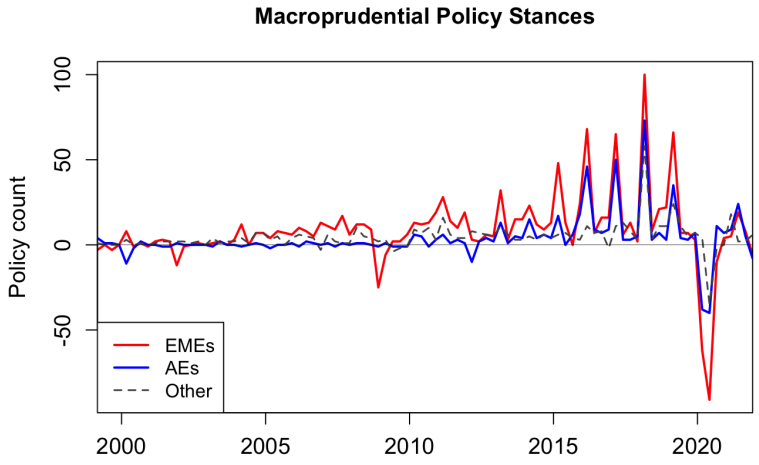
In this context, there have been regulatory responses in the form of updates the Basel Accords, and the establishment of several institutional bodies specifically aimed to strengthen the oversight of the international financial system (e.g. the Financial Stability Board). The revisions of the Basel accords in particular, have tried to address the shortcomings of previous versions that proved in

[3]For a detailed description of the change in the direction of capital flows and towards emerging see McQuade and Schmitz (2017)

some way or another to be unable to prevent or mitigate the effects of financial crises. The specific drawback of the Basel II accord that motivated the latest update (to Basel III), namely, the failure to account for sources of systemic risk beyond the individual sustainability of regulated banks, is of relevance for this study, as its effects are driven by effects between financial firms that can take place within or across borders. In that sense, intuition may dictate that such interdependence can justify for a national regulator to track closely the foreign regulatory developments.

We can see in figure 1 the macroprudential policy responses during this period, shown as the sum of instrument-specific interventions by country groups and where a larger policy count denotes a net macroprudential tightening (i.e. a stricter stance) and negative and lower a net prudential loosening —or a more accomodative stance. [4] Before the crisis the level of regulatory activity reflected in these interventions was relatively small, however, after 2008 there was a steep increase in regulatory activity as well as a generalized tendency to implement less accommodative policy stances (apply more tightenigns). More recent data, covering the COVID episode only made more evident the discretionary nature of the toolkit and its increased use by all countries.

Figure 1: Macroprudential Policy Stance by Country Type



Note: Policy Indicator level. The indicator denotes the policy stance calculated by the indicators of net tightenings across policy tools, increasing by 1 for each tightening and decreasing by -1 for a loosening. At each point the policy indicators at the country level are summed by type of country.

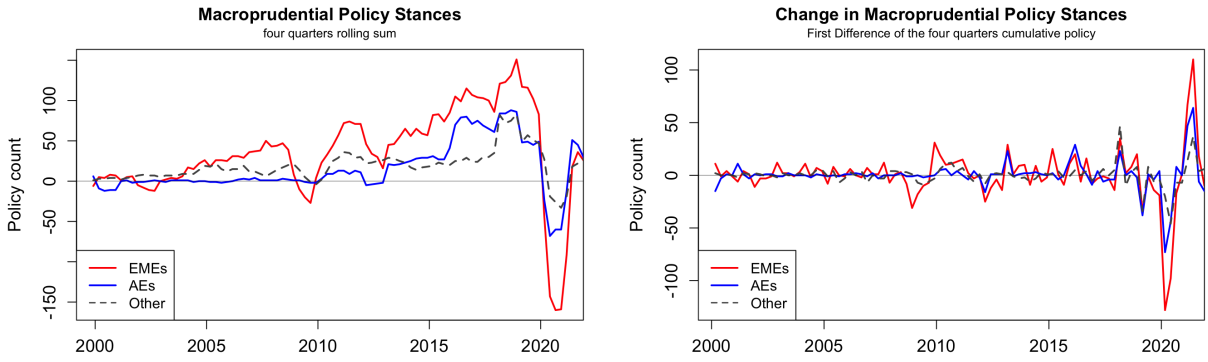
Source: Integrated Macroprudential Policy Database (iMAPP), IMF.

Notice, however, that the policy indicator above is a flow of interventions and only accounts by the date of a tightening (or policy change), but afterwards may not reflect the reigning policy stance of regulators (unless there are further changes). Because of this, to provide a better account of the state of the policy stance, the literature usually focuses on the cumulative policy stance at longer horizons (e.g., Richter et al., 2019; Coman and Lloyd, 2022). We also report such type of indicator in figure 2, where we show the annual policy stance defined as the four quarter rolling

[4] For example, at the start of 2015 the indicator for emerging economies takes a larger than 50, meaning that these countries applied that many more tightenigns across the prudential policy instruments in relation to loosenings.

sum (current and previous three quarters) at each period as well as its first difference. In the case of the annual policy stance we can see even more clearly the tightening pattern in the last decade and the policy accommodative efforts (loosenings) during the COVID lockdown.

Figure 2: Macroprudential Annual Policy Stance by Country Type



Note: Four quarter rolling sum of the quarterly indicator. The indicator measure net tightenigns across policy tools by group of countries. A higher value denotes a tighter (or less accommodative) policy stance.

Source: Integrated Macroprudential Policy Database (iMAPP), IMF.

In addition to higher interventionism patterns we could also expect these policies to co-move over time between economies and particularly so after the 2008 Global Financial Crisis (GFC) episode, if we account for the potential regulatory arbitrage efforts that banks operating in several economies may engage in. This seems hinted by the interventions in Figure 1 and in the right panel of Figure 2 where we see the formation of a comovement between policy interventions by country groups. Additional explorations, shown in the Appendix A, support the presence of a post-crisis strengthening of the macroprudential linkages across countries; for example, we find that the correlation between policy interventions by country groups was virtually zero before the crisis but becomes highly positive afterwards. This pattern seems to hold for both quarterly and annual indicators, and even for the average policy stances, i.e. after filtering out the effect of the increase in the number of countries using these tools which has risen steadily over time and documented in Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier, and Wang (2024).

Now, given our aim is to analyze the cross-border policy co-movement it is more appropriate to depart from the analysis of country group aggregates, and instead exploit the country level variation of these data. However, for carrying out a country-level analysis we require a "rest of the world" (ROW) policy indicator constructed from each country's perspective. This ROW indicator would constitute the foreign policy stance each economy deems relevant when setting their own policy toolkit. We construct such variable based on the financial links between economies approximated by the portfolio investment position data reported by the economies in our sample. We describe the construction and data sources in more detail in Section 3.

With the policy indicator of the rest of the world we can perform an initial exploration at the country cross-section level and calculate the correlation between domestic and foreign prudential

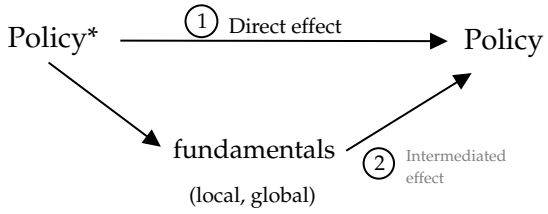
stances for all countries. We carry out these calculations and report the distribution of simple regression coefficients between the macroprudential policy stance of each economy and the rest of the world policies in Figure 17 in Appendix A. We find that the distribution of covariances concentrates around positive values although with a non-trivial mass around zero. Furthermore, at the country group level we obtain that the advanced and emerging countries display positive covariances values while the zero-valued coefficients are attributed to developing economies only (shown as "Other" in the figures). A similar analysis by sub-periods confirms the lack of a co-movement before the crisis, as the modal correlation is zero in every country group, while in the post-crisis sample the positive relationship between domestic and foreign policies for advanced and emerging economies is clearer.

In the sections that follow we will perform a more comprehensive empirical analysis of the cross-country relationship between these policies, but in a more comprehensive framework with adjustments for potential endogeneity of the ROW policies as well as more nuanced delimitations of the policy linkages (e.g., disentangling the effects for specific country or toolkit types).

3 Methodology and Empirical Strategy

Our objective consists in approximating the empirical policy-to-policy effects, that we also denote as "policy interactions" at the cross-border level. These refer to adittional domestic policy adjustments made in response to foreign policies developments that cannot be explained by observable fundamentals. The existence of these effects could imply that prudential regulators also act strategically when setting their policies. Conversely, the effect intermediated by fundamentals may also obey to international policy spillovers but can be consistent with strictly nationally oriented policies, for example, a local regulator may react to changes in fundamentals after these are affected by foreign regulations. Such change in domestic policies would be just an adjustment given some observed spillovers, but does not imply that local regulators are interacting purely in response—or in anticipation—to foreign policy changes.

Figure 3: Types of Foreign-to-Local Policy Effects



Note: the star denotes a foreign variable

We show these types of domestic policy adjustments in figure 3. Methodologically, we will filter out the Intermediated Effect with estimation controls. Then, we capture the remaining policy adjustments with a local projection approach. Crucially, we can see the effects on diagram in 3 only

flow towards the domestic economy. Implicitly, this assumes the foreign policy response we use to gauge the spillovers is exogenous and does not react to local policy changes. To support this assumption we use a narrative approach identification to isolate the foreign policy changes that can be deemed exogenous.

In the rest of this section we describe the data sources, the policy indicators, the construction of the rest-of-the-world policies, and the baseline setup used to obtain this interaction, and the identification strategy to remove sources of foreign policy endogeneity.

3.1 Data

We carry out our analysis based on quarterly data for 65 economies for the period 1999Q1 to 2021Q4. Our sample includes 23 advanced economies, 31 emerging economies and 11 low income economies, the list of countries can be seen in Table 3. Our database includes macroprudential policy variables, as well as economic and financial variables we use as controls in the estimations.

The macroprudential policies are obtained from the Integrated Macroprudential Policy Database (iMAPP) from the IMF and Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier, and Wang (2024). From this source we obtain the policy stance indicators for 17 policy tools and the level of the average Loan-to-Value for a subsample of 52 economies. We discuss the structure of the policy indicators and the specific instruments considered in the next subsection. On the other hand, we construct a measure of the Macroprudential policy of the rest of the world from the perspective of each economy. This variable will be calculated as the weighted average of the policy instruments of the countries, with weights given by the financial links between economies that we approximate using the investment portfolio flows in the Coordinated Portfolio Investment Survey from the IMF.

The economic and financial data used as controls is obtained from several sources, the GDP, CPI, capital flows, exchange rate, and monetary policy rate is obtained from the International Finance Statistics (IFS) from the IMF. The IFS is relatively imbalanced, then as a second step, missing data on credit and policy rates was obtained from the BIS statistics warehouse. Other missing data was obtained from Monnet and Puy (2019) that provide IFS consistent series for a large number of economies. Finally, in some remaining cases we replaced some additional missing data from national sources, such as central banks and statistics departments. Other variables considered were the Financial Development Index from the IMF Financial Development Database, and other global controls such as the CBOE VIX and TED spread were obtained from the St. Louis FRED.

We also adjust some monetary policy rates with zero lower bound issues by replacing them for their associated shadow rates that can take on negative values and are constructed to reflect changes in the monetary policy stance even at times where the official rate is fixed at zero. For the US, EU, and UK, we obtained the shadow rates from Wu and Xia (2016), and for Japan we obtain the rate from Krippner (2013). It should be noticed, nonetheless, that in more recent years these economies are no longer at the zero lower bound, and thus, by the end of the sample the shadow

rates just take on the same values as the original rates.

3.1.1 Macroprudential Policy Variables

We obtain a macroprudential policy stance measure from the Integrated Macroprudential Policy Database reported by the IMF (iMAPP) based on Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier, and Wang (2024). The data consists of policy indicators for 17 instruments (shown in table 1). For each tool and period an indicator is calculated according the policy change observed:

$$MaPP^{j}_{i,t} = \begin{cases} 1 & \text{if tightened} \\ 0 & \text{if unchanged} \\ -1 & \text{if loosened} \end{cases}, \text{ for instruments } j = \{1, 2, 3, \cdots, 17\} \text{ and country } i.$$

We aggregate the indexes through the available instruments and obtain the indicator of the average policy stance of each economy i at time t as: $MaPP_{i,t} = \sum_{j=1}^{17} MaPP^{j}_{i,t}$ This indicator will take values between -17 and 17 at each date depending on the invididual changes in each instrument. In that sense, and similar to the case of Fernández et al. (2015) for capital controls, this net tightenings indicator can be interpreted as a measure of the overall macroprudential of an economy with higher values indicating a stricter regulatory stance.

Now, although this measure accounts for the stance, it is still given in terms of policy changes, which implies that a policy stance adjustment (e.g., a tightening) would be reflected only for one period in the indicator and future values of the variable may fail to capture the posture of the prudential regulators. Because of that, a common practice in the literature (e.g. Richter et al., 2019; Coman and Lloyd, 2022) consists of using a rolling sum of this indicator. We do that as well and focus in the 4 quarter rolling sum, meaning that in each period our policy index accounts for the annual macroprudential policy stance (current and previous three quarters). Additionally we will focus on the change in the annual policy stances in our estimations as it could be argued that just as in the country group in Section 2, and suggested by the left panel of Figure 2, the annual indexes for some countries may be non-stationary for the whole sample period (or by subsamples).

This database is relatively recent and improves on previously available panel data on macroprudential policies at the coutry level. Before, the data available consisted of indicators on the number of instruments being used each period in an economy. In that sense, it was not possible to distinguish the policy stance, and instead, the policy indicator only accounted by the level of policy activity or a more limited number of tools (see for example Cerutti, Claessens, and Laeven, 2017). Similarly, other comprehensive macroprudential policy data has been produced, for example the Macroprudential Policies Evaluation Database (MaPPED) of the ECB that is reported in by the ECB and reported in Budnik and Kleibl (2018) that covers the life-cycle of the prudential interventions for the European Union. For the moment we choose to explore the iMAPP database due to its wider breath of countries covered but recognize that these other prudential data sources can offer

interesting venues for similar exercises as the ones we cover in this study.

The iMAPP dataset also provides the level for one of the tools, namely the Loan-to-Value requirement (LTV), for a smaller set of countries (52 out of our 65 countries sample). Data on the actual policy tool is more meaningful than the policy stance indicator, as it can also account for the intensity of the policy stance (tightening or loosening). However, the availability of this level policy data is still limited as the LTV only relates to regulations targeting borrowers rather than financial institutions. Because of this limitation we still mainly focus on the aggregate policy indicator (and some associated instruments classifications). However, we also estimate the model for the LTV requirement as an additional robustness exercise.

Table 1: Macroprudential policy instruments considered

Countercyclical Capital Buffer	Conservation Cap. Buffer	Capital Requirements
Limits to Leverage	Loan Loss Provision	Limits to Credit Growth
Loan Restrictions	Limits on Foreign Currency Lending	Debt Service to Income Ratio
Loan-to-Value Ratio (LTV)	Taxes	Liquidity Requirements
Loan-to-Deposit Ratio	Limits on FX positions	Reserve Requirements
SIFI (Too-big-to-fail institutions)	Other (e.g. stress testing, structural measures)	

3.1.2 Policy Indicator for the Rest of the World

As mentioned before, we want to exploit the cross-country variation of these policies rather than only analyzing the co-movement policy aggregates by type of economy. To do that, we must construct a policy indicator for the rest of the world that we can relate vis-a-vis with the policy indicator of each domestic economy, i.e. we should have a rest-of-the-world (ROW) indicator from the perspective of each country and at each period of time.

To achieve this we compute the policy of the ROW, labeled with "$-i$" and from the perspective of the domestic economy "i", as a weighted average of the policies of all other (than i) remaining countries:

$$MaPP_{-i,t} = \sum_{s \setminus i} \omega_{s,t} MaPP_{s,t}$$

Ideally the weights should reflect the financial links between economies, which we approximate based on data from the Coordinated Portfolio Investment Survey from the IMF as follows:

$$\omega_{s,t} = \frac{\text{Portfolio Investments of country } s \text{ on country } i \text{ at } t}{\text{Total foreign portfolio investments on country } i \text{ at period } t}$$

The survey provides the investment positions at an annual frequency since 2001 meaning we can update the financial weights every year in our sample. At the same time, for earlier years in our sample we use the weights of the first year available (2001).

3.2 Baseline estimation

We will use a Local Projection approach following Jordà (2005) to model the co-movement between the macroprudential policies in a panel estimation. Our baseline estimation follows closely the lag-distributed structure of Richter, Schularick, and Shim (2019) although our variable of interest is the macroprudential policy stance of a country i and the explanatory variable is the policy stance of the rest of the world:

$$\Delta_h MaPP_{i,t} = \alpha_i^{(h)} + \overbrace{\beta^{(h)} \Delta MaPP_{-i,t}}^{\text{foreign policies}} + \overbrace{\sum_{k=0}^{4} \phi_k^{(h)} X_{i,t-k}}^{\text{controls}} + \varepsilon_{i,t+h}$$

for $h = 1, \cdots, H$ and with $\Delta_h MaPP_{i,t} = MaPP_{i,t+h} - MaPP_{i,t}$ and where $MaPP_{i,t}$ denotes the macroprudential policy in country i and quarter t, α_i is a country effects term. Similarly, $MaPP_{-i,t}$ refers to the macroprudential policy stance in the rest of the world (ROW) from the perspective of country i.

Here, together with the controls, we also include lags of the domestic (dependent) and foreign (independent) policy variables as regressors. With this, not only we put a stringent bar for the model to pass when indicating the presence of international policy spillovers, but we also approximate the VAR structure this model could belong to but for our specific variable (and equation) of interest. At the same time, we can notice that the ROW policies appearing as regressors are not contemporaneous to the domestic policy variable. This is done, also in line with the literature, as a Cholesky-type of restriction to limit potential sources of endogeneity and indicate that domestic regulations would change in response to foreign changes with a lag.

As a very initial exploration, we use a basic fixed effects panel framework (i.e. $h = 1$) to test several control setups. The results of these regressions can be seen in table 2.

Clearly, this estimation can be subject to improvements, however for now we are just arriving to the combination of controls we use. We would like to include as many meaningful controls as possible without compromising our sample size too much. For that, we start with a estimation without controls and add controls by type and eventually opt for a structure similar to model 4. Our baseline, therefore, includes the following set of controls:

- *Domestic Economic Controls*: Real GDP growth, yoy CPI inflation, change in monetary policy rate (or shadow rate for zero lower bound cases)
- *Domestic Financial Controls*: Financial Development Index, annual depreciation of the nominal exchange rate.

We also explore the possibility of using global controls (global measures of growth, interest rates, volatility and credit spreads). However, given our interest is not to capture the domestic policy effects of global aggregate variables we opt out of this specification and instead include

Table 2: Baseline model of Macroprudential Interactions

Model for $\Delta MaPP_i$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta MaPP_{-i}$	0.173 ***	0.203 ***	0.203 ***	0.191 ***	0.183 ***	0.180 ***
	(0.038)	(0.043)	(0.043)	(0.042)	(0.044)	(0.044)
Domestic Economic Controls		Yes	Yes	Yes	Yes	Yes
Domestic Financial Controls			Yes	Yes		Yes
Global Controls				Yes	Yes	Yes
Extra Domestic Financial Controls					Yes	Yes
n	5590	4811	4811	4811	4557	4557
R^2	0.255	0.261	0.262	0.304	0.303	0.305
F	116.04	94.36	133.19	492.01	195.57	53177.22
P-value (F)	0.000	0.000	0.000	0.000	0.000	0.000
Number of countries	65	65	65	65	65	65

Note: The estimations in this table are a preliminary exploration that consider all foreign interventions, including those that can be potentially endogenous, and that are later removed in the identification step in our baseline. Our actual baseline, in contrast, follows the setup of equation (1). A table with analogous estimates for the baseline can be seen in Appendix B.

time fixed effects—given that at best the model with global controls would approximate what the time effects already capture perfectly. On the other hand, in our baseline estimations we include an additional improvement by replacing the foreign policies ($MaPP_{-i}$) with an exogenous policy measure based on our identification ($MaPP_{-i}^{(\text{exog})}$). With that, the baseline specification follows the setup in Equation (1).

All the variables are included in changes (first difference) unless a particular variation (e.g. annual) is mentioned above. We base the selection of controls on other empirical papers in the international finance literature such as Aizenman et al. (2016), Aizenman et al. (2020) and Richter et al. (2019). The approximation of global controls based on principal components is based on Aizenman et al. (2016). Additionally, we consider other potential controls (Extra Domestic Financial Controls in table 2) such as Credit-to-GDP, Capital inflows to GDP, as well as an additional estimation with the capital openness index of Chinn and Ito (2006). However, we decided against including additional controls beyond the listed above because of the high cost in terms of sample size —relative to the low improvement in fit— due to missing data (particularly in credit).

3.2.1 Identification Strategy, Endogeneity and Baseline Formulation

The initial specification above relates the domestic and foreign macroprudential policy indicators along with a set of controls. However, the effects it uncovers are still potentially affected by endogeneity. This occurs because, for some countries in our panel, it cannot be ruled out that some foreign policy changes are driven by the domestic prudential regulations. Because of this, and given our purpose is to uncover a causal response from local to foreign policy dynamics, an adjustment of the setup that leads to a proper identification of an exogenous foreign prudential stance is in order.

To fix this issue we identify a set of exogenous foreign macroprudential policy changes. For this we follow a narrative approach along similar lines as Richter et al. (2019). Here, the idea is to preclude the possibility of a foreign policy that changes due to domestic regulations. However, the challenge lies in the fact that the foreign policy itself is computed as a weighted average of the policy indicators of all countries in the sample, and since we argue that these policies can be interdependent across borders, the average of them could absorb part of these interlinks and become endogenous.

To filter out this type of endogeneity, we leverage on the presence of events that induce exogenous policy changes —i.e., that we can ensure are not motivated as a response to policy adjustments abroad. Specifically, we select the interventions motivated by either: (i) The adherence to Basel III; or (ii) The adjustment to the COVID-19 downturn. Critically, the iMAPP database reports a description for each policy change. Then, what we do is to retain the policy interventions with a description that relates them clearly to (i) or (ii). In contrast, we turn off (set to zero) the other interventions as we cannot ensure they are not endogenous. The result is a set of policy stances with which we create an exogenous foreign policy indicator $MaPP_{-i}^{(\text{exog})}$ that we use to instrumentalize the foreign policy in a local projection specification as below:[5]

$$\Delta_h MaPP_{\boldsymbol{i},t} = \alpha_i^{(h)} + \gamma_t^{(h)} + \beta^{(h)} \Delta MaPP_{\boldsymbol{-i,t}}^{(\text{exog})} + \overbrace{\sum_{k=0}^{4} \phi_k^{(h)} X_{i,t-k}}^{\text{domestic controls}} + \varepsilon_{i,t+h}, \tag{1}$$

for $h = 1, \cdots, H$, with $\Delta_h MaPP_{\boldsymbol{i},t} = MaPP_{i,t+h} - MaPP_{i,t}$, and α_i and γ_t denoting country and time dimension effects. Furthermore, for our exercises we pick $H = 12$.

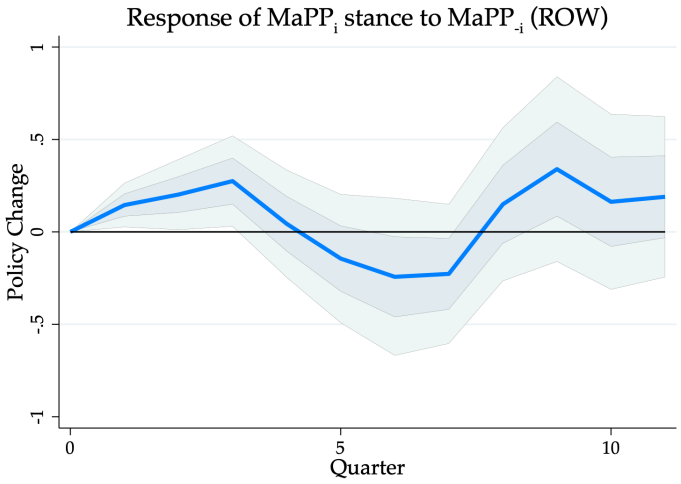
Here, $MaPP_{-i,t}^{(\text{exog})}$ is the identified exogenous ROW policy interventions which are constructed analogously to the ROW original indicator but only using the remaining policy interventions after filtering out the prudential changes that could be potentially exogenous. In addition, the controls are defined as mentioned above, and finally, the estimation also adjusts the errors using robust clustered errors at the country level. This level of clustering acknowledges that the country is the level at which the policies are implemented.

4 Results

We start by generating the Impulse Response Function (IRF) results for our baseline estimation in Figure 4. We also show a summary in Table 4 in Appendix B. The response suggests an average positive policy reaction in presence of a tightening enacted by the rest of the world (ROW), where the foreign country comprises every type of economy (emerging and advanced), and a policy indicator that aggregates the stance reflected in every instrument (17 tools in total).

[5] In Appendix D we provide additional details on the identification procedure for the iMAPP dataset including an account of the percentage of macroprudential interventions that remain after the potentially endogenous policies are filtered out.

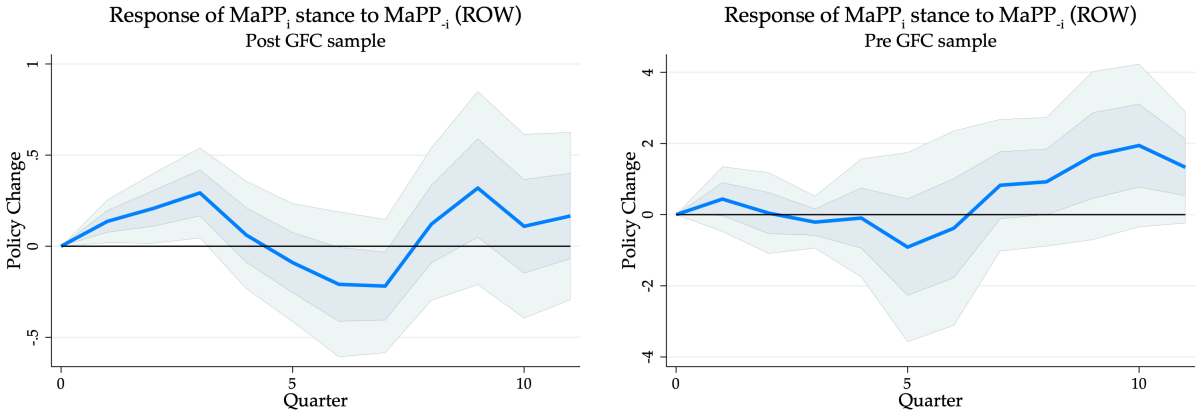
Figure 4: Response of Local MaP policies to policy changes in the rest of the world



Note: Impulse Response Function from a local projection based on equation 1. The MaPP indicator comprises the information for all the 17 instruments. Units: Policy Change (+1: tightenings, -1: loosening). Sample period: 1999Q1-2021Q4

The result indicates that there is a positive response, approximately equivalent to one quarter of a tightening. In other words, domestically, we would see a full macroprudential tightening in the presence of a four tightenigns abroad (e.g., a simultaneous tightening in four policy instruments). The positive response persists for several quarters which is expected given the nature of the policy indicator (annual accumulated macroprudential stance) that reflects any policy change during four quarters. Similarly, if we expect no further domestic reactions after about the fifth quarter, the IRF should go back to zero since the initial —and main— policy reaction would no longer be reflected in the annual (4 quarters sum) stance indicator by construction.

Figure 5: Response of Local MaP policies to policy changes in the rest of the world, after the global financial crisis (left panel) and before (right panel).

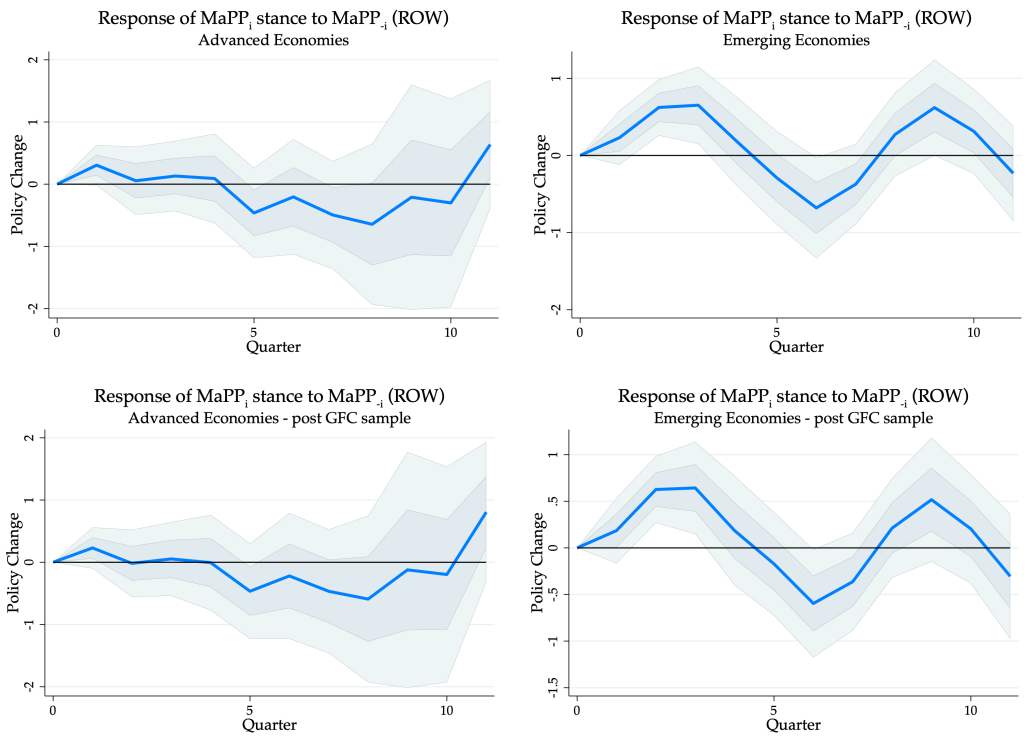


Note: the figure displays Impulse Response Function from a local projection based on equation 1. Where the MaPP indicator comprises the information for all the 17 instruments. Units: Policy Change (+1: tightenings, -1: loosening). Sample period: 2008Q4-2021Q4 (left panel), 1999Q1-2008Q3 (right panel) .

At the same time, we calculate this result on different estimations that consider the sub-periods after and before the Global Financial Crisis and show the result in figure 5. We see that the positive response is more representative of the post crisis period.

Similarly, it is plausible that the policy response implemented by advanced and emerging economies differ. To verify this, we compute the baseline estimation for subsamples considering only countries in each category (one model for 23 advanced economies and another for 32 emerging). The results are shown in figure 6. In this case, we see that the positive overall policy reaction is more resembling of the regulators' behavior in emerging economies while, in contrast, those in advanced economies are not reacting to macroprudential tightenings abroad. This results does not come as a surprise, and instead is consistent with the notion that the cost of relinquishing their policy autonomy (e.g., by following centralized policy recomendations) is higher for advanced economies as documented by di Giovanni and Shambaugh (2008) for fixed exchange rate regimes. The interpretation is similar as before, a policy tightening abroad is followed by domestic tightening adjustments but here we also see that this effect takes place only in emerging economies. The effects are also stronger after the Global Financial Crisis.[6]

Figure 6: Response of MaP policies to policy changes in the rest of the world. Model for Advanced Economies (left panel) and for Emerging Economies (right panel).



Note: the figure displays Impulse Response Function from a local projection based on equation 1. Where the MaPP indicator comprises the information for all the 17 instruments. Left panel: estimation for Advanced Economies (complete sample and post-GFC sample), Right panel: estimation for Emerging Economies (all sample and post-GFC sample). Units: Policy Change (+1: tightenings, -1: loosening). Sample periods: complete sample: 1999Q4-2018Q4, post-GFC sample: 2008Q4-2018Q4.

[6]For additional local projection results not shown here see the appendix B.

Notice, we are making conservative statements about these effects. That is the case because this result corresponds only to the average effect across all instruments and in presence of a policy action taken by an aggregation all types of countries in the ROW. Thus, it is worthy to examine if this average result describes the nature of the policy interactions between countries when tracking down the ROW policy interventions to more specific sources (e.g., by type of foreign economy enacting policies, or by type of intervention or instruments being used).

4.1 Effects by origin of the ROW policies

To understand the origin of the relevant policy actions abroad for the domestic policy stance we perform an estimation where we split the foreign or ROW policies as follows,

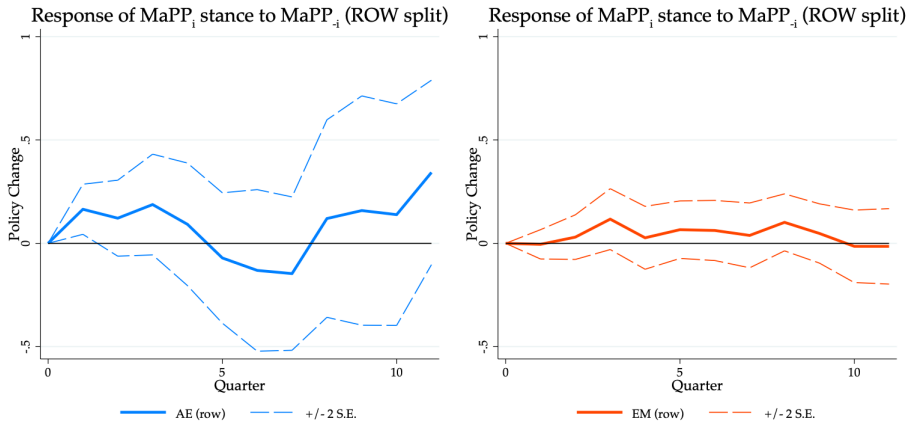
$$MaPP_{i,t+h} - MaPP_{i,t} = \alpha_i^{(h)} + \gamma_t^{(h)} + \beta_1^{(h)} \Delta MaPP_{-i,t}^{AE} + \beta_2^{(h)} \Delta MaPP_{-i,t}^{EM} + \sum_{k=0}^{4} \phi_k^{(h)} X_{i,t-k} + \varepsilon_{i,t+h} \tag{2}$$

where $MaPP_{-i}$ denotes the ROW policy with respect to country i as before and also makes reference to the exogenous foreign policy based on our narrative identification but where, for simplicity, we removed the super index used before (indicating the identification adjustment). We retain this simplification for the remaining expressions in further sections.

The coefficients $\beta_1^{(h)}$ and $\beta_2^{(h)}$ represent the IRF for periods $h = 1, \cdots, H$, to the policy changes implemented in the ROW by advanced economies and emerging, respectively. As with the foreign policy indicator for the totality of the ROW, we construct each policy indicator by taking a weighted average of the policy actions of each group of economies, and analogously, the weights are based on the bilateral portfolio investment positions (as a total of the investments of each group of economies). The estimation procedure and controls used are identical to the baseline specification.

The associated responses can be seen in Figure 7. We can see that the foreign policy actions prompting a domestic policy response are mainly those of the advanced economies (AE). In contrast, the average domestic country is not reacting to the policies enacted in emerging economies. Similarly, the result of models for emerging economies (shown in Figure 8) point a similar conclusion. Emerging countries' regulators are reacting mostly to the policies implemented in advanced economies. Although in that case there are some signs of weaker, but significant reactions to policies implemented in other emerging economies. For example, we can see that the response to foreign advanced economies' policies is that of half a tightening and persists for several quarters while, in contrast, the response to emerging economies' interventions is at most a fifth of a tightening and it doesn't persist beyond a single period.

Figure 7: Response of MaP policies to policy changes in the rest of the world. Model for all economies.

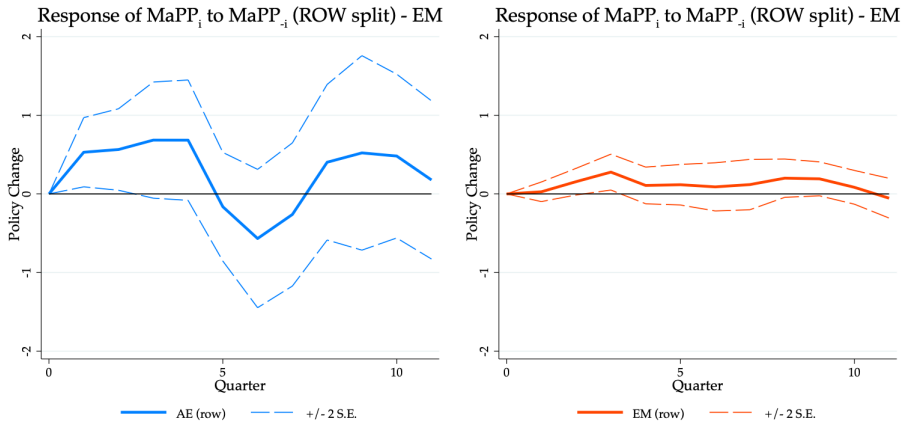


Note: the figure displays the Impulse Response Function from a local projection based on equation (2). Where the MaPP indicator comprises the information for all the 17 instruments. Left panel: Domestic Response to Change in Foreign policy in Advanced Economies, Right panel: Domestic Response to Change in Foreign policy in Emerging Economies. Units: Policy Change (+1: tightenings, -1: loosening). Sample period: 1999Q4-2021Q4

As for the intuition behind this response, there are several hypotheses we can formulate. On one hand, a tightening abroad, i.e., stricter foreign banking regulations will likely elicit an regulation arbitrage effort by banks with cross-border activities (or balance sheet links) looking to circunvent the new (and more constraining) policy stipulations. That intuition aligns with the findings of Aiyar, Calomiris, and Wieladek (2014), and is consistent with the global nature of the banking business and the difficulties it implies for policymakers attempting to enforce a regulation at the local economy level. In this case, the policy abroad may have destabilizing financial stability domestic effects as more intermediaries (banks) might try to increase the scale of their activities to compensate for the hindered activities in foreign locations. The local regulators will aknowledge this and tighten their own policies to prevent it.

Another complementary interpretation to this story relates to the dynamics of the international portfolio flows. These investment flows can be destabilizing and sometimes an economy is interested in repelling them (and prioritize more stable flows such as FDI). It is also plausible, that a country repelling these flows abroad may imply a higher threat for the domestic economy that may try to implement a tightening to shield itself from a potential intake of these flows and the waves of the global financial cycle.

Figure 8: Response of MaP policies to policy changes in the rest of the world. Model for Emerging Economies.



Note: the figure displays the Impulse Response Function from a local projection based on equation (2). Where the MaPP indicator comprises the information for all the 17 instruments. Left: EM policy response to Foreign AE policies; Right: EM policy response to Foreign EM policies. Units: Policy Change (+1: tightenings, -1: loosening). Sample period: 1999Q4-2021Q4

4.2 Effects by Type of Intervention

So far we have analyzed the average domestic policy reaction of an economy in the presence of any foreign macroprudential policy changes. This consists of the local policy response to foreign interventions measured in an aggregate across all 17 policy instruments and for both tightening and loosening adjustments. However, we can also think about the presence of different effects by type of intervention —tightenigns or loosenings— in a similar line as Richter, Schularick, and Shim (2019), or Jordà, Singh, and Taylor (2020). To that effect, we perform our baseline estimation as in Equation (1) (model for all economies) in separate models that consider only tightening or loosening interventions respectively.

The specific estimation equation we consider for separate tightenigns and loosenings is,

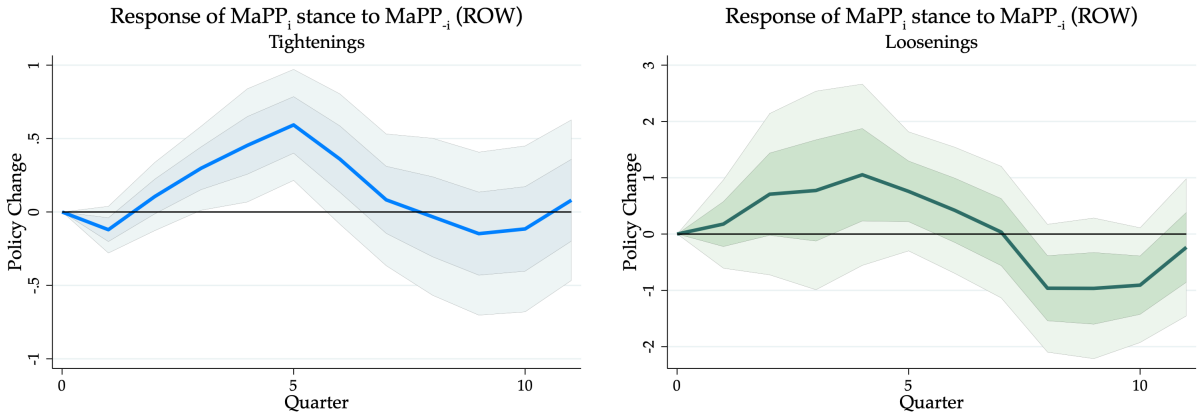
$$\Delta MaPP_{i,t+h} = \alpha_i^{(h)} + \gamma_t^{(h)} + \beta_1^{(h)} \Delta MaPP_{-i,t}^{Tightenings} + \beta_2^{(h)} \Delta MaPP_{-i,t}^{Loosenings} + \sum_{k=0}^{4} \phi_k^{(h)} X_{i,t-k} + \varepsilon_{i,t+h} \tag{3}$$

In this case each foreign policy indicator will take values of 1 if there was a policy change in the direction indicated by the respective superscript (tightening or loosening) or zero otherwise. Additionally, for each indicator we consider the whole toolkit (17 instruments).

The results are reported in Figure 9 and indicate that the policy interactions only take place for tightening policy changes and not for loosening adjustments. To disentangle the effect further we split the origin of the ROW interventions by type of origin economy and compute the local policy responses. The results, shown in Figure 10, indicate —as in our baseline estimation—that only

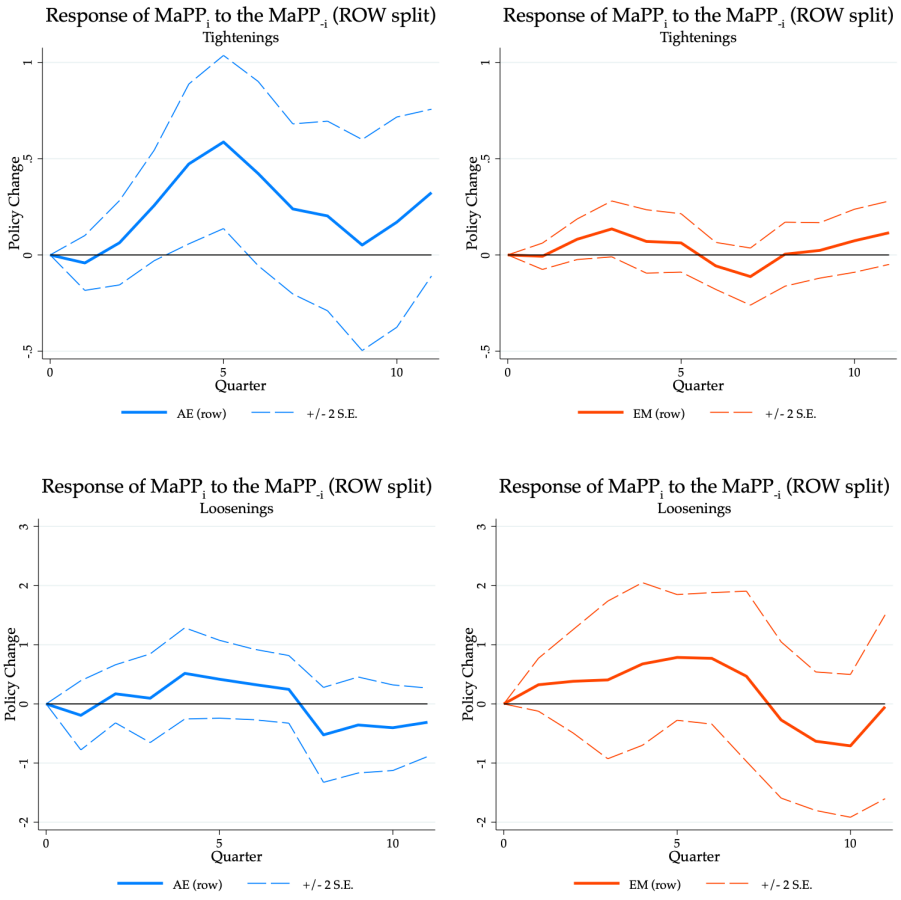
the policies in advanced economies prompt domestic policy reactions. This result is similar to the one found in Richter et al. (2019) when studying the macroeconomic costs of the macroprudential policies. The loosenings, on the other hand, don't seem to generate policy interactions.

Figure 9: Response of domestic MaP policies to policy changes in the Rest Of the World. Response to Tightenings and Loosening interventions.



Note: the figure displays the Impulse Response Function from a local projection based on equation (1) for tightenings and loosening interventions. The foreign MaPP indicator includes Tightenings (response shown in left panel) and Loosenings (right panel) separately as explanatory variables. Units: Policy stance change. Unlike the rest of the estimates, loosenigns are here recorded in absolute value (+1 in lower panels indicate looser regulations). Sample period: 1999Q4-2021Q4.

Figure 10: Response of domestic MaP policies to prudential tightenings and loosenings policy changes in the rest of the world by type of foreign country regulation. Model for all countries.



Note: The figure displays the Impulse Response Function from a local projection based on equation (2). Where the MaPP indicator comprises the information for all the 17 instruments. Top, left: Policy response to foreign AE tightenings; Top, right: Policy response to foreign EM tightenings; Bottom, left: Policy response to foreign AE loosenings; Top, right: EM policy response to Foreign EM loosenings. Units: Policy change. Unlike the rest of the estimates, loosenigns are here recorded in absolute value (+1 in lower panels indicate looser regulations). Sample period: 1999Q4-2021Q4

4.2.1 Effects by Target of Regulations: Borrower and Lender Related Instruments

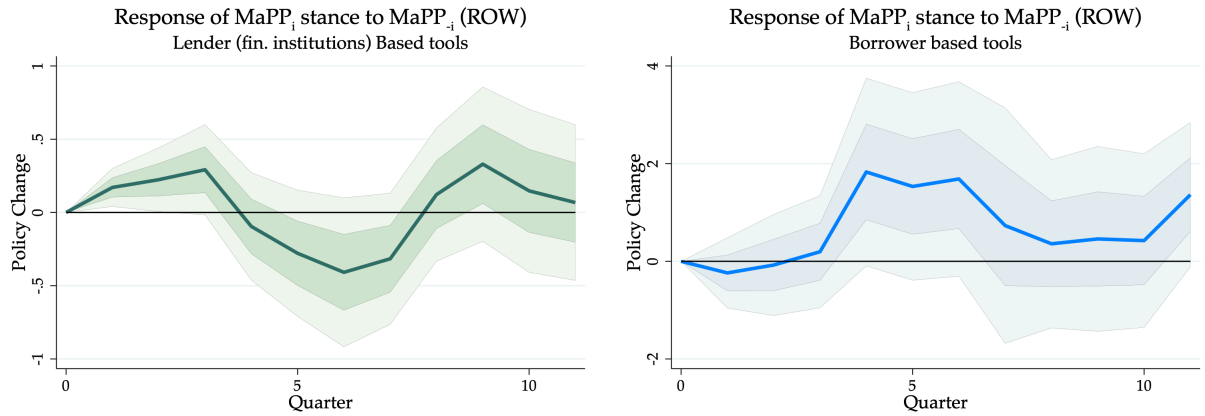
We can also inquire whether the effect differs across tools that aim different agents by dividing the policy stance variable into two separate variables, one considering only borrowers' based tool and a second comprising tools that target lenders (financial institutions). This classification of the interventions is also similar to the one in Cerutti et al. (2017), and will consider as a first index $MaPP^{Borrow}_{-i,t}$ which is an aggregate of the the Loan-to-Value and Debt Service-to-Income ratio (LTV, DSTI), and $MaPP^{Lender}_{-i,t}$ as an aggregate of the stance captured by the rest of the toolkit —that

mostly targets financial institutions. To find these responses we estimate the following equation:

$$\Delta MaPP_{i,t+h} = \alpha_i^{(h)} + \gamma_t^{(h)} + \beta_1^{(h)} \Delta MaPP_{-i,t}^{Borrow} + \beta_2^{(h)} \Delta MaPP_{-i,t}^{Lender} + \sum_{k=0}^{4} \phi_k^{(h)} X_{i,t-k} + \varepsilon_{i,t+h} \tag{4}$$

The policy response to each type of policy action is shown in the figure 11. In the left panel we see the domestic policy reaction to a tightening in the foreign borrower targeted tools. This reaction is positive and is implemented one quarter after the ROW policy adjustments, and amounts to approximately a quarter of a tightening. In that sense, the response is similar to what we found on average for the aggregate prudential stance indicator. On the other hand, the response to borrower based tools is null as shown in the right panel. Indicating that the domestic policy reactions are seemingly explained by regulations affecting financial institutions only. This finding is aligned with the intuition that it financial intermediaries are the agents capable of circumventing prudential regulations, and thus, those that generate financial stability concerns to regulators.

Figure 11: Response of MaP policies to policy changes in the Rest Of the World. Response to Lender instruments (left panel) and to Borrower based policies (right panel).



Note: the figure displays the Impulse Response Function from a local projection based on equation (4). The foreign MaPP indicator includes Borrower tools (response shown in left panel) and Lender tools (right panel) separately as explanatory variables. Units: Policy Change (+1: tightenings, -1: loosening). Sample period: 1999Q4-20214Q4.

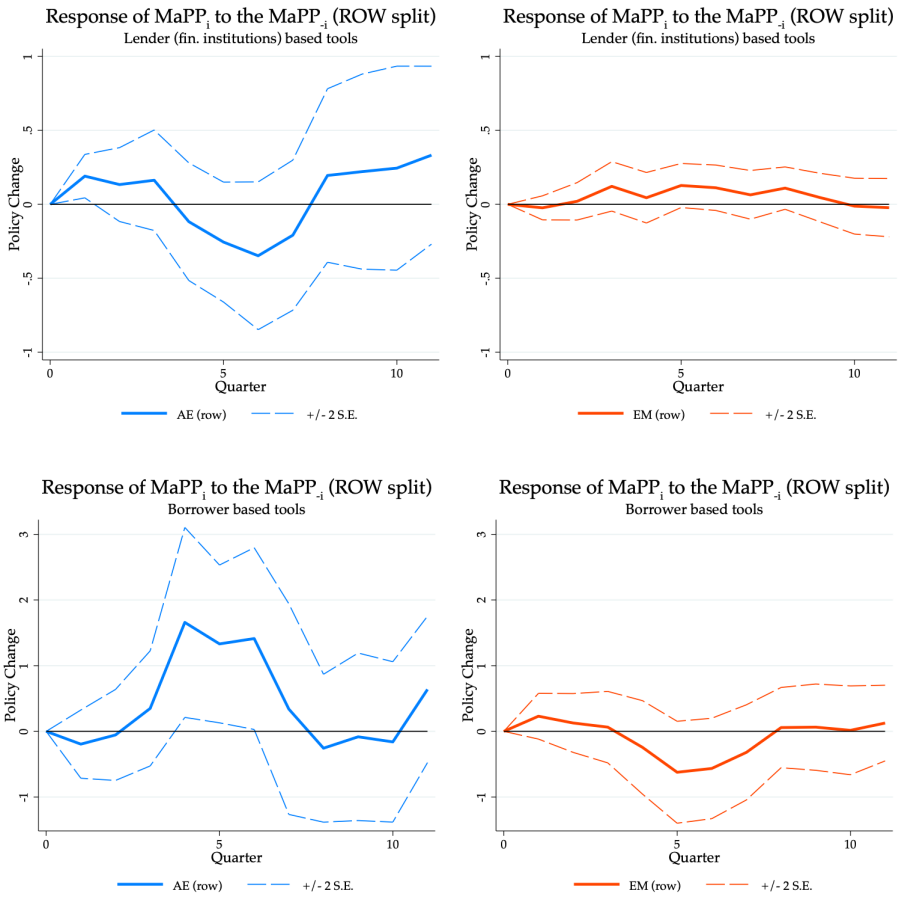
Similar to the case of the aggregate policy before (with all the tools), we can split the effects by origin of foreign country interventions. In that case we carry out an estimation based on the following equation,

$$\Delta MaPP_{i,t+h} = \alpha_i^{(h)} + \gamma_t^{(h)} + \beta_1^{(h)} \Delta MaPP_{-i,t}^{Borrow,AE} + \beta_2^{(h)} \Delta MaPP_{-i,t}^{Lender,AE} + \beta_3^{(h)} \Delta MaPP_{-i,t}^{Borrow,EM} + \beta_4^{(h)} \Delta MaPP_{-i,t}^{Lender,EM} + \sum_{k=0}^{4} \phi_k^{(h)} X_{i,t-k} + \varepsilon_{i,t+h} \tag{5}$$

Figure 12 shows response for this estimation. We can see that the initial positive reaction docu-

mented before is related to changes in lender-targeted instruments in advanced economies. Interestingly, we also see signs of a delayed reaction to borrower tools changes in advanced economies, that although not quite aligned with the result in the model pooling all foreign regulators, now becomes significant once we separate the foreign advanced and emerging policy effects. Finally, and as ubiquitous so far, there are no significant domestic policy reactions to foreign policy changes in advanced economies.

Figure 12: Response of MaP policies to policy changes in the rest of the world. Model for All countries.



Note: the figure displays the Impulse Response Function from a local projection based on equation (2). Where the MaPP indicator comprises the information for all the 17 instruments. Top, left: AE policy response to Foreign AE policies; Top, right: AE policy response to Foreign EM policies; Bottom, left: EM policy response to Foreign AE policies; Top, right: EM policy response to Foreign EM policies. Units: Policy Change (+1: tightenings, -1: loosening). Sample period: 1999Q4-2021Q4

In a nutshell, the positive policy reactions manifest only after prudential interventions in advanced economies with the initial reaction —characterizing most results, including the baseline— occurring for lender based tools and a subsequent one arising for borrower-targeted interventions. Similarly, when performing separate estimations for country groups, we obtain that there are significant responses by emerging economies in line with previous results. However, a caveat to note is that there is a substantial increase in uncertainty when the estimates imply to simultaneously drop countries information (e.g., advanced and developing if estimating the model for emerging

economies), splitting the toolkit by categories of instruments, and separating the origin of foreign policies, which generates results that seem less clear-cut than those with only toolkit or origin distinct effects but where the information of all 65 economies is used as an input.

4.2.2 Further disaggregations of the instruments: Capital, Assets, and Liquidity based tools

It can be argued that previous effects' implied classifications are still to broad and comprise too many instrument within some effects' categories (e.g., the lender category aggregates 15 policy instruments). In that vein, it could be revealing to disentangle further the effects of foreign policies that target the financial institutions. With that in mind, we analize a second classification proposed by Cabral, Detken, Fell, Henry, Hiebert, Kapadia, Pires, Salleo, Constâncio, and Nicoletti Altimari (2019) (ECB) and the BIS (2012). In this case, Capital related tools are pooled in a first category and are meant to capture interventions that affect the resiliency of the financial sector; in addition we consider the Asset-side tools that, instead, are related to the Global Financial Cycle and asset prices fluctuations, and finally, as a third category, we consider Liquidity and Foreign Currency related instruments, which are meant to help mitigate the liquidity and insolvency risk (in local or foreign currency). More specifically, the classification is given —in terms of the individual tools in our dataset—as follows:

> **Capital**: Counter-Cyclical Capital Buffer, Capital Conservation Buffer, Capital Requirements, Leverage Limits, Loan Loss Provissions, SIFI (large banks specific regulations).
>
> **Asset-side**: Limits on Credit Growth, Loan Restrictions, Loan-To-Value ratio (LTV), Debt Service-To-Income ratio (DSTI), Tax based tools.
>
> **Liquidity and Foreign Currency**: Liquidity Requirements, Limits on Loan-to-Deposit ratio, Limits on Foreign Exchange Positions, Limits on Foreign Currency Lending, Reserve Requirements.

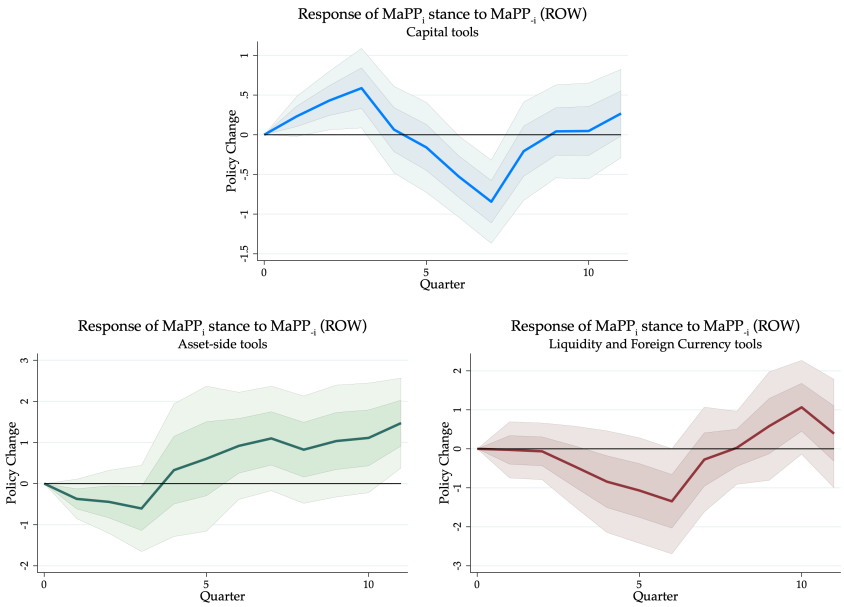
The estimation we consider to study this classification is the following:

$$\Delta MaPP_{i,t+h} = \alpha_i^{(h)} + \gamma_t^{(h)} + \beta_1^{(h)} \Delta MaPP_{-i,t-1}^{\text{Capital}} + \beta_2^{(h)} \Delta MaPP_{-i,t-1}^{\text{Asset}} + \beta_3^{(h)} \Delta MaPP_{-i,t-1}^{\text{Liquidity}} + \sum_{k=0}^{4} \phi_k^{(h)} X_{i,t-k} + \varepsilon_{i,t+h}, \tag{6}$$

for $h = 1, \cdots, H$ and $\Delta MaPP_{i,t+h} = MaPP_{t+h} - MaPP_t$.

The first two types of tools target risks that have been well identified since Basel I, while the liquidity tools target a source of risk that became relevant after the onset of the Global Financial Crisis. At the same time, the Asset-type tools relate to credit, income, and asset prices, and hence, are associated to the global financial cycle. The dynamic domestic response to foreign policy changes in each of these type of tools is estimated based on the equation (6).

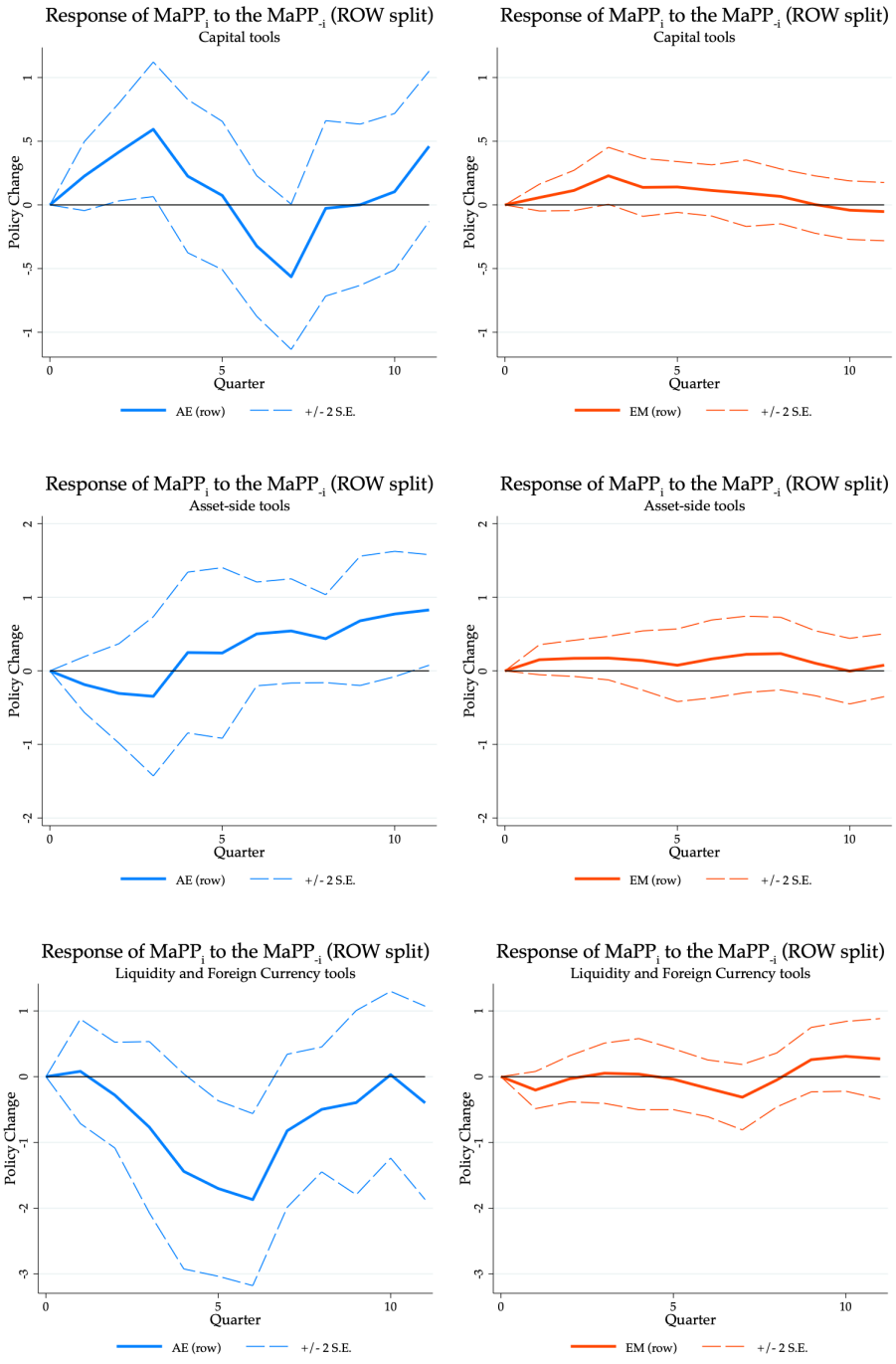
Figure 13: Response of MaP policies to policy changes in the Rest Of the World. Response to Capital instruments, Asset, and to Liquidity and FX flows based policies.



Note: the figure displays the Impulse Response Function from a local projection based on Equation (6). The foreign MaPP indicator includes Capital tools (response shown in top panel), Asset-side tools (bottom, left), and Liquidity and Foreign Currency tools (bottom, right) separately as explanatory variables. Units: Policy Change (+1: tightenings, -1: loosening). Sample period: 1999Q4-2021Q4.

We show the results in Figure 13. First, it is difficult to interpret the response to capital tools' changes as it displays opposing signs at different horizons. We argue this is related to the blending (or averaging) of the responses for different types of economies. This is the reason why we analyze subsamples of countries in the estimations that follow. On the other hand, the response to foreign changes in asset-side tools and is positive but delayed. Finally, and perhaps more surprisingly, the response to liquidity tools, in contrast with the rest of estimates until now, is negative. The latter response is not significant when we pool all types of countries in our ROW policy definition, but again, after splitting the ROW interventions between advanced and emerging economies, we can obtain significant domestic policy effects to the interventions enacted in advanced economies for either category. The domestic responses —by all countries, or in an estimation for all economies in the sample— with separated ROW policies stemming from advanced and emerging economies are depicted in Figure 14. We can see in the figure that the positive response we document in most estimations is more strongly associated to the capital related tools' interventions by advanced economies. On the other hand, the responses to emerging policies are null in all cases, confirming that, on average, there are not substantial policy interactions in response to emerging economies' regulations.

Figure 14: Response of MaP policies to policy changes in the rest of the world. Model for All countries.



Note: the figure displays the Impulse Response Function from a local projection based on Equation (6) but with the ROW policies split by origin as in Equation (2). Top, left: Policy response to foreign AE Capital tools' policies; Top, right: Policy response to foreign EM Capital tools' policies; Middle, right: Policy response to foreign AE Asset-side tools' policies. Middle, left: Policy response to foreign EM Asset-side tools' policies. Bottom, left: Policy response to Foreign AE Liquidity and Foreign Currency related policies; Bottom, right: Policy response to Foreign EM Liquidity and Foreign Currency related policies. Units: Policy Change (+1: tightenings, -1: loosening). Sample period: 1999Q4-2021Q4

At the same time, the negative response in liquidity tools' interventions in advanced economies

may indicate potential policy free-riding incentives for other economies that, perceiving a beneficial policy leakage, can find the scope to relax their toolkit, mitigating the costs of implementing active regulations. This is an interesting finding, as in in principle, it might indicate that emerging regulators internalize potential positive spillovers from the stricter liquidity-related policies in financial centers that could allow them to relax their own policy stance. This aligns with the findings of Tripathy (2020), where policy effects targeting banks in the Spanish financial sector eventually leaked to the Mexican financial sector through Spanish banks' franchises (e.g. BBVA) operating in Mexico, thereby generating financial stability gains outside the intended scope of the original regulation.

Finally, we note that similar to most of our results, in this case the policy reactions are driven by post-GFC effects. Elaborating further, when we estimate these results by sub-periods (after and before the 2008 financial crisis) we obtain that the documented significant responses are significant only in the post-crisis estimations.[7]

4.3 Robustness Exercises

We verify the robustness of the results in the previous sections with a number of additional estimations. The alternative estimations we consider explore changing the toolkit categories, the specification setup, and an estimation —for an individual policy tool with level information available— that accounts for the intensity of the policy stance.[8]

4.3.1 Changes in the specification setup

We verify the presence of these effects in alternative specifications that change features of our baseline specification. For this we changed one or more features of our baseline and alternated them with the following ones:

Global Controls: We change the baseline estimation equation by removing the time effects and replace them with global controls. The results are qualitatively similar. However, the estimations with global controls now point to significant policy interactions at several horizons that even resemble consecutive tightenings in repsonse to a single policy intervention abroad. We, however, prefer to be conservative —or stricter— when suggesting a cross-border policy-to-policy effect since the ones seemingly heightened by dropping the time effects might still be generated by additional global variables that our controls abstract from. In addition, using global variables also implies a non-trivial cost in terms of missing observations, which also motivate our choice to retain our specification with time effects as the baseline.

IV regressions: Although we do not need to fit an exogenous ROW policy given we are already filtering out from the original policies the interventions that are not related to exogenous events

[7] Some additional responses for models with the ROW split in advanced and emerging economies are shown in Appendix B.

[8] All the alternative estimations local projections are available upon request.

(Basel accords implementations and responses to the COVID episode) we stilll could alternatively consider a two-stages regression setup where we fit the original policy data as a function of the one we identified. In this case, all our baseline results hold. However, we note that the IV estimator induces an increase in the uncertainty given that the exogenous policy used as instrument already implies an substantial policy information loss. Given this setup generates the same qualitative responses, but only with heightened uncertainty given the additional estimation stage we retain our baseline with no auxiliary regression (but with an identified foreign policy).

Removal of lagged ROW policies: Our setup is a lag distributed approach that aims to encompass the VAR structure the equation of interest would have if we used a multivariate method as opposed to the local projections. This setup follows the tradition of empirical studies in international finance such as Kalemli-Ozcan (2019) and Coman and Lloyd (2022). However, we can also omit the lags of foreign policy regressions as an experiment. In this case all the results hold qualitatively. We still retain the lags in our baseline to be more conservative (or stringent) when indicating policy interaction effects.

4.3.2 Additional Instrument classifications

We also consider alternative instruments classifications to complement the results of the main categories covered before (by type of intervention, by target of regulation, and by type of risk mitigated —capital, asset, liquidity). To begin, we check whether cyclical concerns could be relevant for regulatory interactions concerns in emerging economies by analyzing a classification by phase of cycle objective along the lines of Claessens et al. (2013). The idea is that a "resilience" is related to enhancing resilience at all cycle phases, while another category "cycle" is aimed to dampening the cycle. The instruments included in each category are:

Resilience tools: Countercyclical Capital Buffer, Conservation Cap. Buffer, Leverage Limits, Loan Loss Provission, Liquidity Requirements.

Cycle aimed tools: Limits to Credit Growth, Loan Restrictions, Limits on Foreign Currency, Loan-to-Value, Debt Service to Income Ratio, Loan-to-Deposit Ratio, Limits on FX positions, Reserve Requirements, Tax.

We obtain that domestic policy adjustments (interactions) only follow after foreign resilience tools policy changes. As in our baseline, the interactions will manifest mostly for estimations for all countries, and for emerging economies. This implies that we find no evidence of strong cyclical responses and confirm that the reactive regulators are based mainly in emerging economies. Furthermore, we also confirm that the reactions take place mainly in response to policy changes in advanced economies.

On the other hand, we analyze the policy interactions at the individual instrument level or for other more specific categories involving fewer instruments compared to the baseline and main classifications (e.g., reserves requirements or tax related policies). However, when studying to

specific categories that are related to only one or two instruments within the toolkit that the estimates become subject to substantial uncertainty which prevents obtaining clear-cut results (relative to our baseline). In this case, although some uncertainty is naturally explained by the sporadic nature of the interventions, it is also amplified —at the individual instrument level— by the removal of information implies by our identification scheme.

4.3.3 Accounting the Intensity of the Policy Changes

There have been improvements in terms of the availability, coverage, and informativeness of the macroprudential policies data at the cross-country level. To make an idea of this, some years ago the data available, and used by some studies such as Cerutti et al. (2017) consisted on indicator variables denoting only the use of a policy instruments rather than the policy stance. Additionally, the number of tools available (only 12), and countries with information were lower too. This changed with the contribution of Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier, and Wang (2024) (iMAPP database). We have certainly benefited form this new database that generated instruments and country specific indicators capturing the policy stance (tightenings or loosenings of tools). However, as Richter, Schularick, and Shim (2019) mention, these policy indicators still fail to capture the intensity of the policy change. That is, in the "stance" indicator used until now, a small or a substantial increase in the capital requirements yields the same value of the policy variable. This is certainly a shortcoming of the available data. Notwithstanding, the integrated database we use tries to fill this void by generating data on the Loan-to-Value ratio for a smaller number of economies (52 out of the 65 in our sample). We use this information and repeated our exercise. The baseline estimation is similar to (1) but now the policy variables on the equation is the LTV ratio.

The results are similar but not as conclusive as those reported in previous sections. We obtain a similar positive cross-country complementarity effects in presence of foreign tigthenings using the full sample. However, unlike in the rest of our exercises, the same outcome may fail to appear in subsamples (by periods, or when splitting the rest of the world policies). We see this as an issue generated by the data limitation for instrument specific (individual) interventions as discussed before. Perhaps, if the same type of variable would be available for more instruments and countries we could use the actual level for our baseline exercises rather than the indicators. However, for now we consider more appropriately to retain the conventional approach and use the indicator. On the other hand, it should be noted that even if the outcome of this intensity-inclusive estimation is consistent with our primary results, the extent of support it provides is still relatively limited as this instrument-level information is only related tothe borrower related policies and abstracts from most ofthe prudential toolkit.

5 Policy Implications and Scope for Coordination

We found a number or results suggesting the presence of cross-border policy-to-policy spillovers, or policy interactions. In a nutshell, on average we obtain that domestic regulators react to their

foreign advanced counterparts, usually moving in the same direction as the policy change abroad. Similarly, we find that the emerging economies' regulators are the ones adjusting their instruments to ROW policy changes while advanced economies are not reacting much to foreign regulations. At the same time, these stylized facts hold more strongly for certain types of interventions (tightenings) and instruments' categories and may indicate the presence of concerns on the part of financial regulators in emerging economies about the existence of international macroprudential policy leakages. Ultimately, these results talk to the way in which regulators may internalize the actions of their foreign counterparts.

A related question, given these policy interactions, is whether multilateral or international policy cooperation efforts are worth pursuing.[9] Similarly, a key concern for emerging economies evaluating whether to coordinate their policies at the regional level is the potential for retaliative actions by regulators in too influential, usually advanced, economies.[10] Our findings suggest that such type of responses by advanced economies' regulators is not likely as these seem less reactive to foreign macroprudential regulations and instead stick to "keep their house in order." This, may indicate an increased scope for cooperation between macroprudential regulators in emerging economies which may coordinate their policy stances without fearing regulation. Finally, for the latter countries the types of regulations with higher coordination potential seem to be those targeting financial institutions (as opposed to borrowers) and within these, the policies related to capital requirements and liquidity controls.

6 Conclusions

We study the empirical policy interactions between macroprudential regulators at the cross-country level. Our objective is to determine whether regulators set their policies with strategic considerations in mind after internalizing the spillovers of foreign regulations in their economies, and not only as a function of local and global economic conditions. For that purpose, we exploit a recently available dataset on instrument-specific policy stance indicators in a panel of 65 economies. By using data on investment flows and a narrative identification approach on the prudential policy dataset, we generate an exogenous indicator of the policy stance of the rest of the world from the perspective of each economy and verify the presence of cross-border interactions using a panel local projection approach.

Our findings suggest that domestic regulators do react in response to foreign policy changes, and on average will tighten their policy instruments after witnessing a prudential tightening abroad. We also find that this behavior has gained traction after the onset of the Global Financial Crisis.

[9] Although the literature on international policy cooperation is rooted more strongly for monetary policy (Obstfeld and Rogoff (2002); Canzoneri et al. (2005); Bodenstein et al. (2024)), this type of question is also explored for macroprudential policies in several papers, some explaining the necessary conditions for welfare gains of coordination (Korinek, 2020) and others gauging these gains in varied environments (e.g., Davis and Devereux, 2022; Kara, 2016; Bengui, 2014)

[10] See Jin and Shen (2020) for a framework where emerging economies engage in cooperation with a non-retaliative center and Granados (2021) for a study where the advance economy can retaliate.

However, this policy reactions are characteristic of the regulators in emerging economies only. Similarly, the foreign policies that prompt this type of interactions are mainly the ones enacted in advanced economies. The policies in advanced economies, in contrast, do not seem reactive to the macroprudential policy changes enacted abroad. On the other hand, we disentangle further the interactions and find that they take place after policy tightenings (and not loosenings), which together with the reactiveness of emerging economies aligns closely with the results of Richter et al. (2019) when analyzing the macroeconomic costs of macroprudential policy. Furthermore, we also find that the type of instruments prompting the cross-border policy effects are those targeting financial intermediaries and among these, the tools related to capital requirements and liquidity controls.

Now, we also note that an important caveat applies for this study; namely, the sporadic nature of the macroprudential interventions, coupled with our identification approach, which implies dropping policy information from the dataset, will boost the uncertainty of our estimates, particularly at the individual instrument level. We see this as the trade-off of the endogeneity adjustment. As a result, analyses at a very specific category of the toolkit can become unreliable. This is the reason why we keep our intepretations, as most studies do, at the toolkit level or at a broad level of aggregation for most exercises.

As for the interpretability and implications of our results, we have that a positive reaction (tightenings vis-à-vis a foreign tightening) can be thought of as a policy competition effort where local regulators implement stricter policies to protect their local markets from arbitrage by financial intermediaries looking to circumvent the foreign regulations (by expanding their business in other locations), while a negative reaction —displayed in some fewer cases— is more resembling of a policy substitution effort where domestic planners rely on foreign policy changes for stabilizing purposes, thereby finding the scope for implementing policy relaxations. From a normative perspective, the presence of policy interdependency on either direction (competition or substitution) could increase the scope for an internationally coordinated policy design effort with similar features as the Basel accords and other multilateral policy guidelines. The empirical results in this paper are indicative of non-trivial spillovers that can support such type of initiative. Finally, are more data at the instrument level becomes available an even more comprehensive account for the interactions, that accounts for the intensity of the policy stance, can be a promising venue for future research.

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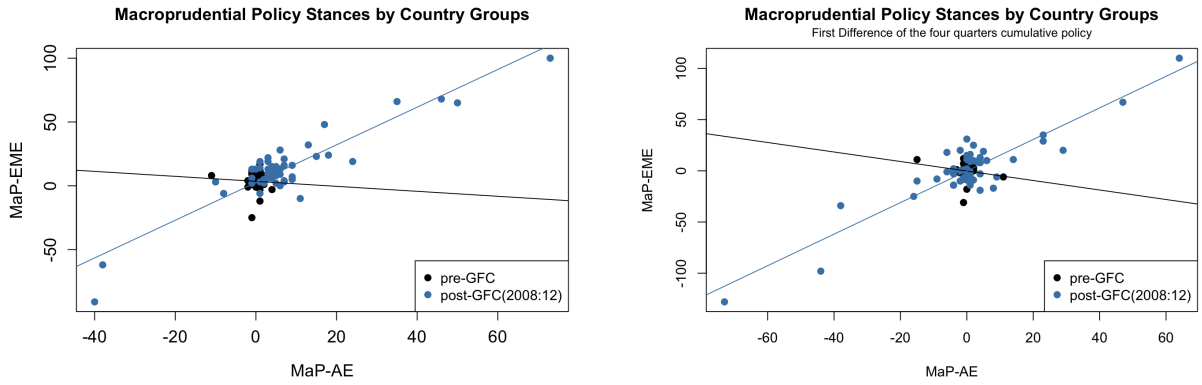
A Additional descriptive data

Co-movement of policy stances between country groups:

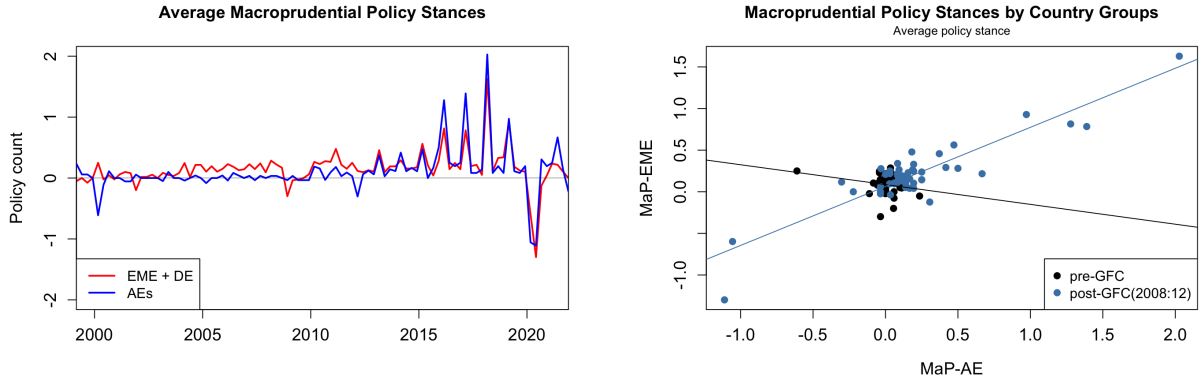
Figure 15: Macroprudential Policies in AE vs. EM, 1999-2021



Note: Scatterplot and regression line between the macroprudential policy stance of AE and EM. In the left panel we use the quarterly level of the policy indicator, in the right panel we report the first difference of the (accumulated) annual policy stance given the annual stance itself becomes non-stationary.

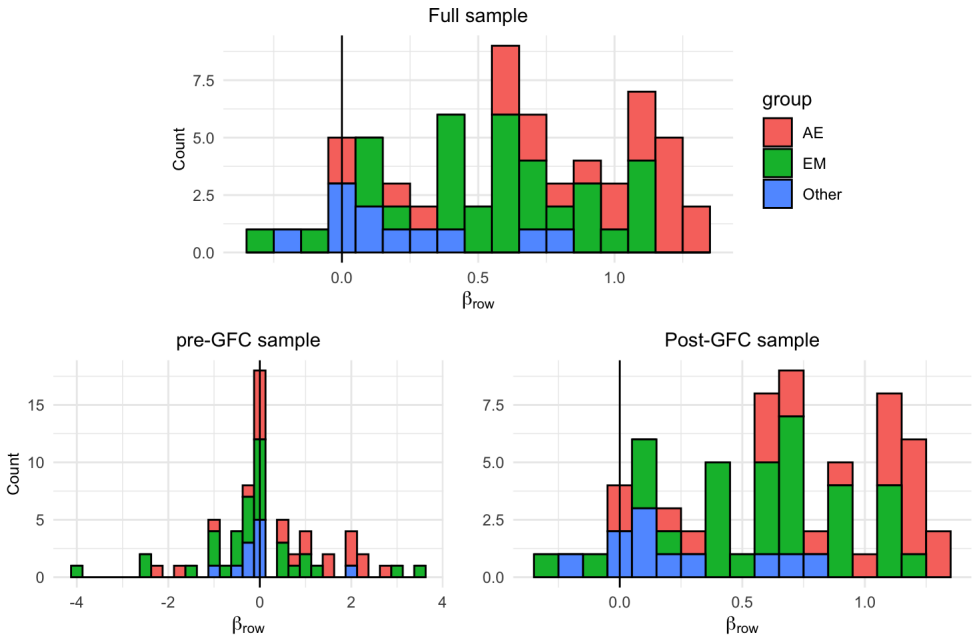
There is a co-movement between country groups' policies after the crisis. The correlations between policies in the AE and EM shown in the plots are -0.05 for the quartely and -0.2 for the annual policies and become 0.919 and 0.903 in the post-crisis sample.

Figure 16: Average Macroprudential Policies in AE vs. EM, 1999-2021



Note: left panel: average macroprudential policy indicator by country group. We divide the level of the policy indicator in levels by the number of countries reporting an active use of these instruments. Right panel: scatterplot and regression line between the average macroprudential policy stance of AE and EM. The correlation between the average policies in AE and EM before the GFC is 0.25, for the post-GFC period it becomes 0.873

Figure 17: Histogram for the coefficient of country-wise regressions for the change in the annual policy vs. change in annual policy in the rest of the world (ROW)



Note: the figure displays the histogram for the $MaPP_{i,t} = \alpha_i + \beta_{row} MaPP_{-i,t} + \epsilon_{i,t}$. Sample periods: Full sample: 1999Q1-2021Q4, pre-GFC: 1999Q1-2008Q3; post-GFC: 2008Q4-2021Q4.

Table 3: Countries included in the sample

Advanced Economies		Emerging Economies		**Other**
Austria	Luxembourg	Argentina	India	Albania
Australia	Netherlands	Azerbajan	South Korea	Armenia
Belgium	Norway	Bulgaria	Mexico	Cape Verde
Canada	Norway	Brazil	Malaysia	Georgia
Switzerland	New Zealand	Belarus	Peru	Jamaina
Germany	Portugal	Chile	Phillipines	Kyrgyzstan
Denmark	Sweden	China	Poland	Moldova
Spain	United States	Colombia	Romania	Mongolia
Finland		Costa Rica	Russia	Mauritius
France		Cyprus	Singapore	Nigeria
United Kingdom		Czechia	Thailand	Paraguay
Greece		Dominican Republic	Turkey	
Ireland		Hong Kong	Ukraine	
Iceland		Hungary	Uruguay	
Italy		Indonesia	South Africa	
Japan		Israel		

B Additional Local Projection Results

Table 4: Local Projection: Response of domestic aggregate macroprudential policy stance to a change in foreign macroprudential policies.

	$h=1$	$h=2$	$h=3$	$h=4$	$h=8$	$h=12$
Dep. var.: Dom. Macroprudential Stance (full sample)						
Foreign Macroprudential Policy Change (exog.)	0.145*	0.202*	0.275*	0.044	0.149	0.141
	(0.061)	(0.097)	((0.125)	(0.148)	(0.212)	(0.262)
R^2 (adj.)	0.389	0.419	0.421	0.411	0.412	0.377
Observations	4811	4748	4685	4622	4366	4110
Dep. var.: Dom. Macroprudential Stance (post-crisis)						
Foreign Macroprudential Policy Change (exog.)	0.137*	0.208*	0.293*	0.062	0.122	0.133
	(0.060)	(0.098)	(0.126)	(0.151)	(0.214)	(0.269)
R^2 (adj.)	0.413	0.452	0.459	0.451	0.454	0.442
Observations	3156	3093	3030	2967	2711	2455

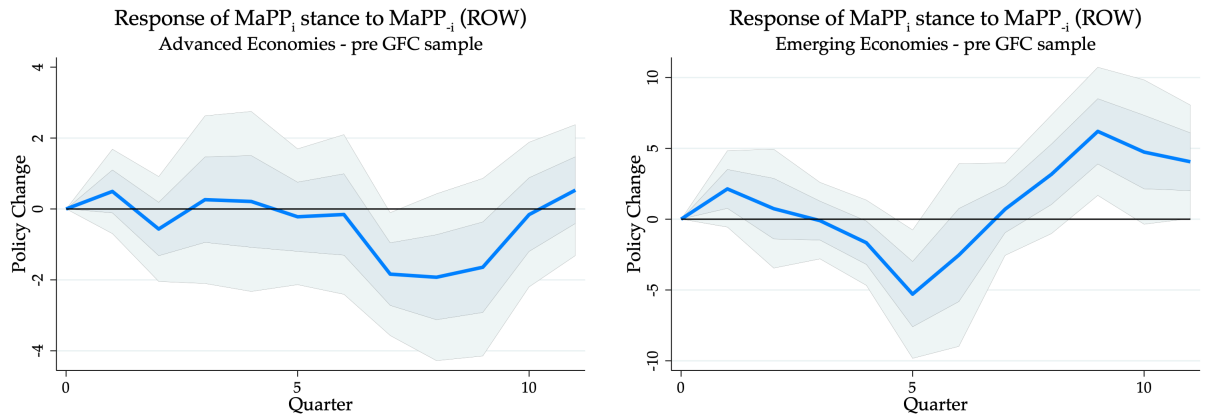
Note: * p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001

Table 5: Local Projection: Response of domestic aggregate macroprudential policy stance to a change in foreign macroprudential policies.

	$h=1$	$h=2$	$h=3$	$h=4$	$h=8$	$h=12$
Dep. var.: Dom. Policy Stance (Advanced Economies)						
Foreign Macroprudential Policy Change (exog.)	0.305	0.0547	0.131	0.0906	-0.645	0.387
	(0.164)	(0.279)	(0.288)	(0.367)	(0.659)	(0.497)
R^2	0.517	0.583	0.596	0.594	0.591	0.628
Observations	1909	1886	1863	1840	1748	1656
Dep. var.: Dom. Policy Stance (Emerging Economies)						
Foreign Macroprudential Policy Change (exog.)	0.231	0.622**	0.652*	0.172	0.273	-0.615
	(0.179)	(0.186)	(0.255)	(0.294)	(0.277)	(0.329)
R^2	0.382	0.407	0.406	0.399	0.415	0.349
Observations	2311	2281	2251	2221	2101	1981

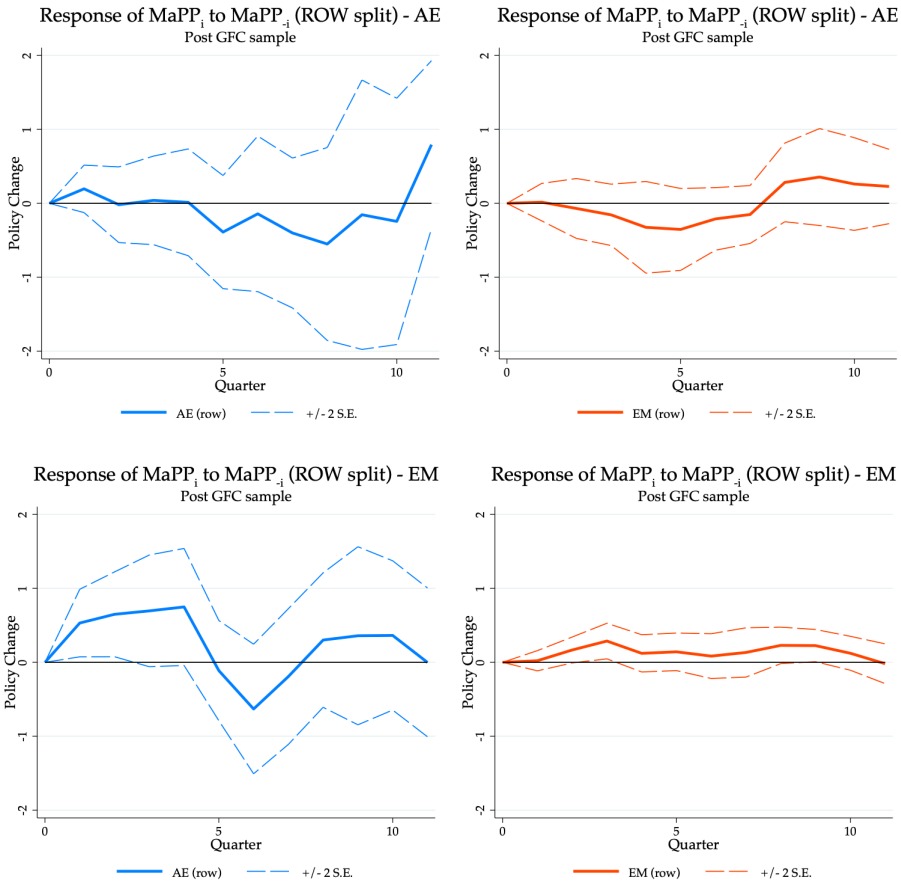
Note: Post-GFC (crisis) sample: 2008Q4-2018Q4. * p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001

Figure 18: Response of MaP policies to policy changes in the rest of the world. Model for Advanced Economies (left panel) and for Emerging Economies (right panel).



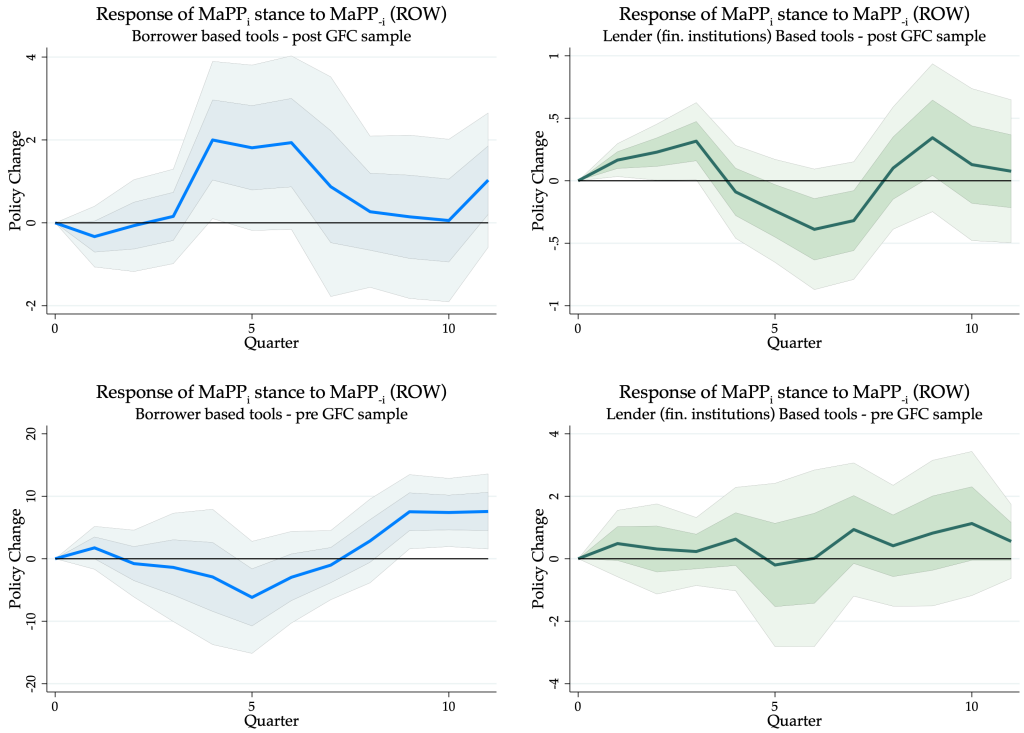
Note: Impulse Response Function from a local projection based on equation (1). Where the MaPP indicator comprises the information for all the 17 instruments. Left panel: estimation for Advanced Economies, Right panel: estimation for Emerging Economies. Units: Policy Change (+1: tightenings, -1: loosening). Sample periods: complete sample: pre-GFC sample: 1999Q1:2008Q3

Figure 19: Response of MaP policies to policy changes in the ROW. Model for Advanced Economies.



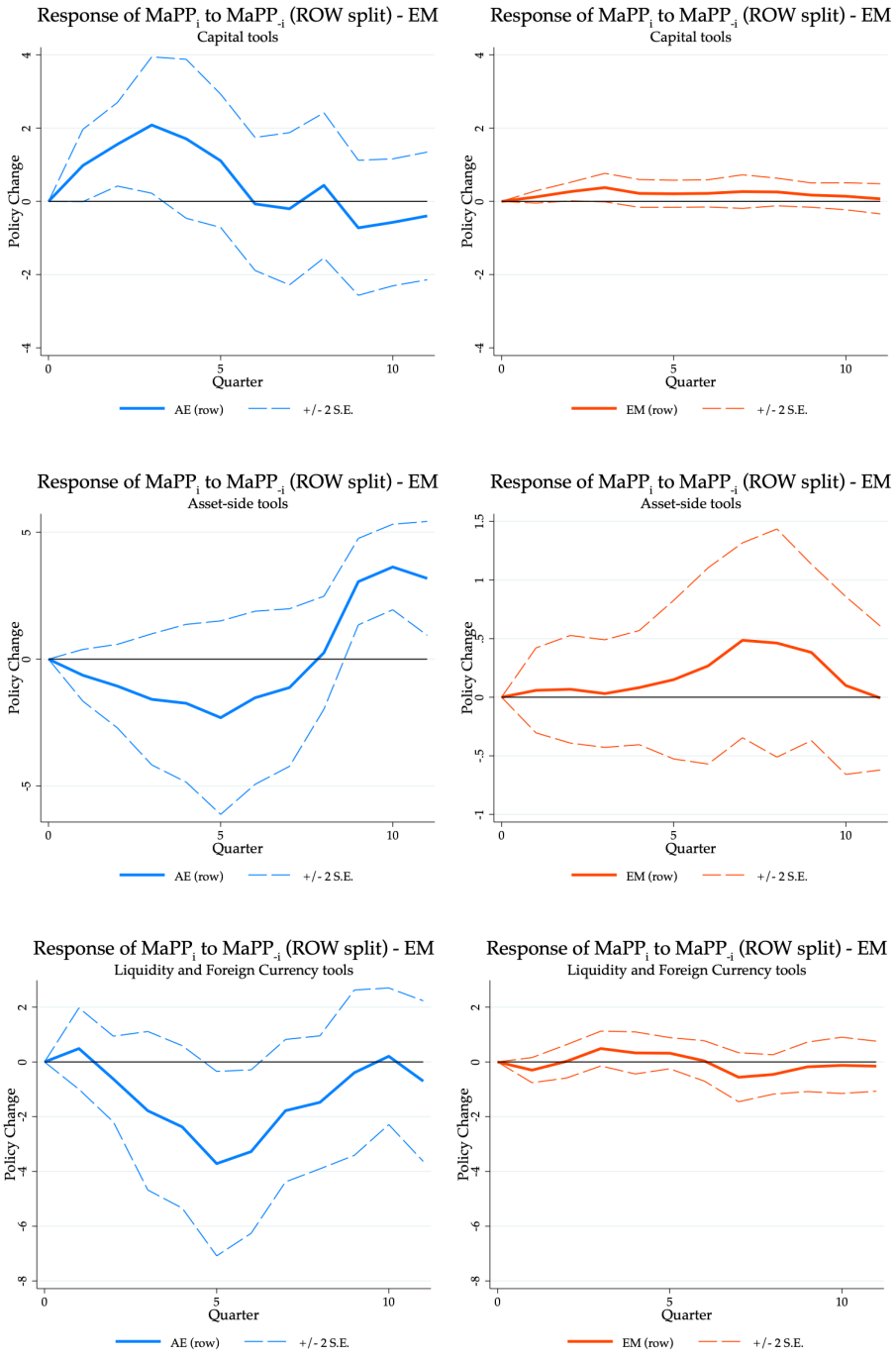
Note: Impulse Response Function from a local projection based on equation (2). MaPP Indicator: All 17 instruments. Top, left: AE policy response to Foreign AE policies; Top, right: AE policy response to Foreign EM policies; Bottom, left: EM policy response to Foreign AE policies; Top, right: EM policy response to Foreign EM policies. Units: Policy Change (+1: tightenings, -1: loosening). Sample periods: post-GFC sample: 2008Q4-2021Q4.

Figure 20: Response of MaP policies to policy changes in the Rest Of the World. Response to Borrower instruments (left panel) and to Lender based policies (right panel).



Note: the figure displays the Impulse Response Function from a local projection based on equation (4). The foreign MaPP indicator includes Borrower tools (response shown in left panel) and Lender tools (right panel) separately as explanatory variables. Units: Policy Change (+1: tightenings, -1: loosening). Sample periods: post-GFC sample: 2008Q4-2021Q4; pre-GFC: 1999Q1-2008Q3,

Figure 21: Response of MaP policies to policy changes in the rest of the world. Capital, Asset-side, and Liquidity tools. Model for Emerging Economies.



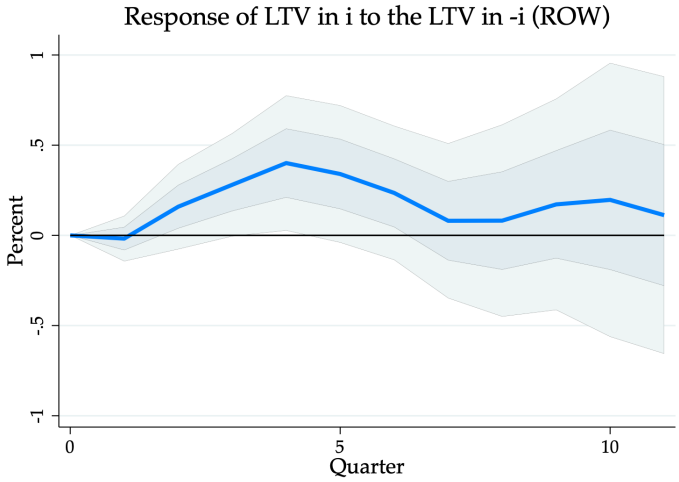
Note: the figure displays the Impulse Response Function from a local projection based on equation (2). Where the MaPP indicator comprises the information for all the 17 instruments. Top, left: AE policy response to Foreign AE policies; Top, right: AE policy response to Foreign EM policies; Bottom, left: EM policy response to Foreign AE policies; Top, right: EM policy response to Foreign EM policies. Units: Policy Change (+1: tightenings, -1: loosening). Sample period: 1999Q4-2021Q4

C Loan-to-Value Ratio Linear Projection Results

Estimation Equation for Loan-to-Value instrument:

$$\Delta_h LTV_{i,t} = \alpha_i^{(h)} + \gamma_t^{(h)} + \beta^{(h)} \Delta LTV_{-i,t-1} + \varepsilon_{i,t+h} + \sum_{k=0}^{4} \phi_k^{(h)} X_{i,t-k} + \varepsilon_{i,t+h} \tag{7}$$

Figure 22: Response of Local LTV MaP policies to policy changes in the LTV in rest of the world.



Note: the figure displays Impulse Response Function from a local projection based on equation 1. Where the MaPP indicator comprises the information for all the 17 instruments. Units: percentage. Sample period: 2008Q4-2021Q4 (left panel), 1999Q1-2008Q3 (right panel) .

D Identification of exogenous prudential interventions in the iMAPP database

For carrying out the identification of exogenous prudential interventions we use a narrative approach to select the interventions related to:

1. The adherence to Basel III accords (or Basel II if still pending implementation).
2. The response to the COVID-19 downturn.

In either case, it could be argued that a policy change related to these drivers is guided by nationally oriented incentives rather than by responses to regulations enacted in other economies. Other interventions are nullified (set to zero) or removed from the dataset. In the latter cases we cannot ensure that a removal is in order, however, it cannot be ruled out either that there are endogenous policy responses (the policies in other locations).

Impact of narrative approach selection in the dataset. The initial total count of policies across all locations and periods in the dataset is 2347 interventions. Of these, only 1018 are associated to

Basel Accords (I, II, or III) compliance or to COVID-19 policy responses. We can gauge the impact of the identification for country groups in the following table:

Table 6: Macroprudential interventions count in the iMAPP-IMF database.

Advanced Economies	**Original Interventions**	**Filtered Interventions (exogenous)**
Advanced Economies	592	274
Emerging Economies	1231	510
Other	524	234
Total	2347	1018

Note: An exogenous policy, or filtered (by endogeneity) is defined as an intervention that is not driven by policy changes in other locations. The table only displays a policy count regardless of whether it implied a tightening or loosening. The sample of the data set is 1999Q1-2021Q4.

Therefore, we can retain about 43% of the policies in the dataset for estimation of the international policy-to-policy spillovers.