Spillovers at the Extremes: The Macroprudential Stance and Vulnerability to the Global Financial Cycle[*]

Anusha Chari, The University of North Carolina at Chapel Hill, NBER, and CEPR

Karlye Dilts-Stedman, Federal Reserve Bank of Kansas City

Kristin Forbes, MIT-Sloan School of Management, NBER and CEPR

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Abstract: Prior evidence suggests that macroprudential policy has small and insignificant effects on the volume of portfolio flows. We show, however, that these small effects mask very different relationships across the global financial cycle. A tighter *ex ante* macroprudential stance can amplify the impact of global risk shocks on bond and equity flows—increasing outflows by significantly more during risk-off episodes and increasing inflows significantly more during risk-on episodes. These effects are small and often insignificant around the risk distribution mean (and much smaller than the direct effect of risk-on/risk-off shocks), but larger at the extremes, especially for extreme risk-off periods. These amplification effects can occur even if macroprudential regulations moderate the impact of the global financial cycle on banks, because the regulations shift risks in ways that aggravate vulnerabilities in other parts of the financial system. This paper estimates these relationships using a policy-shocks approach that corrects for reverse causality by combining high-frequency risk measures with weekly data on portfolio investment and a new measure capturing the intensity of macroprudential stances. Overall, the results support a growing body of evidence that macroprudential regulation can reduce the volume and volatility of bank flows but increase vulnerabilities through portfolio investors, especially during extreme risk shocks.

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1. Introduction

Countries around the world implemented macroprudential policies more actively over the last decade in an effort to reduce the build-up of risks during good times and mitigate their amplification during bad times. A growing body of literature critically assesses the performance of these policies and finds that some can accomplish specific domestic goals (such as moderating credit growth or foreign currency-denominated borrowing), but are less effective by other measures (such as stabilizing cross-border capital flows). There is also growing evidence that macroprudential policies generate spillovers and leakages that shift risks elsewhere in the economy —particularly to corporate bond markets and the broader "shadow" financial system (Ahnert et al., 2021; Avdjiev et al., 2020; Forbes, 2019). If the magnitude of these spillovers and leakages is large enough, and the corresponding risk exposure shifts to financial intermediaries that are more vulnerable to shocks, macroprudential regulations could undermine, rather than mitigate, financial sector vulnerabilities during certain periods. There is little systematic analysis, however, of what these spillovers and leakages imply over different phases of the global financial cycle.

Another rapidly growing body of literature examines extreme events in capital flows, returns, and global risk shocks, with a focus on the entire distribution of outcomes rather than average relationships that may pertain only to "normal" times (Bergant et al., 2020; Chari et al., 2020; Eguren-Martin et al., 2020; and Gelos et al., 2019). Some policies may have minimal impact during stable periods, but be highly effective at mitigating vulnerabilities during extreme events (or just extreme adverse events). Macroprudential regulations could be one such example; they could reduce the likelihood of extreme tail events but have little measurable impact on mean outcomes or during stable periods. The spillovers and leakages from macroprudential policies may also be more critical during certain phases of the financial cycle, especially if they shift financial intermediation outside the regulated banking sector to entities more vulnerable to extreme events. Therefore, assessing the effectiveness of macroprudential policies may require focusing on the distribution of outcomes—and not just on averages. This type of analysis was difficult before 2020, as the previous decade when macroprudential regulations were becoming more widely used corresponded to a scarcity of extreme events.

This paper links these two recent branches of the academic literature and tests if a country's macroprudential stance affects the sensitivity of portfolio investment flows at different phases of the global financial cycle. It finds that tighter macroprudential regulations (adopted *ex ante*) can amplify the impact of risk shocks on bond and equity portfolio investment—increasing outflows during "risk-off" episodes and increasing inflows during "risk-on" episodes. These amplification effects are usually moderate in magnitude and often insignificant at the mean of the risk distribution, but increase at the extremes, especially for extreme risk-off periods. These effects are also larger for bond than equity flows, and for macroprudential tools targeting FX exposures and the bank supply of credit, but weaker for countercyclical policies (such as the Countercyclical Capital Buffer or CCyB). These results support evidence that some macroprudential regulations shift financial intermediation outside the regulated financial sector to portfolio investors that can be more vulnerable to shifts in the global financial cycle. The findings do not imply that macroprudential regulations should be diluted or rolled back, as they may still provide significant benefits by improving the resilience of the domestic banking system. The results highlight, however, that it is vital to consider the precise macroprudential tools, spillovers and leakages, and corresponding vulnerabilities when designing an optimal macroprudential policy package.

This paper reaches these conclusions based on several important and related innovations not applied to this literature thus far. First, we analyze the marginal effects of policy choices at different points in the risk distribution, allowing us to test how relationships change across the global financial cycle, and particularly in response to extreme risk shocks. This method highlights how focusing on averages across the cycle, a standard practice in regression frameworks, can overlook highly consequential relationships that prevail during certain stress periods. Second, we use high frequency data to capture the sharp (and often short-lived) events targeted by macroprudential policy that proved difficult to identify using data at the more common quarterly frequency, especially for “extreme” movements. We achieve this high frequency focus by combining weekly EPFR portfolio flow data with a daily risk measure. Third, we construct several new measures of macroprudential policy capturing the intensity of existing regulations, an improvement over most work that focuses on dummy variables of recent policy changes. These new measures better capture the overall tightness of the regulatory stance, which is what matters to investors and likely to affect how flows shift to non-bank intermediation. Finally, we use a policy-shocks estimation methodology to address concerns with reverse causality—a challenge for any study assessing the impact of macroprudential policy. This methodology is able to identify and estimate the exogenous component of the macroprudential stance because of the other innovations in the paper: the higher frequency of the data and the more accurate measure of the intensity of the macroprudential stance.

This analysis begins by examining the correlations between portfolio flows and a country's macroprudential stance during the period of heightened risk aversion at the start of the COVID-19 pandemic, as well as during periods of relative calm. Plotting the evolution of capital flows in this early phase of the crisis shows a striking pattern; countries with *ex ante* tighter macroprudential stances experienced meaningfully larger bond and equity outflows during the period of market stress as COVID-19 began to spread globally. During calmer periods, countries with an *ex ante* tighter stance also experienced more volatility in portfolio flows, albeit to a more modest extent than during the extreme risk-off period in March 2020. These patterns are consistent with other research showing that tightening macroprudential regulations can shift financial intermediation away from banks and towards other financial intermediaries that may be more sensitive to the global financial cycle. There are also other possible explanations for these patterns, however, such as the greater likelihood of countries with more volatile portfolio flows adopting tighter macroprudential stances.

To more formally test if a country’s macroprudential stance affects country sensitivity to different phases of the global financial cycle, we draw on alternative data sources and create several new statistics. To measure a country's macroprudential stance, we construct new indices to capture the intensity of the country’s existing regulations. These indices address two important shortcomings in much of the literature on macroprudential policy: ignoring the intensity of any regulations and only capturing recent policy changes (instead of the overall stance). Our measure combines different data sources, including two that capture the levels at which regulations are set, in order to have a quantitative indicator of intensity. Our measure also focuses on the *ex ante* macroprudential stance—which includes the current levels of regulations and/or aggregates past changes in regulations—so that it can capture the overall tightness of the existing policy stance rather than just focusing on the impact of recent policy changes. Both of these improvements should not only provide a more accurate measure of how existing macroprudential regulations affect portfolio flows, but are also important as they allow us to use an estimation methodology that controls for selection bias and reverse causality between portfolio flows and macroprudential regulation.

To measure risk shocks, the other key variable of interest, we focus on the Risk-on-Risk-off (RORO) measure of the global financial cycle developed in Chari, Dilts-Stedman, and Lundblad (2020). This measure captures variation in investor risk appetite by calculating the first principal component of the daily variation in advanced economy credit risk, equity market volatility, funding conditions, currencies, and gold. To measure portfolio flows, we use weekly, detailed EPFR data, which captures how investors allocate funds (domestically and internationally) and separates flows into bonds and equities, as well as the flow's currency-denomination. This high-frequency data is vital to capture the relationship between high-frequency risk shocks and portfolio flows.

Before analyzing how macroprudential regulations affect portfolio flows' sensitivity to different phases of the global financial cycle, we address an identification challenge in this literature: reverse causality. Reverse causality can arise if adjustments in the macroprudential stance occur in response to financial and macroeconomic developments linked to capital flows. To account for these endogenous forces, our baseline analysis builds on the literature on policy shocks to extract a measure of the macroprudential policy stance orthogonal to observables (as in Ahnert et al., 2021).

Next, we use this approach to confirm two earlier findings in the literature: risk-off (risk-on) shocks correspond to large and significant portfolio outflows (inflows), and tighter macroprudential regulations generally have small and insignificant effects on portfolio flows. When we also account for the interaction between macroprudential regulations and risk shocks, however, we find that the negative impact of risk shocks on portfolio flows is larger in countries with a tighter macroprudential stance. This suggests that macroprudential regulation in place at the time of a risk event could aggravate the impact of the shock; this is the opposite of what one might expect if tighter regulation moderates the build-up of risks during boom times and moderates the unwinding of risks during risk-off episodes. The magnitude of this estimated interaction effect, however, is small on average relative to the unconditional effect of the risk shock. Moreover, these interaction effects between risk and the macroprudential stance may be difficult to capture in a standard regression framework, which estimates average effects across time and across different stages of the financial cycle.

Therefore, we turn to the paper's primary focus: how the relationships between risk, the macroprudential stance, and portfolio allocation change across the global financial cycle. To capture these relationships, we focus on the marginal effects of a tighter *ex ante* macroprudential stance at different points in the risk distribution. The results suggest that the impact of tighter macroprudential policy varies significantly across the risk distribution. More specifically, a tighter macroprudential stance amplifies the effects of risk shocks at both ends of the distribution. More stringent regulation increases bond and equity *inflows* during risk-on periods and increases bond and equity *outflows* during risk-off episodes. These amplification effects are substantial at the extremes of the distribution, particularly for risk-off shocks and for bond flows. For example, a one-standard deviation tighter (*ex ante*) regulatory stance increases bond outflows during 99% risk-off events by 30%-96% relative to countries that initially had weaker macroprudential regulations (with the range reflecting different macroprudential measures). The effects during risk-on events are also meaningful, albeit about half as large (and of opposite sign) at the 1% of the risk distribution.

Do all macroprudential regulations generate these strong interactions with risk shocks at the extremes of the global financial cycle? To better understand which regulations drive these results, we repeat the analysis using five more granular measures of the macroprudential stance. We examine two specific tools that we can measure in magnitudes and are fairly comparable across countries: the Countercyclical Capital Buffer (CCyB) and Loan-to-Value (LTV) ratio[1]. We also use three more granular groups of macroprudential tools: focused on FX exposures, the demand for bank loans and the supply of bank loans. This analysis shows that LTV ratios, FX-related measures and supply-related measures are important drivers of the amplification effects of risk on bond flows. This supports evidence in Ahnert et al. (2021) on how tighter FX regulations cause riskier borrowers to shift from obtaining FX loans from banks to selling FX bonds to non-bank financial intermediaries, as well as evidence in Sverges Riksbank (2012) on how tighter LTV ratios caused borrowers to shift from housing-backed loans to unsecured debt. These types of reactions to macroprudential regulations would shift risks to non-bank financial intermediation and increase the sensitivity of these investments to risk shocks. In contrast, the CCyB does not appear to have similar effects. This buffer may be more effective than the other tools at moderating cyclicality in not just bank lending, but also broader credit growth in response to changes in the global financial cycle. A comparison of results using different measures also highlights the importance of including the intensity of macroprudential policies; for example, when LTV ratios are measured using the *magnitude* of the ratio, estimates of the interaction effects between risk and the macroprudential stance are significant, but when LTV ratios are measured based on *dummy variables*, the estimates become insignificant.

The paper also estimates a number of extensions to better under these relationships between risk and macroprudential policy across the global financial cycle for different types of investment flows and countries. Although the main results and amplification effects are similar for equity flows as for bond flows, they are somewhat larger for bond than equity investments, especially at the extremes of the distribution. The main results, however, do not appear to be significantly different for advanced economies relative to emerging markets, or for US dollar investment flows relative to non-US dollar flows. The main results are also unchanged if we drop the period of heightened volatility around the COVID-19 pandemic.

Although this paper focuses on how global risk shocks, macroprudential regulations and their interactions across the global financial cycle impact the bond and equity allocations of

[1] CCyB is the Countercyclical Capital Buffer and LTV is Loan-to-Value.

institutional investors, it is also useful to understand if these relationships are similar for cross-border bond and equity flows, as well as other types of international capital flows (such as bank flows). This extension is also useful in order to place this paper's results in the context of the international economic literature on the drivers of capital flows. Therefore, the final section of this paper repeats the main analysis using IMF data on international capital flows. This international capital flow data captures a different aspect of investment; it only includes cross-border transactions (rather than the investor portfolio allocation in the main analysis) and includes a larger universe of investors (rather than the institutional investors in the main analysis).This international capital flow data also has the disadvantage of only being available at a quarterly frequency (as compared to the weekly frequency in the main analysis), but has the advantage of covering additional types of capital flows than just equity and debt. Despite all of these differences, the key results using this alternative data generally support the results from the higher-frequency portfolio-level analysis, although the coefficient estimates are rarely significant. Most noteworthy are how the patterns for the interactions between risk and macroprudential regulation change for different types of international capital flows. Tighter regulations appear to amplify the impact of risk shocks on international bond and equity flows, especially at the extremes of the distribution and for risk-off shocks (as found for the portfolio flows). For bank flows, however, tighter regulations appear to dampen the impact of risk shocks on international flows, especially at the distribution's extremes. These results support arguments that macroprudential regulations may improve the resilience of bank flows to the global financial cycle, but shift risks to other types of capital flows.

These results have important implications for the use of macroprudential policy. Although tighter macroprudential regulations can yield significant benefits, such as improving the resilience of a country's banking system and reducing the volatility of cross-border bank flows, they also appear to increase the sensitivity of portfolio bond and equity flows to extreme risk shocks. Tighter macroprudential regulation seems to amplify the effects of the global financial cycle on portfolio flows at both extremes—corresponding to significantly more inflows during risk-on periods and significantly greater outflows during risk-off periods. These amplification effects appear to be larger for some types of macroprudential regulations, such as FX-related measures and measures affecting bank supply of loans. In contrast, other macroprudential actions (such as the CCyB) cause no significant amplification effects on portfolio flows. These results are consistent with recent papers showing that tighter macroprudential regulations may be effective in terms of building resilience of the banking system, but shift risk taking outside the banking system, including to portfolio flows and the shadow financial system (which includes institutions more likely to invest in bonds and equities). Any cost-benefit analysis of macroprudential regulation must carefully consider these effects at the extremes and during more stable periods.

The remainder of the paper is as follows. Section 2 puts this analysis in the context of related literature and examines if portfolio flows behave differently in countries with tighter macroprudential regulation during extreme risk-off shocks (such as the early phases of COVID-19) and in calmer periods. Section 3 describes the key data used in the analysis, including the creation of several new measures of the macroprudential stance, the RORO measure of risk, and the portfolio investment data. Section 4 develops the policy shock methodology used as the baseline in the remainder of the paper and then performs the principal analysis of the impact of risk, the macroprudential stance, and their interaction on portfolio flows on average and at different stages of the global financial cycle. This section also reports results using other estimation methodologies and for more granular measures of the macroprudential stance. Section 5 reports several extensions: for equity flows, for advanced versus emerging economies, for portfolio flows in different currencies, and a series of sensitivity tests. Section 6 repeats the baseline analysis for lower-frequency international capital flows (including bank flows). Section 7 concludes.

2. Previous Literature and Initial Evidence

This section places the analysis in this paper in the broader literature and documents patterns in the data consistent with arguments that the macroprudential policy affects portfolio flows differently at the extremes of the risk distribution.

2.1. Previous Literature

This paper builds on several areas of academic research: a rapidly growing literature assessing the use and effectiveness of macroprudential regulations, a literature focusing on the spillovers and unintended consequences of policy choices, and a newer focus on the distribution of outcomes.

A burgeoning literature evaluates the effectiveness of macroprudential regulations.[2] The 2008 Global Financial Crisis highlighted the importance of adopting policies that focused on the resilience of the broader financial system, especially of mitigating the amplification of shocks across the economy. These developments generated a new literature modeling the optimal use of macroprudential policy (i.e., Bianchi and Mendoza, 2018; Brunnermeier et al., 2013; Claessens, 2015; and Engel, 2016). As more countries began to implement different macroprudential regulations, a more recent empirical literature began assessing various policies' effectiveness. This empirical literature (summarized in Araujo et al., 2020; Cerutti et al., 2017; and Forbes, 2021) generally finds that macroprudential policy can: address specific vulnerabilities, such as reducing credit growth or riskier exposures; provide somewhat more independence for monetary policy (i.e., Bergant et al., 2020); and possibly reduce the variance of growth, although at the expense of slightly slower short-term growth. The papers that focus on whether macroprudential regulations affect the volume of capital flows generally find insignificant effects, albeit with more convincing evidence that they can affect the composition of flows.[3]

A more recent branch of this literature is beginning to examine not only the direct effects of macroprudential policies on their targets, but also the indirect spillovers to other countries and leakages to non-bank financial intermediation (Agénor and da Silva, 2018; Avdjiev et al.,

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[2] Macroprudential regulations (which cover the overall financial system) are distinct, but closely related to, microprudential regulations (which focus on the resilience of individual financial institutions) and capital controls (which focus on cross-border transactions).
[3] For example, see Magud et al. (2011), Ostry et al. (2012), and Forbes et al. (2015).

2016).[4] For example, Ahnert et al. (2021) show that tighter regulations on the FX exposure of banks can reduce cross-border bank flows and cause firms to shift to financing from other sources, corresponding to an increase in cross-border debt flows. Shin (2013) discusses how tighter macroprudential regulations contributed to companies increasing corporate dollar-denominated debt financing. These results suggest that although macroprudential regulations may yield an important benefit of increasing bank resilience, they may shift risky financial exposures to other types of investors that may be more sensitive to risk shocks. If these non-bank investors have high leverage, lower reserves and/or less liquidity, they may be more likely to sell portfolio positions after adverse risk shocks and increase positions during risk-on shocks, thereby aggravating the global financial cycle. Similarly, if these non-bank investors are more likely to be forced to sell and unwind positions during risk-off shocks due to funding shocks from their investor base, this would amplify the initial impact of the risk-off shock.

One limitation of most of this empirical work assessing the impact of macroprudential regulations, however, is it assesses the average effects over the financial cycle using a linear framework. Macroprudential regulation might have minimal effects during "normal" periods, but more potent effects "at the extremes," especially for portfolio allocation decisions and capital flows. For example, during periods of average risk appetite, tighter macroprudential regulations may have minimal impact on investment decisions. During risk-on episodes when borrowing costs are low and leverage is high, macroprudential regulations may be more likely to bind by triggering limits (such as on high LTV mortgages) or increasing capital requirements (such as through a CCyB). These regulations could dampen the increase in leverage that traditionally builds during risk-on episodes and boosts asset prices (Bruno and Shin, 2015). During risk-off episodes the impact could be even more substantial, albeit in the opposite direction. Risk-off shocks, which cause asset price declines, would act as funding shocks and cause investors to reduce portfolio allocations, especially for riskier investments (Jotikasthira et al., 2012). These effects could be magnified by tighter regulations, such as stricter leverage and reserve requirements, which could generate a more abrupt sell-off and thereby aggravate the price declines. These effects could also be magnified in countries with tighter macroprudential regulations if these regulations shifted more financial intermediation outside the banking system to financial intermediaries with more leverage or that were otherwise more sensitive to these types of funding shocks. On the other hand, countries with tighter macroprudential regulations should have better-capitalized banks with stronger buffers to withstand any risk-off shocks, especially if any buffers are cyclically adjusted, which should reduce the amplification effects from risk-off shocks on bank lending.

Although the academic literature has not addressed these potential interactions between risk and macroprudential regulations at different phases of the global financial cycle, it has recently begun to focus more on the distribution of outcomes and how relationships may differ at the tails of the risk distribution. Earlier work focused on "disaster risk" and extreme negative tail events (such as Barro, 2009; Gabaix, 2012; Wachter, 2013; and Gourio, 2012). More recent work has built on the "growth at risk" framework developed in Adrian et al. (2019), which has been

[4] See related work for analyses of spillovers from US monetary policy on credit conditions (Kalemli-Ozcan, 2020) and on international portfolio flows (Chari, Dilts-Stedman and Lundblad, 2021) as they relate to global risk perceptions.

influential in prompting a series of papers using quantile regression frameworks to understand how different shocks and policy actions can affect the full distribution of future growth. Gelos et al. (2019), Eguren-Martin et al. (2020), and Mano and Sgherri (2020) adopt this quantile regression framework to estimate the impact of push and pull shocks (including risk shocks) on future quarterly capital flows in emerging markets. These papers find significant effects of these shocks on different parts of the distribution, especially on the tails. These papers also include some analysis of how various policies can moderate the impact of these shocks, but most find little impact of macroprudential regulations on the future distribution of capital flows. The one exception is Eguren-Martin et al. (2020), which finds evidence that tightening macroprudential policy can reduce the impact of push factors on capital flows-at-risk at the extremes. The proxy for macroprudential regulations used in these papers is usually blunt, however, with dummy variables capturing any recent changes in any type of macroprudential policy.[5] The two papers that focus on the macroprudential stance and go beyond dummy variables in assessing how macroprudential regulations may interact with risk are Bergant et al. (2020) and Eguren-Martin et al. (2020), although their measures are only rough proxies of intensity.[6] They find that macroprudential regulations can significantly dampen GDP growth sensitivity to movements in the VIX and capital flow shocks, mainly by allowing countries more freedom to pursue countercyclical monetary policy.

A potentially more significant challenge in these papers that examine the impact of different shocks across the risk distribution is that they use quarterly data and may therefore miss important relationships between risk shocks and portfolio allocations that occur at a higher frequency. Chari et al. (2020) is one exception and analyzes the relationship between risk shocks and capital flows across the distribution at a higher frequency, using weekly EPFR data on portfolio allocation for a subset of equity and bond investors. Although this data has some important differences to the international capital flow data used in the papers discussed above (differences discussed in more detail in Section 6), the results also suggest that risk shocks have very different effects on the distribution of future flows and returns. Chari et al. (2020), however, does not include any analysis of how these effects could be amplified or dampened by macroprudential regulations or any other policy tools.

Our analysis builds on these different papers—assessing how macroprudential regulation can interact with risk shocks to affect portfolio flows across the risk distribution. Using the higher frequency and more detailed EPFR data allows us to capture better any effects of high-frequency risk shocks as well as investigate aspects of these relationships beyond the volume of

[5] For example, Gelos et al. (2019) and Mano and Sgherri (2020) measure macroprudential policy as a dummy indicating any net tightening or loosening in macroprudential tools in the Alam et al. (2020) database over the last quarter (with the former focusing on changes in any tools and the later only on tools related to FX exposures or transactions). Neither paper considers the underlying macroprudential stance.

[6] Eguren-Martin et al. (2020) attempt to measure the stance by accumulating changes in macroprudential tools in the Cerutti et al. (2017) database, which includes a more limited set of tools, and Bergant et al. (2020) accumulate changes in tools using the Alam et al. (2020) data. These approaches are closer to a macroprudential stance but suffer from the challenge discussed in Section 3.1. More specifically, some countries adjust policies more often, but by small amounts, such that they appear to have much tighter policy by this type of measure than an index that incorporates some measure of intensity instead of just the number of changes over time.

flows (such as on flows in different currencies). By focusing on new and more disaggregated measures of the macroprudential stance, we can delve deeper to understand exactly how specific macroprudential tools can affect investment flows. Finally, to better highlight the impact of changes in macroprudential policy, we focus on the marginal effects on portfolio flows at different points in the risk distribution—rather than on the average effects or quantile regressions that are the focus of most other work evaluating how risk shocks affect the future distribution of capital flows.

2.2. Initial Evidence

As a first look at whether macroprudential regulations may amplify—or mitigate—the impact of extreme adverse risk shocks on portfolio flows, panel A of Figure 1 graphs private-sector capital investments into equity and bond funds during the COVID shock in early 2020. This is an extreme risk-off episode, and we normalize investment to 100 on February 19, 2020—just before markets began to be affected by concerns about the virus—and examine movements in capital flows through mid-April.[7] Each graph shows the average portfolio flows for a sample of 72 advanced economies and emerging markets divided into two groups[8]: those with tighter and looser macroprudential policy stances at the start of 2019.[9]

During this period of heightened risk aversion during the COVID shock, countries with a tighter macroprudential stance had meaningfully larger investment outflows than those with a looser stance. Specifically, countries with tighter macroprudential policy experienced a collapse of about 25% in bond investment flows and 10% in equity investment flows through mid-April, compared to a decline of 15% and 2%, respectively, for countries with looser macroprudential policies. This greater sensitivity of investment flows to the COVID shock in countries with tighter macroprudential policy could simply reflect different characteristics, i.e., countries with more volatile investment flows also tend to have tighter macroprudential stances. This greater sensitivity, however, could also result from tighter macroprudential policy *ex ante* shifting financial flows into riskier debt and equity investments that are more sensitivity to extreme risk shocks.

To understand if this correlation between macroprudential stances and investment volatility also occurs during more stable times, panel B of Figure 1 graphs flows to the same two groups of countries during four relatively tranquil years (2016-2019), a window after the volatility around the US tapering of asset purchases and commodity price shocks, but before the COVID pandemic. Investment is normalized to 100 on January 3, 2016, and the resulting window captures a risk-on period in international financial markets marked by comparative financial market tranquility. Even during this calmer period, however, investment flows appear to be comparatively higher and more volatile in countries with a tighter macroprudential stance,

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[7] We cumulatively sum fund flows based on EPFR data and rebase to 100 before the onset of financial market volatility associated with COVID-19. We describe the EPFR data in more detail below.
[8] Appendix Table C lists the countries in the sample.
[9] The macroprudential policy stance is constructed using data in Alam et al. (2019), updated through end-2018, and described in more detail below. A country is defined as having a tighter stance if it has tightened macroprudential policy on net more than once since 1990.

albeit the differences across the two groups of countries varies across time. There are different explanations for these patterns, but they correspond to an important insight from the more formal analysis below; the impact of a country's macroprudential policy stance on portfolio investment can vary across the financial cycle. Any assessment of the impact of macroprudential regulations ought to assess effects during extremes of the cycle—and not just at the means or on average over long periods. To more formally examine this relationship between macroprudential policy, portfolio flows, and the stage of the global financial cycle, however, it is necessary to shift to a framework that can control for country characteristics and better assess key interactions at different stages of the risk distribution.

3. The Data

This section discusses the main data used in the remainder of the paper: the macroprudential policy stance, the RORO measure of risk, the EPFR data on equity and bond flows, other control variables, and the resulting data set.

3.1. The Macroprudential Policy Stance

We construct several new measures of a country's macroprudential policy stance, combining updated data on countercyclical capital buffers (CCyBs) with different components of the IMF's Integrated Macroprudential Policy (iMaPP) database to create different indices of a country's macroprudential policy stance. To obtain the CCyB for a large set of countries, we combine information from the Bank of International Settlements (BIS) and the European Systemic Risk Board (ESRB).[10] Both datasets provide details on when the CCyB was changed, and the resulting buffer level set. These data have the important advantage of providing a quantitative measure of the stringency of the regulation that is comparable across countries. The data is also available through late 2020 and therefore provides more timely information than in other datasets; this allows us to capture macroprudential adjustments in response to the early stages of the COVID pandemic. The disadvantage of this data is that it only incorporates one type of macroprudential regulation (building a cyclical reserve buffer in banks), and therefore does not capture other tools focusing on vulnerabilities in other sectors (such as the housing market or foreign currency), which are important parts of the macroprudential toolkit in many countries.

The other main source of macroprudential data is the iMaPP database, described in Alam et al. (2019) and recently updated through end-2018.[11] The iMaPP is the most comprehensive cross-country, time-series data on a broad set of macroprudential regulations available today. This database combines information from several pre-existing surveys with a new IMF annual survey and country-specific data to provide detailed information on a range of macroprudential tools for 134 countries monthly from 1990-2018. It groups these tools into 17 different types of

[10] The BIS data is available at: www.bis.org/bcbs/ccyb/ and the ESRB data at: www.esrb.europa.eu/national_policy/ccb/html/index.en.html. Both datasets were accessed as of 11/2020. If a country is not included in either database, we record the CCyB as 0.
[11] Available at: https://www.elibrary-areaer.imf.org/Macroprudential/Pages/Home.aspx

policy instruments with subcategories. We can use these data to track macroprudential policies that focus on different sectors of the economy, such as the demand for credit, the supply of credit, and international exposures based on the transaction currency, such as limits on FX lending and FX positions.[12] For each measure, the database tracks when the tools are tightened or loosened using dummy variables. Dummy variables have the drawback of only capturing when a regulation was changed, with no information on the overall intensity of the regulation or magnitude of the change. The only exception is for loan-to-value (LTV) ratios, for which the database provides quantitative measures that allow a comparison of the intensity of this measure across countries and time.[13]

The iMaPP data only report when a policy is tightened or loosened for each of the macroprudential measures (except LTV ratios) and does not measure the overall macroprudential policy stance in each country. It is possible, however, to construct a proxy for the macroprudential stance by aggregating the changes in each country's policies since 2000 —a year when the use of these tools was fairly limited, so each country can be assumed to start from a similar, neutral stance. Adopting this approach (also used in Bergant et al., 2020 and Forbes, 2021), we construct a measure of each country's macroprudential policy stance each month. The resulting stances range from -7 to 72 across 72 countries, with a higher value indicating a tighter stance and a panel median of 0 (mean of 2.3). Across the full sample period, China has the tightest stance (72), followed by South Korea (41), Russia, and Hong Kong (both at 40). Iceland has the loosest stance (-7), followed by India and Argentina (-6). Advanced Economies (AEs) had a looser macroprudential stance on average compared to Emerging Market and Developing Economies (EMDEs), although the gap was closing by the end of the sample. The looser stance for AEs reflects their greater tendency to loosen more during recessions, rather than a hesitation to tighten during stable times.

Figure 2 (top panel) graphs the sample mean and median for the CCyB and this aggregated measure of the macroprudential policy stance each quarter. There was only a small degree of net tightening in the macroprudential stance over the early 2000s, and no use of the CCyB, so that on the eve of the 2008 Global Financial Crisis, countries had very loose macroprudential stances. Countries began to tighten macroprudential policy more frequently after 2010, and then the CCyB even more quickly after 2014, so that at the end of 2018, the mean net macroprudential stance was 15 tightenings and mean CCyB was 0.21%. The data on the macroprudential stance ends in 2018, but the sharp decline in the CCyB in early 2020 captures the quick easing in this tool in response to COVID-19. The distribution of both these measures is asymmetric, however, with long right tails, as reflected in lower median values and a median CCyB of 0 throughout the sample. The difference between the mean and median of the

[12] Policies targeting the demand for credit include limits based on debt-service to income and loan-to-value (LTV) ratios. Policies targeting the supply of credit include reserve requirements, liquidity requirements, capital requirements, conservation buffers, the leverage ratio, capital surcharges for systemically important financial institutions, countercyclical capital buffers, limits on credit growth, loan loss provisions, and loan restrictions. Policies targeting international exposures include: capital requirements on FX-loans; limits on FX lending or rules or recommendations on FX loans; and limits on net or gross open FX positions, limits on FX exposures and FX funding, and currency mismatch regulations.

[13] Different countries can use different definitions and have different coverage for their LTV ratios, so that they are not directly comparable across countries—albeit still a better measure of relative intensities than dummy variables.

macroprudential stance grows near the end of the sample, capturing a few countries tightening much more frequently.

While the macroprudential stance had become tighter on average over time, this masks important differences across countries, especially in recent years. This increased variation in macroprudential stances could help identify if these policies improve country resilience to global shocks in empirical research. An analysis of these patterns in Forbes (2021), however, suggests that some of these differences, especially near the end of the sample, appear to reflect different approaches toward adjusting macroprudential policy rather than fundamentally different intensities of their stances. For example, China tends to make frequent but small adjustments to its macroprudential tools, which aggregate to a large number of net tightenings and what appears to be a very tight macroprudential stance by this measure. In contrast, other countries (such as the UK) tend to adjust macroprudential policy less frequently, but in larger increments, which would result in what seems to be a significantly weaker stance according to this index.

Given the advantages and disadvantages of different macroprudential measures, and especially the tradeoffs in capturing intensity, timeliness, and a range of tools, our baseline analysis will focus on four different measures of country-level macroprudential policy stances.[14] Our first—and preferred measure—is an equally-weighted index of the CCyB (from the BIS and ESRB data), LTV ratio (from the iMaPP database), and FX macroprudential stance (calculated based on the iMaPP data using the aggregation procedure above).[15] All three components of the index are scaled based on their standard deviations, and the LTV ratio is expressed as 100-LTV, so that a higher value is a tighter stance (to correspond to the other indicators). This index has the important advantages of incorporating the two best intensity measures of macroprudential policy that are comparable across countries (the CCyB and LTV ratio) and incorporating adjustments to policy in 2020 after the spread of COVID-19 (in the CCyB). It also benefits from incorporating adjustments in three of the most widely used tools that target different risk areas: countercyclical risk in banks, the housing sector, and international exposures. The disadvantage is that the measure does not incorporate other tools that may be widely used in certain countries.

Our second measure of the macroprudential stance focuses only on statistics that incorporate intensity and are most comparable across countries. We calculate the first principal component of the CCyB and LTV ratio using the above data. This measure has the advantage of "letting the data speak" to extract the macroprudential stance without forcing a weight on the different subcomponents. This measure also has the advantage of capturing changes that occurred after the start of the COVID pandemic (through changes in the CCyB). This measure has the disadvantage, however, of reflecting a narrower set of policies, as it does not include

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[14] We have also used several other definitions, such as a dummy equal to one if the country tightened policy five times or more, or tightened more than the mean each quarter, or more than the mean/median plus one standard deviation. The key results are similar to the measures reported in our base case using the closest methodology (such as focusing more on the time-series dimension using an absolute cutoff or the cross-section dimension using a relative cutoff).

[15] The FX macroprudential stance is the sum of the dummy variables measuring changes in macroprudential policy targeting international exposures, including capital requirements on FX-loans; limits on FX lending or rules or recommendations on FX loans; and limits on net or gross open FX positions, limits on FX exposures and FX funding, and currency mismatch regulations.

changes in FX regulations, which are an important part of the macroprudential toolkit for many emerging markets.[16]

Our final two measures of the macroprudential stance are based on the aggregated measure of policy changes discussed above (and shown in the top panel of Figure 2). Our third measure focuses on each country's macroprudential stance relative to other countries, calculated as a dummy equal to one if a country's macroprudential stance is tighter than the sample median over the year. Our final measure focuses on each country's stance on an absolute basis (instead of relative to other countries) and is simply a dummy variable equal to 1 if a country has tightened macroprudential policy more than once on net since 2000.[17] Therefore, these two measures will capture very different approaches to defining a "tight" macroprudential stance. The former defines "tight" relative to other countries and therefore may not capture the general tightening in policy stances that occurred over time. By contrast, the latter defines "tight" relative to the time series and will capture the general tightening later in the sample but miss many cross-country differences within this broader time-series trend.

The bottom of Figure 2 graphs the resulting four measures of the macroprudential policy stance that will be the baseline throughout this paper: the *Broad Intensity Index* (the equally weighted index of the CCyB, LTV, and FX measures), the *Narrow Intensity Index* (the principal component of the CCyB and LTV), the *Country Relative Dummy* (a dummy if the aggregate index is above the sample median each quarter) and the *Time Relative Dummy* (a dummy if the aggregate index is above one). The figure highlights the different concepts that each of these measures captures. The *Intensity* indices and *Time Relative Dummy* capture the general tightening in macroprudential stances over the 2010s. The indices that incorporate the CCyB capture the loosening during 2020. The *Country Relative Dummy* misses these time trends but has a consistent share of the sample that is defined as having a "tight" or "loose" macroprudential stance. In contrast, the *Time Relative Dummy* has most of the sample with a "loose" macroprudential stance at the start and "tight" stance at the end of the sample. While the two *Intensity* indices capture intensity over both the time series and cross-section, they do not include as many macroprudential tools as the dummy-based measures.

3.2. The RORO Measure of Risk

While an extensive literature has highlighted the impact of risk (as measured by the VIX) on capital flows and investment portfolios (i.e., Forbes and Warnock, 2012), recent work has highlighted the benefits of measuring risk using a broader measure than simply the VIX (see Miranda-Agrippino and Rey, 2015 and Scheubel et al., 2019). We build on this literature and focus on a broader measure of risk calculated following the method developed in Chari et al. (2020). This method computes a risk-on/risk-off (RORO) index which index captures the

[16] We have calculated a principal component that also includes changes in the macroprudential stance for FX exposure based on the aggregated dummy variables. The main results are basically the same as for the equally-weighted index of the three measures. A principal component should not be calculated using two continuous measures and one based on dummy variables, however, so we focus on the equally-weighted index.

[17] We use more than one tightening as the cutoff as it is between the sample mean (2) and median tightening (0), but at least requires more than one tightening to qualify as "tighter" policy.

realized variation in global investor risk appetite using the first principal component of a multi-faceted set of daily changes in several standardized asset market variables. Briefly, the method is as follows. The index's components are normalized, such that positive changes in the index imply risk-off behavior, and their respective historical standard deviations scale the normalized changes. Finally, we extract the first principal component and compute the z-score, which serves as the RORO measure.

The RORO index incorporates several series. To capture changes related to credit risk, it uses the change in the ICE BofA BBB Corporate Index Option-Adjusted Spread for the United States and the Euro Area, along with Moody's BAA corporate bond yield relative to that for 10-year Treasuries. To capture changes in risk aversion emanating from advanced economy equity markets, it includes the additive inverse of total daily returns on the S&P 500, STOXX 50, and MSCI Advanced Economies Index, along with associated changes in option implied volatilities from the VIX and the VSTOXX. To account for changes to funding liquidity, it uses the average daily change in the G-spread on 2-, 5-, and 10-year Treasuries, along with changes in the TED spread, the 3-month LIBOR-OIS spread, and the bid-ask spread on 3-month Treasuries. Finally, the index includes the growth in the trade-weighted US Dollar Index against other advanced economies and the spot gold price change.

Figure 3 displays the time series of the resulting RORO index. There is a sharp increase in the index around the 2008 global financial crisis and 2020 COVID crisis (as expected), and more moderate swings in risk-on and risk-off in other windows. The distribution is skewed with long tails toward risk-off, indicating that large risk-off events occur more frequently than large risk-on events. This measure of the global financial cycle exhibits not only significant skewness, but also fat tails. Chari et al. (2020) illustrate that adverse RORO shocks reduce median emerging market capital flows and returns and shift their distributions to the left, especially for the left tail (i.e., weaker flows and returns).

3.3. The Portfolio Flow Data

To assess the relationships between macroprudential regulations, risk shocks, and portfolio investment, we focus on the Country Flows dataset from Emerging Portfolio Fund Research (EFPR) Global. This dataset has high-frequency information on portfolio investment in a large sample of countries. Specifically, EPFR Global publishes weekly portfolio investment flows by more than 14,000 equity funds and more than 7,000 bond funds, with more than USD 8 trillion of capital under management. The Country Flows dataset combines EPFR's Fund Flow data (which reports the amount of cash flowing into and out investment funds) and Country Weightings data (which reports fund manager allocations to each of the various markets in which they invest).[18] Combining these two datasets allows us to track a large proportion of money flows into world equity and bond markets by portfolio investors (Jotikasthira, Lundblad, and Ramadorai, 2012). Moreover, because the country flows comprise the sum of fund-level aggregate re-allocations, they come cleansed of valuation effects and represent real quantities. Although this dataset does not focus on cross-border capital flows (as it includes domestically

[18] Since all funds do not report their allocations to all countries, the EPFR estimates some allocations. See Koepke and Paetzold (2020) for details on the EPFR data and how it compares to data on international capital flows.

domiciled funds) and does not include all portfolio investors (such as sovereign wealth funds and hedge funds), the flows have significant predictive content for lower frequency, aggregate data on international portfolio flows (Koepke and Paetzold, 2020).

Using the EPFR data, we scale the bond and equity flows in a given month *t* by the holdings in the previous month, *t-1*. We also include the lag of the resulting scaled variable as an additional control in our benchmark specifications. The scaling and control for lagged flows ensure that the larger countries with larger capital flows do not mechanically drive the analysis. The EPFR flows are winsorized at the 0.5% and 99.5% levels to prevent several large outliers (that appear to be errors) from driving the results.

3.4. Policy Shocks, Other Control Variables and Final Data Set

In the first stage of our main approach, we estimate a country's macroprudential policy stance as a function of a large set of variables capturing the risks and vulnerabilities for financial stability that could cause policy makers to adjust macroprudential regulations. This list of eighteen variables draws from Cerutti et al. (2015, 2017), Cizel et al. (2019), and Ahnert et al. (2021), and be can roughly divided into four groups: “Crisis”, “Credit”, “Growth”, and other macro/institutional characteristics. Details on each of these variable sources and definitions are in Appendix Table A.

The first set of variables, “Crisis”, includes whether the country has had a crisis in the last 12 months (from Laeven and Valencia, 2020), a z-score of the distance to default in a country's banking sector (from the Global Financial Development Database), the count of countries in crisis and intensity of the financial crisis index over the last half year (based on Romer and Romer, 2019), and a count of the number of countries in a sovereign debt, currency, or banking crisis (from Laeven and Valencia, 2020). The second set of variables, “Credit”, includes the cross-border borrowing ratio (using BIS data on external claims and claims on public non-financial corporations), domestic credit growth (measured as the percent change in private credit as a share of GDP from the IMF’s *International Financial Statistics*), and the growth in property prices (for real residential property prices from the BIS). The third set of variables, “Growth”, includes real exchange rate appreciation (of broad exchange rate indices from Bruegel), forecast GDP growth (from the IMF's *World Economic Outlook*), inflation expectations as proxied by lagged year-on-year CPI inflation (from Haver), and real GDP growth (from Haver). Finally, the last set of variables is other macro and institutional characteristics: financial openness (measured by the Chinn-Ito index), FX volatility (based on data from Haver), an index of institutional quality (based on the legal environment from the ICRG), the policy interest rate, the policy rate differential vis-à-vis the US federal funds rate, and a fixed exchange rate dummy (based on Ilzetski et al., 2019).

We use these four sets of variables to predict the “policy shock”, i.e., the exogenous component of each of the four measures of the macroprudential stance developed in Section 3.1. Then, in our baseline analysis (discussed in the next section), we estimate regressions using these macroprudential shocks and a set of standard global/push and domestic/pull variables to understand portfolio flows. We build most closely on the push and pull variables used in Chari et al. (2020), which in turn draws on the extensive literature on the determinants of capital flows.

For the push variables that reflect global conditions, we include the *AE Monetary Stance* and *AE IP Growth*, measured by the short-run shadow interest rate and growth in industrial production, respectively for the four largest advanced economies.[19] The shadow rate should capture monetary policy changes that occur through changes in the policy interest rate and "unconventional" tools, such as quantitative easing. To control for other slow-moving aspects of the business cycle and for changes to the mutual fund and ETF industries over time, we also include year fixed effects.

For the pull variables that capture country-specific conditions, we include the *Exchange Rate* (bilateral exchange rate with the US dollar), *i-i** (the interest rate differential with the US), *Real Growth* (domestic, quarterly, real GDP growth) and *FX Volatility* (the volatility of the exchange rate over the past thirty days). We also include two slow-moving structural variables: *Openness* (each country's financial openness, measured using the Chinn-Ito index) and *Institutional Quality* (measured using the ICRG index).[20] Except for *FX Volatility*, all control variables enter as lagged values in the benchmark specifications to reduce endogeneity concerns. Finally, all specifications include a country fixed effect. Appendix B reports additional details on the definitions and sources of these control variables.

After merging the EPFR data with the data on macroprudential regulations and the full set of controls, the resulting sample includes 55 advanced and emerging markets. We exclude the United States, Japan, and Switzerland from our main analysis, as the relationships between risk shocks and capital flows that are the focus of this paper would likely differ for these safe-haven countries. A list of countries in the baseline sample is in Appendix C. Summary statistics, and additional information on key variables are in Appendix D.

4. The Macroprudential Stance and Risk: Bond Flows across the Global Financial Cycle

In order to analyze how macroprudential policies affect portfolio flows' sensitivity to the global financial cycle during extreme events and more normal times, this section begins by developing the methodology used as the baseline in this paper. In order to address potential endogeneity in a country's macroprudential stance, we use a policy shock approach that extracts the portion of the macroprudential stance that remains after accounting for observables determining capital flows. Then it uses the variables discussed in the last section to estimate how investors adjust their portfolios based on a country's macroprudential stance, the risk environment, and their interaction—on average and at different points in the risk distribution.

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[19] Advanced economy push variables are calculated as chained USD denominated GDP-weighted averages for the relevant variable for the US, Japan, UK and Euro area. The shadow rates were provided by Leo Krippner and accessed via Haver. More information is available at: https://www.ljkmfa.com/

[20] For more information on the Chinn-Ito index, see Chinn and Ito (2008) and http://web.pdx.edu/~ito/Chinn-Ito_website.htm. For more information on the ICRG index, see https://www.prsgroup.com/explore-our-products/international-country-risk-guide/

Next we compare the baseline results to standard OLS estimates that do not use a policy-shocks two-stage approach to control for reverse causality and selection bias, and the section closes by examining the impact of more granular measures of the macroprudential stance to understand which specific policies drive the key results.

4.1. Empirical Methodology

Any empirical assessment of the impact of macroprudential policies must address a perennial challenge in this literature; changes in the dependent variables could lead to changes in macroprudential policy instead of vice versa (reverse causality). In the present framework, such reverse causality could occur if a sharp increase in portfolio flows raised concerns about domestic financial stability risks, causing policymakers to tighten macroprudential regulations. This could generate a positive correlation between portfolio flows and the macroprudential stance—a relationship aggravated during large risk shocks when policymakers are likely to pay closer attention to large moves in portfolio flows. Most papers attempt to address the challenge of reverse causality by lagging their macroprudential policy measures, but this approach is unlikely to fully address endogeneity concerns (see Forbes, 2021 for more details).

To better address any potential issues from reverse causality, we extract exogenous macroprudential shocks as a proxy for the macroprudential policy stance. This approach builds on previous work in the macroeconomics literature assessing the impact of policy shocks, such as papers constructing exogenous fiscal policy shocks (Auerbach and Gorodnichenko, 2013), exogenous monetary policy shocks (Furceri, Lougani, and Zdzienicka, 2016), and exogenous FX regulation shocks (Ahnert et al., 2021). In order to apply this approach to our analysis, we estimate a first-stage regression of the macroprudential stance on a large set of variables that could affect the implementation of macroprudential regulation. Next, we use a subset of these explanatory variables to predict the macroprudential stance. The residual of this regression is the macroprudential policy shock, which we use as the measure of the macroprudential policy stance in our baseline fixed-effects regressions.

More specifically, we begin by estimating a first-stage regression of the macroprudential stance on the four sets of variables that could affect the implementation of macroprudential policies:

$$MP_{it} = \alpha_i + \boldsymbol{\beta_1 Crisis_{it-1}} + \boldsymbol{\beta_2 Credit_{it-1}} + \boldsymbol{\beta_3 Growth_{it-1}} + \boldsymbol{\beta_4 Controls_{it-1}} + \varepsilon_{i,t} \quad (1)$$

$$\widetilde{MP}_{it} = MP_{it} - \widehat{MP}_{it} \quad (2)$$

The definitions and sources for each of the eighteen variables used to measure “Crisis”, “Credit”, “Growth” and other “Controls” are discussed above in Section 3.4, with more detail in Appendix A. These variables are chosen to be consistent with the literature on the factors driving the use of macroprudential and prudential regulations more broadly, including Ahnert et al. (2020), Cerutti et al. (2015) and Cerutti et al. (2017). After estimating equation (1) with the full set of eighteen variables, we then use backward and forward inclusion to drop insignificant variables and add significant ones in order to narrow down the set of explanatory variables. This process sequentially excludes explanatory variables that do not meet conventional levels of statistical significance. Then, the set of excluded variables is reintroduced one at a time to determine whether they meet the threshold when included in the more parsimonious set. This process continues until each excluded variable has been reintroduced for each such significant set of variables.

Next, we use the resulting subset of the variables in equation (1) to predict the macroprudential stance ($\widehat{MP}_{it}$). Then, we subtract the predicted value of the macroprudential stance from the actual value to calculate the macroprudential policy shock ($\widetilde{MP}_{it}$), as in equation (2). This policy shock provides a more exogenous measure of each country's macroprudential stance in each period, which we use as the explanatory variable in the second stage regression (equation 3):

$$PI_{it} = \alpha_i + \beta_1 \widetilde{MP}_{i,t} + \beta_2 RISK_t + \beta_3 \widetilde{MP}_{i,t} * RISK_t + \boldsymbol{\gamma PUSH_t} + \boldsymbol{\delta PULL_{i,t}} + \delta_t + \varepsilon_{i,t}. \quad (3)$$

This baseline regression models portfolio flows as a function of the macroprudential policy shock (which proxies for a country's *ex ante* macroprudential policy stance), global risk, the interaction between the macroprudential policy shock and risk, and other push/global and pull/local factors.[21] Portfolio Investment (PI_{it}) measures portfolio flows into equity or debt (or in different currencies) for each country *i* in week *t*. $\widetilde{MP}_{i,t}$ is the policy shock from equations (1) and (2), and $RISK_t$ is the risk-on, risk-off (RORO) measure (discussed above), with higher values indicating risk-off. The α_i is country fixed effects and δ_t is year fixed effects, with the latter included to control for slow-moving business cycle effects, slower-moving changes in global financial conditions, and any structural changes (such as in the market for ETFs). We also include a lag of the relevant left-hand side variable to account for the autocorrelation introduced by scaling over lagged positions. As mentioned previously, the specification also includes additional global/push and domestic/pull variables to capture other factors that can affect portfolio flows.

The key coefficients of interest in equation (3) are the β's, which capture the effects of global risk, the domestic macroprudential stance, and their interaction, on portfolio investment. As discussed above, previous research generally finds a negative effect of risk shocks on portfolio flows, so β_2 would be expected to be negative (notwithstanding some evidence that the effect has weakened since 2008). The literature has often found that macroprudential regulation has no consistently significant effect on portfolio flows, albeit with some exceptions. Some papers find evidence that tighter regulation can reduce flows (especially if the analysis focuses on bank flows or includes bank flows in a measure of aggregate flows), while others find a weakly positive effect of regulations (especially if the analysis focuses on bond and equity flows, which can increase if financial intermediation shifts away from banks). These findings suggest that β_1 could be of any sign but is likely to be insignificant. There is no prior evidence on the

[21] To correct for the estimated regressors, we bootstrap 10,000 replications of the two-step process, clustering by country.

interaction of risk shocks and macroprudential regulations, but a negative (positive) coefficient on β_3 would indicate that *ex ante* macroprudential regulations aggravate (mitigate) the effects of risk shocks on portfolio flows when risk is near the mean of its distribution. In the discussion below, we will refer to estimates of β_1 as the "conditional" estimates between risk and macroprudential policy when it controls for the interaction between macroprudential regulations and the policy stance as in equation (3). We will also compare these results to the "unconditional" estimates for β_1, which are closer to the existing literature as they do not include the interaction between risk and the policy stance (i.e., the β_3 term).

Finally, since equation (3) provides information about the <u>average</u> effects of macroprudential regulation, risk, and their interaction on portfolio allocation, we also calculate a series of marginal effects conditioning on the macroprudential stance for different points of the risk distribution. These calculations examine whether the *ex ante* macroprudential stance mitigates or amplifies the impact of risk shocks at different stages of the global financial cycle. More specifically, we compute the first derivative of portfolio investment with respect to our macroprudential measure as follows:

$$\frac{\partial PI_{it}}{\partial \widetilde{MP}_{i,t}}|_{RISK_t=\bar{r}} = \beta_1 + \beta_3\bar{r} \quad . \qquad (4)$$

Next, we evaluate the above marginal effect of the macroprudential policy stance at different points of the risk shock distribution. The *RISK* measure takes on different values ranging from the 0.5^{th} to the 99.5^{th} percentile across the distribution, which constitutes points at which we can compute marginal effects. We do this to examine whether a particular macroprudential stance amplifies or mitigates the impact of these different risk shocks on capital flows.[22]

If macroprudential regulation amplifies the effects of the global financial cycle on portfolio flows, we would expect larger capital inflows at the left of the risk distribution (risk-on shocks) and larger capital outflows at the right of the distribution (risk-off shocks). These effects at the extremes could be significant even if the marginal effect of a tighter macroprudential stance around the mean of the risk distribution is insignificant. By estimating these marginal effects at all points in the risk distribution, we can also assess if the effects are larger at the "extreme extremes" (0.5^{th} and 99.5^{th} percentiles), or if they are larger at one end of the distribution (such as risk-off shocks).

[22] To understand the computation of the marginal effects further, starting with our benchmark specification in equation 3, we can take the first derivative of capital flows with respect to different *ex ante* macroprudential stances. Note that $\frac{\partial PI_{it}}{\partial \widetilde{MP}_{i,t}}$ @ $\widetilde{MP}_{i,t} = 0$ is 0 and $\frac{\partial PI_{it}}{\partial \widetilde{MP}_{i,t}}$ @ $\widetilde{MP}_{i,t} = 1$ is $\beta_1 + \beta_3\bar{r}$. The difference between the two derivative values gives us the marginal effect which we can evaluate at different values of *RISK* across the distribution.

4.2. Baseline Analysis

To begin, Table 1 presents results from the first-stage regressions from which we extract our policy shocks. The left panel reports results when all the possible variables are included, and the right shows results after the backward and forward inclusion. The instruments generally have the expected signs, and many are statistically significant—especially on the right side of the table, which would be expected as the narrower set of instruments reduces multicollinearity. The results suggest that a tighter macroprudential policy stance corresponds to more cross-border borrowing, higher inflation, more FX volatility, a longer time to default, recent exchange rate appreciation, having a recent banking crisis, lower domestic policy rates, a larger interest rate differential with the global rate, a more flexible exchange rate, and faster domestic credit growth. For several variables, the sign of the relationship varies based on the measure of the macroprudential stance. We have also estimated these models using different combinations of variables in the first stage, and without using the inclusion/exclusion procedures to narrow down the variable list, and these changes have no meaningful impact on our second stage results reported below.

The explanatory power of these first-stage regressions is relatively high, with F-statistics around 100 for our preferred *Intensity* indices. This is an improvement over past work, which has had more limited success in predicting the use of macroprudential regulations. The greater success of these first stage estimates in Table 1 likely reflect three innovations in this paper. First, we are estimating the macroprudential policy stance, instead of changes in regulations over a quarter or year, which can be challenging as many hard-to-measure factors can affect the precise timing of changes in policy (including political events, institutional structure, pre-set meeting dates, etc.). Second, and closely related, we focus on macroprudential measures that capture the intensity of policies, rather than using dummies that do not capture magnitudes. Finally, we use higher frequency data that can better capture changes in financial variables that could affect decisions about the macroprudential stance.

Next, we use the coefficients in Table 1 to estimate the fitted values of the macroprudential stance and calculate our measure of the macroprudential policy shock (the residual from equation (2)) to use in our baseline estimates. Table 2 reports these baseline second-stage estimates of the effects of changes in the risk-on/risk-off index and macroprudential policy stance on weekly bond flows (equation 3). Each column reports results using one of the four different measures of the macroprudential stance discussed in Section 3.1: the *Broad Intensity Index* (our preferred measure, the equally weighted index of the CCyB, LTV ratio, and FX stance), the *Narrow Intensity Index* (the principal component of the CCyB and LTV ratio), the *Country Relative Dummy* (a dummy if the aggregate index is above the sample median each quarter) and the *Time Relative Dummy* (a dummy if the aggregate index is above one). We cluster robust standard errors by country in all specifications.

The coefficient estimates show that higher RORO values (i.e., risk-off shocks) are associated with sizable and statistically significant declines in portfolio bond flows across all macroprudential measures. In contrast, tighter macroprudential policy (ignoring the interaction with risk) is not significantly correlated with bond flows. Both of these results agree with the existing literature, as do the global/push and domestic/pull coefficient estimates. For example, the global variables are more consistently significant—with stronger global growth and looser monetary policy in advanced economies significantly correlated with larger portfolio debt flows. Some of the domestic variables are also significant, such as a larger interest rate differential (relative to the U.S.) significantly correlated with weaker bond flows.

More noteworthy are the coefficient estimates on the interaction between the macroprudential stance and risk, which was not previously included in this literature. This interaction is negative and usually significant (in three of the four macroprudential measures, including the two preferred *Intensity* indices). These estimates suggest that when the RORO measure of risk is near the mean of its distribution, a tighter macroprudential stance amplifies the impact of the global financial cycle on bond flows (i.e., increases bond outflows when risk increases and increases bond inflows when risk falls).

But how large are these magnification effects—especially in comparison to the unconditional effects of risk shocks and macroprudential policy? To help put these in context, it is useful to compare these estimates with those from the "unconditional" regressions—for equation (3) but excluding the interaction between risk and the macroprudential stance. The key coefficients from this unconditional regression are reported at the top of Table 3, with the corresponding key coefficients for the conditional regression (from Table 2) in the middle of the table. These unconditional estimates suggest that an increase in the RORO index of one unit[23] corresponds to an 0.09%-0.10% decline in weekly bond flows, equivalent to -$2.3 to -$2.4 billion (based on AUM at the start of 2020). This finding agrees with the extensive literature documenting a large, adverse effect of risk shocks on portfolio flows.[24] In contrast, the relationship between portfolio flows and the macroprudential stance is not only insignificant but estimated to be weak in magnitude—with an increase in macroprudential regulation of one unit (which is less than one standard deviation) reducing capital flows by about one-tenth of the impact of a one-unit increase in risk.

These unconditional estimates, however, do not capture the interaction effect between risk and the macroprudential stance. The middle of Table 3 suggests that the magnitude of this interaction effect, however, is modest near the mean of the risk distribution, especially compared to the unconditional effects of risk shocks. For example, the results suggest that if a country has a one unit[25] tighter *ex ante* macroprudential stance and global risk increased by one unit, this correlates to an additional decline in bond inflows of about $242-$840 million (0.01% to 0.05%)

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[23]This increase of one in the RORO measure is a moderate and common increase in risk, as shown in Figure 3. It is equivalent to one standard deviation and close to the 90th percentile of the distribution for the full the sample.

[24] For example, see Chari et al. (2020, 2021) for evidence on portfolio flows, Forbes and Warnock (2012) for evidence for extreme capital flow movements, and Rey (2013) for evidence across a broad set of asset categories. Recent work has suggested that this relationship between risk measures (such as the VIX) and capital flows may have weakened since 2008 (see Forbes, 2020), although this evidence is based on quarterly data that may miss the high frequency movements captured in this paper.

[25] An increase of one unit for the *Broad* or *Narrow Intensity Indices* is close to one standard deviation (see Appendix Table D). An increase of 1 unit for the *Country* or *Time Relative Dummies* is equivalent to tightening regulation so that the dummy moves from 0 to 1, i.e., if a country moves from having aggregate regulation weaker than the median to tighter than the median in a given period (the *Country Relative Dummy*) or adjusts regulations to move from one or less net tightenings across measures to more than one (the *Time Relative Dummy*).

using the AUM at the start of 2020. These magnitudes suggest a meaningful impact—but moderate when compared to the unconditional impact of a one unit increase in risk (which corresponds to a decline in bond inflow of over -$2 billion).

These moderate estimates of the impact of a country's macroprudential stance (including its interaction with risk) on bond flows, however, capture the average effects across the full distribution of the risk index. As discussed above, a tighter macroprudential stance could mitigate or amplify the impact of risk shocks at the extremes of the risk distribution in different ways from around the mean of the RORO index. In other words, relationships estimated at the mean of the risk distribution may obscure the effect at other points in the global financial cycle, and especially at the extremes.

To capture these effects at different stages of the global financial cycle, we calculate the marginal effects on bond investments of adjusting the *ex ante* macroprudential stance by one unit at different realizations of the RORO index.[26] These marginal effects include any direct impact plus any impact through the interaction of the macroprudential stance with the RORO index multiplied by the size of the risk shock. The bottom of Table 3 shows these results, reporting the marginal effects from this tighter macroprudential stance as the RORO index moves from extreme risk-on to extreme risk-off (at the bottom of the table).

As we suspected, smaller estimates near the mean obscure relationships in the tails of the risk distribution. The marginal effects from having a tighter macroprudential stance varies meaningfully across the risk distribution for bond flows, with positive marginal effects of tighter macroprudential policy for risk-on shocks (RORO<0) and negative effects for risk-off shocks (RORO>0). In other words, adopting a tighter macroprudential stance amplifies the subsequent effects of risk shocks at both ends of the distribution, by increasing bond inflows during risk-on periods and increasing bond outflows during risk-off episodes. These effects are highly significant across our preferred indices of the macroprudential stance, and only insignificant for risk-on episodes using the time-relative measure of the policy stance. The magnitudes of these amplification effects also increase more at the extremes of the risk distribution, with especially large marginal effects at the 99th and 99.5th percentiles of the distribution (i.e., for extreme risk-off shocks).

Moreover, the coefficients suggest that the magnitudes of these amplification effects between risk and the macroprudential stance can be large and meaningful at the extremes of the risk distribution—even when compared to the large, unconditional effects of risk shocks. For example, increasing macroprudential regulation by one for the *Broad Intensity Index* corresponds to bond flows statistically indistinguishable from zero when risk is at the median level, but a decline in flows of -$745mn, -$1,707mn, and -$2,296mn when risk is at the 95th, 99th and 99.5th percentiles of the distribution, respectively.[27] This is a significant amplification of risk shocks compared to the unconditional effect of -$2 billion from the same risk-off shock (which does not incorporate this impact of macroprudential policy and its interaction effects). The effects during

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[26] This is equivalent to the macroprudential index increasing by 1 when measured by the *Broad or Narrow Intensity Index*, or moving from 0 to 1 when measured by the *Country* or *Time Relative Dummy Variables*.
[27] Based on AUM at the start of 2020.

risk-on episodes tend to be meaningful, but smaller at the extremes of the distribution, with the same increase in macroprudential regulations corresponding to bond inflows of +$621mn, +$981mn, and +$1,248mn during risk-on episodes when the RORO index is at the 5th, 1st and 0.5th percentiles of the distribution, respectively.

Finally, to further put the magnitudes of these risk shocks in context, consider an example of a shock that causes risk to increase to the 99th percentile of the distribution (3.49), which Figure 3 shows occurred during the Global Financial Crisis in 2008 and 2009, the Euro crisis in 2011, and during the COVID pandemic. For countries with the *Broad* or *Narrow* macroprudential index set at zero, this corresponds to bond outflows of $7.9 bn. For countries with a macroprudential index one unit higher, this would instead correspond to bond outflows of $11.6-$16.5 billion. In other words, this *ex ante* tighter macroprudential policy stance would amplify the impact of risk-off shocks on bond outflows by about 30%-96% (based on all four measures of the macroprudential policy stance, or by 47%-75% for our preferred two intensity indices).

These large movements in capital flows resulting from the interaction of macroprudential regulations and risk at different phases of the global financial cycle and correspond to significant disruptions in financial and economic activity. Analyses focusing on estimates based on risk outcomes at the central tendency of the risk distribution, however, overlook these interactions. These results highlight the importance of analyzing these effects across the complete financial cycle and assessing the relationships at the extremes of the distribution.

4.3. Alternative Methodology: Ignoring Endogeneity

This paper focuses on the “policy-shock approach”, which estimates a more exogenous measure of the macroprudential stance in a first-stage regression in order to control for reverse causality between portfolio flows and a country’s macroprudential stance. This methodology is an improvement over most past work and is possible due to the new measures of the regulatory stance that better incorporate the intensity of macroprudential policy, in addition to the high frequency and longer time series of the data used in this analysis. For comparison with past work, however, this section reports key results using a more traditional OLS estimation methodology, which simply lags measures of the macroprudential stance to address reverse causality.

To begin, we repeat our baseline estimates from equation (3), but instead of using the constructed measure of the macroprudential policy shock, simply insert a lagged measure of the macroprudential stance. We continue to use the same four measures for the macroprudential stance, as well as the same measure for risk and the other control variables as discussed above. The results of the key coefficients in the unconditional regressions, conditional regressions, and marginal effects are reported in Table 4. This corresponds directly to Table 3 (estimated with the policy-shocks methodology).

The estimates in Table 4 are similar to those based on the policy shocks approach. The pattern of coefficient signs and significance is qualitatively similar, and the estimated interactions between the macroprudential stance and risk at different points in the risk distribution continue to suggest that a tighter stance amplifies the impact of risk shocks on bond flows. The primary difference, however, is that the policy shocks approach has greater power and usually delivers larger coefficient estimates at both the mean and the margins of the risk distribution.

4.4. More Granular Measures of the Macroprudential Stance

The analysis above controls for countries' macroprudential stances with four newly constructed measures (discussed in Section 3.1) that aggregate across different macroprudential tools. The indices are useful in capturing a country's general macroprudential stance but could miss important distinctions in how individual macroprudential tools interact with portfolio flows and risk. These broader measures also do not answer a key question for policymakers: what are the effects of adjusting a specific macroprudential tool? Do different types of macroprudential regulations have different effects?

To better understand if specific macroprudential tools, or types of tools, have different effects, we repeat the baseline analysis separately for more granular measures of the macroprudential stance. More specifically, we focus on five measures. The first two measures are the two variables that can be expressed in magnitudes that are fairly comparable across countries: the LTV ratio and CCyB. Details on both of these measures are in Section 3.1. The other three measures aggregate tools that focus on a specific aspect of macroprudential regulation: *FX Measures* which target foreign-currency exposures and transactions (and are defined in Section 3.1 as part of the *Broad Intensity Index*); *Demand Measures,* which focus on the demand for loans, including debt-service-to-income (DSTI) and loan-to-value limits (LTV); *Supply Measures*, which are a broad range of tools focusing on the bank's ability to supply credit.[28] These three categories of tools are calculated by summing dummy variables of changes in the relevant tools since 2000 based on the iMaPP data, with each tightening of the relevant tool denoted by a +1 and each loosening by a -1. Although changes in each of these tools are not as comparable across countries as for the LTV ratio and CCyB, the cumulative adjustment in each type of tool should provide a rough measure of the intensity of use.[29]

Next, we estimate our baseline model predicting bond investment using the policy-shock approach for each of these five more granular measures of the macroprudential policy stance. Table 5 reports the results, using the same format as Tables 3 and 4. The top of the table confirms the main results from the more aggregated macroprudential measures: risk shocks are correlated with significantly lower bond flows, and the macroprudential stance does not significantly affect flows—even using these more disaggregated measures.

The main differences in these results for the more granular measures of the macroprudential stance are the coefficients on the interaction between risk and the

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[28] Policies targeting the supply of credit include reserve requirements, liquidity requirements, capital requirements, conservation buffers, the leverage ratio, capital surcharges for systemically-important financial institutions, countercyclical capital buffers, limits on credit growth, loan loss provisions, and loan restrictions.
[29] As discussed in Section 3.1, however, these cumulative measures may overstate the intensity of the macroprudential stance if a country adjusts the given tool often, but by small increments.

macroprudential stance—at the extremes as well as the mean of the risk distribution. Adjustments in *LTV ratios, FX Measures,* and *Supply Measures* correspond to those for the aggregate macroprudential measures; they significantly amplify the impact of risk shocks, particularly for extreme "risk-off" shocks. The *CCyB* and *Demand Measures* appear to work in the same direction, but the effects are usually not significant, including at both extremes of the risk distribution.

These varied effects of different macroprudential tools on bond flows suggest that some of these tools work as expected, while others may have unintended consequences. For example, the *CCyB* is a policy focused on moderating the impact of the financial cycle on financial institutions. It adjusts bank capital buffers across the cycle, such that buffers should be higher during risk-on periods and lower during risk-off periods. Even if the *CCyB* remains constant, it is more likely to bind and affect lending and credit growth during sharp risk-on and risk-off movements. Given this focus, it is not surprising that the *CCyB* does not significantly amplify the impact of risk shocks as found for other measures.[30]

On the other hand, the results for *FX Measures*, the *LTV* ratio and *Supply Measures* suggest that some macroprudential policies may have the unintended consequence of shifting risks to portfolio flows. This supports evidence from other research that has examined the impact of these types of regulations in more detail and provide clear evidence of how these leakages occur. For example, Ahnert et al. (2021) document that tighter FX regulations on banks reduce bank lending and borrowing in FX, but then cause companies to shift to other sources of cheaper FX credit, especially through issuing bonds that are sold to non-bank investors. Their underlying model shows that this shift away from bank loans occurs in riskier firms that are less well hedged against currency risk—a shift which would make bond flows more sensitive to global financial conditions (on average and particularly at the extremes of the risk distribution)—as found above. Similarly, Sveriges Riksbank (2012) provides a concrete example of how a tighter LTV ratio could have similar effects. When Sweden increased LTV limits on secured lending, making it harder for borrowers to purchase homes with mortgages secured by property, there was an increase in unsecured loans. These unsecured loans, which are then often packaged and sold to bond investors, are likely to be more sensitive to risk shocks than those backed by assets, thereby increasing the sensitivity of bond investments—even if there is no increase in the underlying volume of flows.

It is also worth noting that this result of significant interaction effects between risk and macroprudential regulations from tighter LTV ratios, but not tighter *Demand Measures* (which primarily consist of changes in LTV and DSTI ratios) supports our focus of using measures of the macroprudential stance that incorporate intensity, rather than being based on dummy

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[30] This result is supported by estimates (not reported) from a more granular breakdown of *Supply Measures*. *Supply Measures* includes three components: *Capital Measures* (which include conservation buffers, capital surcharges for SIFIs and CCyBs); *Loan Measures* (which focus on limits on credit growth, loan loss provisions, and loan restrictions), and *General Measures* (such as reserve requirements and liquidity requirements). Although the broader *Supply Measures* significantly amplifies the impact of risks shocks (as shown in Table 5), when this relationship is estimated for each of the subcomponents, it is <u>not</u> significant for *Capital Measures* (which are more cyclically focused and include the CCyB), but is significant for the other two subcomponents.

variables. More specifically, the difference in results likely reflects that the *LTV* measure is a precise magnitude measuring the intensity of the LTV ratio, while the *Demand Measures* is the sum of dummy variables for any past changes in these housing-related ratios. Further supporting the importance of capturing intensity, when the analysis is repeated with *Demand Measures* calculated based on just dummy variables indicating past changes in LTV ratios (excluding DSTI ratios), and therefore directly comparable to the *LTV* statistic except without the precise ratios, the interactions based on the dummy-based measure are insignificant. Although summing dummy variables of past changes in policy over time may create a better measure of the policy stance than simply focusing on whether a policy was changed recently, it does not appear to capture the intensity of that policy as well as precise ratios. This lack of precision in the estimates will introduce noise, making it more difficult to estimate any relationship between the macroprudential stance and risk, at the means as well as at different points in the risk distribution. These more significant results for macroprudential measures that capture intensity relative to those for the same measure based on dummy variables highlight the importance of incorporating intensity in a measure of the macroprudential stance—as done in our two preferred indices.

4.5. Summary: Bond Flows, the Macroprudential Stance and Risk across the Cycle

This series of results supports earlier evidence that risk-off episodes correspond to large and significant declines in portfolio bond investments, but also finds new evidence that a country's macroprudential stance can meaningfully amplify these effects. Even though a country's macroprudential stance does not appear to meaningfully affect the volume of bond flows directly, its interaction with risk shocks can generate significant effects. These effects are moderate at the means of the risk distribution, but large in magnitude at the extremes of the distribution. More specifically, a tighter macroprudential stance tends to amplify the negative impact of risk-off shocks (causing larger bond outflows) and of risk-on shocks (causing larger bond inflows). The magnitudes of these amplification effects are larger at the extremes, and especially for extreme risk-off episodes.

These results suggest that although macroprudential tools may improve the resilience of financial institutions to a range of shocks, they also correspond to a meaningful increase in the sensitivity of bond flows to the global financial cycle. This could increase a country's vulnerability—especially to extreme risk-off shocks. Although these spillovers from macroprudential regulations on the volume of bond flows are small on average and during more stable periods, they are large during periods of stress. This heightened vulnerability should be an essential consideration when designing a package of macroprudential policies.

5. Extensions: Equity Flows, Country Groups, Currencies and Other Sensitivity Tests

This section extends the baseline analysis on how investors adjust portfolios based on a country's macroprudential stance, risk shocks, and their interaction at different points in the risk distribution (from Section 4.2) but explores several dimensions in more detail, including for portfolio equity investments, differential effects for advanced economies relative to emerging markets, and for capital flows in different currencies. The section closes by reporting several additional sensitivity tests, such as for capital controls (instead of macroprudential regulations), excluding the COVID period, and using different risk measures.

5.1.Equity Flows, Macroprudential Policy and Risk

This section repeats the baseline analysis in Section 4, replacing bond flows with portfolio equity flows. The pattern of results is very similar to those for bond flows, albeit with smaller magnitudes for many of the estimated coefficients.

Table 6 presents the key results for equity flows. The left side of the table reports results using the aggregate measures of the macroprudential stance (comparable to Table 3), and the right side reports results using the five more granular measures (comparable to Table 5). Across each of the measures for the macroprudential stance, the risk-on/risk-off index continues to be negatively and statistically significantly correlated with portfolio flows. The unconditional effect of macroprudential policy also continues to be insignificant in most of the specifications and small in magnitude. Both of these results agree with prior work that risk shocks have significant negative effects on equity flows, while macroprudential policy tends to have modest or insignificant effects. More interesting, the interaction between macroprudential policy and risk continues to be negative and is usually significant when the macroprudential stance is measured using one of the indices (as also found for bonds). The magnitude of these coefficient estimates for equity flows, however, are smaller in magnitude than those for bond flows. In some respects, this is not surprising given that many macroprudential policy measures explicitly target debt instruments to counteract the adverse effects of excessive leverage in the economy.

Moving to the bottom of Table 6, the marginal effects from a tighter macroprudential policy stance also vary meaningfully across the risk distribution for most of the macroprudential indices, including our preferred *Broad Index*. Specifically, for equity flows there are positive marginal effects of a tighter macroprudential stance for risk-on shocks (RORO<0) and negative effects for risk-off shocks (RORO>0). In other words, a tighter macroprudential stance amplifies the effects of risk shocks at both ends of the distribution, by increasing equity inflows during risk-on periods and increasing equity outflows during risk-off episodes. The magnitudes of these amplification effects also increase more at the extremes of the risk distribution, and even though the size of the effects is smaller than for bonds, the aggregate effects on capital flows can be larger in our sample as the size of the equity portfolios included in this data is larger than for bonds. For example, increasing *ex ante* macroprudential regulation by one for the *Broad Intensity Index* corresponds to equity outflows of -$71.8mn when risk is at the median, but $659mn, $1,687mn, and $2,318mn when risk is at the 95%, 99% and 99.5% point in the distribution, respectively.[31] The conditional magnitudes constitute a significant amplification effect compared to the base effect of -$3.9 billion from the same risk-off shock. As for bonds, the effects during risk-on episodes tend to be somewhat smaller at the most extreme values, with the same increase in macroprudential regulations corresponding to equity flows of +$800mn, +$1,186mn, and +$1,473mn during risk-on episodes when the RORO index is at the 5%, 1% and 0.5% of the distribution, respectively.

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[31] Based on AUM at the start of 2020.

To further put the magnitudes of these risk shocks in context, consider once again the example of a 99^{th} % risk shock (3.49), during the Global Financial Crisis, the Euro crisis, and the COVID crisis. For countries with the *Broad* or *Narrow* macroprudential index set at zero, this corresponds to equity outflows of $13.3 billion. For countries with a one unit higher macroprudential index before the shock occurs, this would instead correspond to equity outflows of $15.8-$30.3 billion. In other words, this tighter macroprudential policy stance would amplify the impact of risk-off shocks on equity outflows by about 19%-130% (or 19%-44% for our two intensity indices). These varied effects—across different macroprudential tools and across equity and bond flows—suggest that some of these tools work as expected, while others may have unintended consequences.

Turning to the more granular measures of macroprudential regulation, the right side of Table 6 shows similar patterns as for bond flows in Table 5. A tighter macroprudential policy stance as measured by the *LTV* ratio, *FX measures* and *Supply measures* interact with risk states of the world in a negative and statistically significant way to magnify their impact on investment flows. There is also somewhat more difference in how these macroprudential policies interact with risk at different points in the risk distribution. The effects of the *LTV* ratio, *FX measures* and *Supply measures* are seen on both ends of the distribution, although the effects of the *FX* and *Supply measures* appear to be more potent during risk-off episodes, while the *LTV* ratio appears to be more potent for risk-on episodes. It is also worth noting that while the mean impact of the *CCyB* is not significant, the interaction is moderately significant for risk-on episodes. This could indicate that the CCyB could modestly amplify equity inflows during risk on episodes.

Finally, it is worth noting that although the key estimates for bond flows (in the last section), are unchanged when we use an OLS estimation methodology that does not control for reverse causality (as shown in Section 4.3), these results for equity flows can fluctuate based on whether an attempt is made to control for reverse causality. More specifically, the results reported above use the policy-shock approach (discussed in Section 4.1) to control for reverse causality between equity flows and a country's macroprudential stance. When we estimate the same model but simply use a lagged measure of the country's macroprudential stance (instead of the residuals from the first-stage regression), some of the coefficient estimates change meaningfully. For example, the naive estimates (i.e., not adjusted for reverse causality) show that a macroprudential stance stabilizes equity flows during extreme risk-off episodes, instead of amplifying capital outflows (as found in Table 6). On the face of it, this might suggest that macroprudential regulations have beneficial effects for equity portfolio flows, consistent with evidence that macroprudential policy slows credit creation and therefore capital flows. Although this effect could still occur, these unadjusted estimates are also not robust to modest changes in specification. For example, if we remove the initial period of the COVID pandemic from the sample, the interaction effects between macroprudential regulation and equity flows shift to insignificant. Given this lack of robustness, we focus on the preferred specification that should not only control for the key challenge of reverse causality, but also is more robust to these types of modifications to the sample and period.

In summary, macroprudential regulations appear to amplify the impact of changes in global investor risk on equity portfolio flows. These effects follow similar patterns as found for bond flows, including stronger effects at the tails of the risk distribution and being more potent for macroprudential regulations through changes in LTV ratios, FX measures and Supply measures. The magnitude and statistical significance of the effects of macroprudential regulation interacted with risk on equity flows is, however, more moderate than for bond flows.

5.2. Advanced Economies versus Emerging Markets

This section repeats the main results (for both bond and equity flows), but tests for different effects in advanced economies and emerging markets. In order to perform this test, we continue to use the baseline model in equation (3) but add interaction terms for our key variables with a dummy equal to one if the country is an emerging market. More specifically, we add two interaction terms: one for the EM dummy and RORO measure of risk, and another for the EM dummy, RORO measure of risk and the macroprudential stance. Columns 1 and 2 of Table 7 report the results for bond and equity flows, respectively, using our preferred measure of the macroprudential policy stance (the *Broad Intensity Index*). The bottom of the table continues to report marginal effects across the risk distribution, but now reports the marginal effects for EMs relative to AEs (from a one-unit tighter macroprudential policy stance at different points in the risk distribution).

Focusing first on the coefficient estimates near the mean of the distribution (in the middle of the table), the pattern of coefficients from the baseline analysis is unchanged, and the additional interaction terms are insignificant at the 5% level. This suggests that there are no significant differences between EMs and AEs at the mean of the distribution for the corresponding measures. The coefficient for the one interaction is negative and marginally significant at the 10% level for bonds, however, which may suggest a further amplification effect of risk shocks on bond flows for emerging markets relative to advanced economies. This is not even marginally significant for equity flows, and the coefficient for a triple interaction between macroprudential regulation, risk and a dummy for the country grouping is statistically insignificant for both types of capital flows. Moreover, the marginal effects (reported at the bottom of the table) are now calculated based on the triple interaction between risk, the macroprudential stance and the EM dummy, and these are not statistically significant at any points in the risk distribution. Together, these results suggest that the effect of macroprudential regulations in times of high risk-on or risk-off sentiment does not differ between emerging markets and advanced economies in a statistically significant manner.

5.3. Capital Flows in Different Currencies

This section repeats the baseline analysis (for both bond and equity flows), but tests for different effects for portfolio flows in USD relative to in other currencies. Most analyses of capital flows and portfolio flows use data that aggregates across flows denominated in different currencies. There has recently been increased attention, however, to how the currency denomination of capital flows can influence various relationships (Hofman et al., 2020). The EPFR data used in this paper has the important advantage over most other data on capital flows of classifying flows by currency denomination. We take advantage of this feature and examine whether the interactions between the macroprudential stance, risk and portfolio flows are more or less pronounced for dollar-denominated flows. Given the dollar's unique role in the global financial cycle, we might expect dollar-denominated, non-US assets to be more sensitive to shifts in global risk aversion. On the other hand, countries with larger US$ exposures and/or more sensitive to currency movements might also be more likely to enact macroprudential FX regulations to attempt to limit these exposures.

To begin, we divide our capital flow measures into USD flows and flows in all other currencies. We do not differentiate flows between USD flows and local currency flows because many countries in the sample receive trivially small flows in their own currency. The results, which appear in columns 3 through 6 in Table 7, confirm that, in general, dollar-denominated flows (for both equities and bonds) respond more strongly to risk-on/risk-off shocks. The differential impact of risk shocks based on the level of the macroprudential stance, however is more pronounced for non-USD denominated flows for bonds (but generally insignificant for equities). More specifically, for USD-denominated bond flows, the impact of risk shocks on countries with a tighter macroprudential stance is about 19% higher than the base case of a lower macroprudential stance. For non-USD denominated flows, the magnitude of impact is about two and a half times higher (at about 48%).

5.4. Other Extensions and Sensitivity Tests

We also performed a number of additional extensions and sensitivity tests, a subset of which are reported in columns 7 to 12 of Table 7. Each of these tests continues to replicate the baseline analysis using the policy-chock approach (for both equity and bond flows), focusing on results using our preferred measures of the macroprudential policy stance, the *Broad Intensity Index* (described in 3.1).

To begin, we test if the results change if we analyze the direct effects and interactions with risk from prior adjustments to capital controls (instead of macroprudential policy.) This extension builds on recent work (such as Bergant et al., 2020 and Frost, Ito, and Stralen, 2020) which suggests that FX-macroprudential measures can have different effects than capital controls on capital inflows and the resilience of growth to VIX and capital flow shocks.[32] In order to control for capital controls, we use data from Fernandez et al. (2015, updated through 2017), which allows a detailed disaggregation of different types of capital controls. Like our preferred measure of the macroprudential stance, the Fernandez et al. data provides detailed information on the regulatory stance, instead of capturing recent changes in policy. The data, however, has three limitations: (1) it does not capture the intensity of the capital controls;[33] (2) the latest date available is 2017; and it is only available at an annual frequency.

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[32] See Rebucci and Ma (2019) for a recent survey of the literature on capital controls.
[33] The measure uses 0-1 dummies to indicate if there is a control on specific categories of capital flows. When these are averaged across categories, the statistics can capture intensity in the sense that more categories of flows are included, but not the magnitude of each set of controls.

The results when our measure of the macroprudential stance is replaced with this measure of capital controls are reported in columns 7 and 8 of Table 7.[34] The results are similar to those for macroprudential regulations; capital controls have no independent, significant impact on bond or equity flows (ignoring the interaction with risk), but on average appear to magnify the impact of risk shocks on portfolio bond and equity flows. The interaction effects for extreme risk shocks follow similar patterns (magnifying capital inflows during risk-on periods and capital outflows during risk-off periods), although the effects are less often significant, especially for risk-on episodes for bond flows.

Next, we repeat the baseline analysis focusing on the role of the macroprudential stance (measured by the Broad Index) but drop the period of the COVID shock. This window was by far the biggest shock in the sample and coincided with sharp reductions in the CCyB and *Broad Intensity Index*. The results from dropping the window from February 15, 2020 through the end of the sample are shown in columns 9 and 10. (Estimates are similar if we only drop March 2020, the month of the sharpest risk-off move.) The key results remain robust and suggest the key estimates are not driven by the sharp movements during the pandemic episode.

Finally, we repeated the baseline analysis, but use the VIX instead of RORO to measure risk. Columns 11 and 12 report the results. Although the main results remain robust for bonds, and the *pattern* of signs and estimates remains for equities, the interaction effect near the mean of the distribution, as well as at the tails of the distribution, is no longer significant for equities. The main factor driving this difference is that the RORO measure includes a broader set of risk-responsive asset prices that are not reflected in the VIX, such as center-country equity returns, corporate spreads, gold prices, other option-implied volatilities and several different spreads intended to capture liquidity risk. These differences also highlight the benefits of using a broader measure of risk aversion than the VIX (as also argued in Miranda-Agrippino and Rey, 2015 and Scheubel et al, 2019).

6. The Macroprudential Stance and Risk across the Global Financial Cycle: Different Forms of International Capital Flows

This paper focuses on the high-frequency EPFR data on portfolio flows to analyze how investors adjust their equity and bond portfolios based on a country's macroprudential stance and its interaction with changes in risk—during normal times and at different phases of the global financial cycle. To understand if the relationships documented above apply to international capital flows, as well as to place these results in the context of the international economics literature, this section performs a similar analysis using data on international capital flows. The data on international capital flows captures a different investment aspect (focusing on cross-

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[34] To estimate the first-stage regressions, we repeat the same steps outlined for the main analysis, using the same set of candidate explanatory variables with backward and forward exclusion and inclusion to generate a residual capital controls "shock" measure.

border transactions rather than portfolio allocation by country) and is only available at a lower quarterly frequency, which could miss meaningful relationships between capital flows, risk, and macroprudential policy. This data has the advantage, however, of covering a broader set of portfolio equity and debt investors, as well as other types of capital flows (such as bank flows and FDI), any of which may respond differently to changes in risk and macroprudential regulation.

To perform this analysis, this section continues to use the same definitions for the macroprudential policy stance, risk, and other control variables as above, except instead of using the EPFR data on portfolio investment, uses data on capital flows from Forbes and Warnock (2021), based on the IMF's *International Financial Statistics* (IFS). The IMF's IFS data provides data on quarterly capital flows for a large sample of countries, disaggregated into categories such as portfolio debt, portfolio equity, foreign direct investment (FDI), and bank flows (and others). Forbes and Warnock (2021) use this data, but then fill in several gaps with source-country data and exclude suspect data and gaps to yield a dataset on quarterly capital flows for 59 countries from 1980q1-2020q3.[35] In this dataset, the categories for portfolio debt and equity are the closest to the bond and equity flows captured in the EPFR database, albeit with several important differences. The EPFR data only includes reporting investment funds (primarily mutual funds and exchange-traded funds) and do not include other types of institutional investors (such as sovereign wealth funds, hedge funds, pension funds, and banks' proprietary trading desks). Also important, the EPFR data reports portfolio investment by domestic and international investors (i.e., includes purchases by residents of the country). In contrast, the IMF data only includes cross-border flows calculated on a residency basis (i.e., only including transactions between residents of different countries).[36] Not surprisingly, and as shown in more detail in Koepke and Paetzold (2020), these differences contribute to a low correlation between the IFS and EPFR data on equity and bond flows.[37]

In order to estimate the relationship between cross-border portfolio flows, macroprudential regulations, risk, and their interactions, we combine the variables and framework used above for bond and equity investment with the standard approach to modeling quarterly international capital flows (i.e., Avdjiev, Gambacorta, Goldberg and Schiaffi, 2020). More specifically, we estimate international capital flows as a function of the country's macroprudential policy stance, global risk, the interaction between the macroprudential stance and risk, and other push/global and pull/local factors:

$$ICF_{it} = \alpha_i + \beta_1 \widetilde{MP}_{it} + \beta_2 RISK_t + \beta_3 \widetilde{MP}_{i,t-1} * RISK_t + \boldsymbol{\gamma PUSH_t} + \boldsymbol{\delta PULL_{i,t}} + \varepsilon_{i,t} \,. \quad (5)$$

[35] The Forbes and Warnock (2021) dataset is available at: https://mitmgmtfaculty.mit.edu/kjforbes/research/. We follow standard conventions and use the term “bank flows” to refer to the “Other Investment” category in the BoP statistics. This category is a residual that is dominated by bank flows.

[36] For example, if a resident of India invests in a mutual fund that invests in Indian equities, this would be included in the EPFR data, but not the IMF data.

[37] Another difference, discussed above, is how the EPFR data allocates fund flows by country for funds which do not report specific allocations.

We measure international capital flows (*ICF*$_{it}$) as the percent change in cross-border inflows (for portfolio debt, portfolio equity, bank or total flows) over the last four quarters for country *i* in quarter *t*, relative to a year ago (to avoid seasonality).[38] We continue to measure the macroprudential stance (($\widetilde{MP}_{it}$) using the policy shock approach discussed in Section 4.1 in order to adjust for reverse causality. For our base case, we focus on our preferred measure, the *Broad Intensity Index,* which is based on the level of the CCyB, LTV ratio, and macroprudential FX stance so that a higher value indicates a tighter stance. $RISK_t$ is the quarterly z-score of the risk-on, risk-off (RORO), with a higher value indicating risk-off shocks. The key coefficients of interest are the β's, which capture the correlation between global risk, domestic macroprudential policy, and their interaction with international capital flows. The specification also includes a matrix of additional global *PUSH* and domestic *PULL* control variables to capture other factors that affect capital flows.

We use two formulations for the additional *PUSH* and *PULL* variables. The first specification follows Avdjiev et al. (2020), a standard framework modelling capital flows in the international economics literature. In this specification, the two global/push variables are the change in the US shadow interest rate and global GDP growth, and the three domestic/pull variables are: lagged values of domestic GDP growth, domestic institutions, and financial openness. We follow Avdjiev et al. (2020) and estimate the model with country fixed effects, robust standard errors, and most variables estimated as differences or changes to avoid stationarity. The second specification incorporates the variables used above for the EPFR regressions and is more common in the finance literature analyzing portfolio investment, often at a higher frequency. The five *PUSH* and *PULL* variables from the first specification continue to be included, as well as three additional *PULL* variables: the percent change in the bilateral US$ exchange rate, the change in the interest rate differential versus the US, and the quarterly volatility of the exchange rate (all lagged by one quarter). All sources and variable definitions for both specifications are the same as in Sections 3 and 4 (except at quarterly frequency).

Table 8 follows the same format as Table 3 and reports results for the key coefficients of interest (the macroprudential stance, risk, and the interaction of the two) for different types of capital flows: debt, equity, bank and total (which also includes FDI and other components). The columns labelled "macro" include the smaller set of control variables that are more standard in the international macro literature, and the columns labeled "finance" include the larger set of controls common in the finance literature. Complete regression results for the full set of control variables are in Appendix E and agree with the general findings in other research.[39] Regressions predicting quarterly movements in capital flows often have a low degree of explanatory power, and coefficient estimates are often insignificant.[40] This weak explanatory power is particularly true in the post-2008 period, which is the majority of the sample used in this paper, as the

[38] We focus on capital inflows (instead of net flows) as done in Gelos et al. (2019), Eguren-Martin et al. (2020), and Mano and Sgherri (2020). We also winsorize growth in capital flows at the 0.5 and 99.5 level.
[39] Results for the unconditional regressions, which do not include an interaction between risk and the macroprudential stance, are so similar that we do not report them both.
[40] In contrast, regressions predicting "extreme episodes" in capital flows (such as Forbes and Warnock, 2012) or using higher frequency data (such as Chari et al., 2020) tend to have a higher degree of explanatory power and more significant coefficients.

relationship between global risk measures and capital flows (including extreme capital flow episodes) appears to have broken down (as shown in Avdjiev et al., 2020; Forbes and Warnock, 2021; and Forbes, 2020).

Turning to the key coefficients of interest, there is usually a negative correlation between the macroprudential stance and capital inflows for each of the four types of capital flows, but this is never significant. The correlation between risk and capital inflows is negative and significant for bank flows, but not the other types of flows. The interaction between risk and macroprudential regulation is negative for debt and equity flows (as found in the higher frequency analysis, albeit no longer significant), but positive for bank flows.

Next, to test for the effects of a tighter macroprudential policy stance (continuing to use the *Broad Intensity Index*) at different stages of the global financial cycle, we estimate the marginal effects of a one-unit tighter *ex ante* macroprudential stance at different points in the distribution of the RORO measure. The lower part of Table 8 shows these marginal effects. The patterns for portfolio debt and equity flows (with either set of control variables) generally agree with the results from the analysis using the higher-frequency, portfolio data from EPFR. A tighter macroprudential stance is correlated with larger portfolio inflows at lower risk levels, and larger portfolio outflows at higher risk levels, with larger effects at the extremes and especially for risk-off episodes. In other words, macroprudential regulation appears to amplify the effects of the global financial cycle on international debt and equity flows, and the effects are larger at the extremes of the risk distribution. None of these effects are significant, however, as found for the EPFR data. The lack of statistical significance may reflect the data's lower frequency, or the different types of investment flows in these two datasets (as explained above). This general insignificance of the estimated effects of macroprudential regulations on capital flows at a quarterly frequency agrees with the results in Gelos et al. (2019)—albeit they use a different measure of macroprudential regulations and different framework (amongst other differences).

We have also performed several sensitivity tests, such as using different measures of the macroprudential stance (all four measures discussed in Section 3.1), different measures of risk (including the VIX), different measures of capital flows (net flows instead of inflows and scaled relative to GDP). The series of estimates generally supports the results discussed above; models explaining quarterly movements in capital flows since 2004 generally have a low degree of explanatory power. Although some coefficients are occasionally significant, most significant estimates are not robust to changes in definitions and control variables.

With these caveats about significance, there is one particularly noteworthy result in Table 8: the different patterns for portfolio (equity and debt) flows compared to bank flows for the interaction of risk and macroprudential regulations across the risk distribution. A tighter macroprudential stance appears to amplify the impact of risk shocks on international bond and equity flows, especially at the extremes of the distribution and for risk-off shocks, as found in the analysis above for portfolio investment (bond and equity) flows. For bank flows however, a tighter stance appears to dampen the impact of risk shocks on international flows, especially at the extremes of the distribution. This dampening (instead of amplifying) effect on banks is not surprising as most macroprudential regulations apply to banks—and therefore countries with tighter regulations might be expected to be less, instead of more, sensitive to changes in the global financial cycle. Nevertheless, these patterns across the different categories of international capital flows suggest that even if macroprudential regulations improve the resilience of bank flows to the global financial cycle, they simultaneously shift risks to bond and equity markets and increase the sensitivity of these flows.

7. **Conclusions**

Although the academic literature generally finds only modest effects of a country's macroprudential stance on bond and equity flows, the results in this paper suggest that these modest "on average" effects mask large and significant effects during extreme risk-on and risk-off shocks. More specifically, portfolio flows in countries with tighter *ex ante* macroprudential regulations are more sensitive to the global financial cycle; portfolio investment flows increase by more during good times and fall by more during bad. Moreover, these amplification effects from a tighter macroprudential stance are large and meaningful—especially for large risk shocks and risk-off shocks. These amplification effects also appear to be larger for bond than equity investments, but not significantly different for advanced economies relative to emerging markets, or for US dollar investment flows relative to non-US dollar flows. The amplification effects are also larger for bond flows when macroprudential regulations are tightened on FX exposures and LTV ratios, but usually insignificant when tightened using more cyclically-based measures (such as the CCyB). The series of results highlights the importance for research on macroprudential regulations to look carefully at the impact of different tools (and not just the overall regulatory stance), as well as to incorporate the intensity of various policies (and not just focus on recent changes or measures based on dummy variables).

Our results support a growing body of evidence on the importance of examining the impact of different policies at different stages of the financial cycle, as well as of incorporating spillovers and leakages. An extensive literature shows that a more stringent macroprudential stance reduces the volume of cross-border bank flows (which tend to be highly sensitive to the global financial cycle) and increases the resilience of the banking system to different types of shocks. This literature also finds, however, that borrowers respond by shifting to obtain funding from other sources than banks, such that financial intermediation can shift towards bonds, equities, and other institutions in the "shadow" financial system. The results in this paper suggest that as tighter macroprudential regulation can cause this shift in financial intermediation, it has the unintended consequence of increasing the sensitivity of portfolio flows to risk shocks. It is important to highlight that we do not suggest that macroprudential policies render the broader economy less resilient or more sensitive to risk shocks—as the increased resilience of banks may outweigh the greater sensitivity of non-bank financial intermediation. Our results do, however, suggest that the broader spillovers and interaction effects deserve attention in any discussion of the costs, benefits and effectiveness of macroprudential regulation. Careful attention ought to be paid to the regulatory perimeter for macroprudential policies.

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Table 1
First Stage of Policy Shocks Estimation

	All Variables				After Inclusion Procedures			
MP Stance	**Broad Index**	**Narrow Index**	**Country-Relative**	**Time-Relative**	**Broad Index**	**Narrow Index**	**Country-Relative**	**Time-Relative**
Crisis in last 12 months	0.0254	0.136**	0.0158	0.0617**		0.119**		
	(0.0477)	(0.0612)	(0.0250)	(0.0250)		(0.0526)		
Distance to default	0.0175***	0.0208***	0.0134***	0.00872***	0.0162***	0.0231***	0.00951***	0.00587***
	(0.00267)	(0.00343)	(0.00140)	(0.00140)	(0.00242)	(0.00307)	(0.00126)	(0.00120)
Romer & Romer count	-0.0135***	-0.0168***	-0.00417***	-0.00554***	-0.0121***	-0.0132***	0.00184*	-0.00378***
	(0.00242)	(0.00311)	(0.00126)	(0.00126)	(0.000455)	(0.000572)	(0.00105)	(0.00101)
Romer & Romer intensity	0.00220	0.00362	0.000545	-0.000774			-0.00377***	-0.00149*
	(0.00201)	(0.00259)	(0.00105)	(0.00105)			(0.000876)	(0.000838)
Sovereign crisis count	-0.0681***	-0.0826***	-0.0365***	-0.0700***	-0.0807***	-0.0848***	-0.0261***	-0.0676***
	(0.0105)	(0.0135)	(0.00547)	(0.00547)	(0.00973)	(0.0123)	(0.00474)	(0.00457)
Currency crisis count	-0.00587**	-0.00626*	-0.00202	0.00326**	-0.00926***	-0.0141***	-0.00227*	
	(0.00265)	(0.00341)	(0.00137)	(0.00137)	(0.00246)	(0.00314)	(0.00118)	
Banking crisis count	0.00377	0.00654	0.00159	0.0150***	0.0127***	0.0150***	0.0104***	0.0157***
	(0.00539)	(0.00692)	(0.00281)	(0.00281)	(0.00225)	(0.00286)	(0.00234)	(0.00224)
Cross-border ratio	0.434***	0.696***	0.123***	-0.0927***	0.389***	0.692***	0.115***	-0.0952***
	(0.0346)	(0.0445)	(0.0182)	(0.0182)	(0.0336)	(0.0427)	(0.0178)	(0.0171)
Domestic credit growth	0.00678***	0.00926***	0.0106***	-0.00245***	0.00500***	0.00849***	0.00580***	-0.00341***
	(0.00167)	(0.00215)	(0.000876)	(0.000876)	(0.00132)	(0.00167)	(0.000654)	(0.000666)
Property prices	-0.00398***	-0.00443**	-0.00415***	-0.00158**				
	(0.00145)	(0.00186)	(0.000757)	(0.000757)				
REER growth	0.366***	0.418**	0.137*	0.172**	0.316***		0.0932*	0.151***
	(0.135)	(0.173)	(0.0708)	(0.0708)	(0.116)		(0.0562)	(0.0535)
Growth forecast	-0.0680***	-0.0409***	-0.0125***	-0.00690	-0.0756***	-0.0506***	-0.0195***	-0.0186***
	(0.00869)	(0.0112)	(0.00453)	(0.00453)	(0.00670)	(0.00858)	(0.00317)	(0.00318)
Inflation	0.0187***	0.0613***	0.00249	0.0230***	0.0136***	0.0354***		0.0115***
	(0.00570)	(0.00732)	(0.00298)	(0.00298)	(0.00351)	(0.00446)		(0.00158)
Real GDP growth	1.136***	1.873***	1.204***	0.747***				0.400***
	(0.392)	(0.504)	(0.205)	(0.205)				(0.146)
Openness	0.222***	-0.0827***	0.0444***	0.00176	0.155***	-0.0841***	0.0844***	
	(0.0241)	(0.0309)	(0.0126)	(0.0127)	(0.0220)	(0.0275)	(0.0112)	
FX Vol.	0.000753	-0.000360	-0.000112	0.000104				
	(0.000710)	(0.000912)	(0.000373)	(0.000373)				
Institutional quality	0.00748*	0.0120**	-0.000898	-0.00528***	0.0125***	0.0105***		-0.00375**
	(0.00389)	(0.00500)	(0.00204)	(0.00204)	(0.00317)	(0.00400)		(0.00158)
Policy rate	-0.183***	-0.226***	-0.0865***	-0.142***	-0.198***	-0.244***	-0.0550***	-0.130***
	(0.00861)	(0.0111)	(0.00451)	(0.00452)	(0.00754)	(0.00938)	(0.00365)	(0.00353)
*i - i**	0.132***	0.123***	0.0553***	0.0892***	0.169***	0.155***	0.0306***	0.0853***
	(0.00966)	(0.0124)	(0.00506)	(0.00506)	(0.00807)	(0.0102)	(0.00387)	(0.00360)
Exchange rate regime	-0.00250	-0.0618	-0.145***	-0.290***	-0.362***		-0.115***	-0.274***
	(0.0744)	(0.0955)	(0.0391)	(0.0391)	(0.0576)		(0.0277)	(0.0261)
Number of countries	***41***	***41***	***42***	***42***	***44***	***44***	***55***	***55***
F-statistic	***70.46***	***65.36***	***46.11***	***102.3***	***107.6***	***110.6***	***53.56***	***160.2***

Notes: Results of first-stage regressions predicting the macrorpudential stance listed at the top as a function of the variables listed to the left. See Appendix A for details on the definitions and sources for the explanatory variables. Bootstrapped standard errors clustered by country are reported in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2
Baseline Results
Bond Flows, the Macroprudential Stance and Risk

	Broad Index (1)	Narrow Index (2)	Country-Relative (3)	Time-Relative (4)
MP Stance	-0.000808	0.000535	-0.00887	-0.0101
	(0.00730)	(0.00681)	(0.0105)	(0.0120)
Risk	-0.0921***	-0.0922***	-0.0982***	-0.0983***
	(0.00416)	(0.00434)	(0.00465)	(0.00517)
Interaction of MP stance and risk	-0.0196***	-0.0125***	-0.0245***	-0.00916
	(0.00419)	(0.00334)	(0.00713)	(0.0106)
Domestic				
Exchange Rate (t-1)	-1.34e-05*	-1.35e-05*	-1.51e-05*	-1.52e-05*
	(7.80e-06)	(7.74e-06)	(8.62e-06)	(7.82e-06)
i - i (t-1)*	-0.00654***	-0.00661***	-0.00618***	-0.00590***
	(0.00182)	(0.00181)	(0.00159)	(0.00161)
Real Growth (t-1)	-0.151	-0.156	-0.111	-0.102
	(0.118)	(0.120)	(0.104)	(0.103)
FX Volatility	-0.000856*	-0.000854*	-0.000792*	-0.000783*
	(0.000429)	(0.000429)	(0.000408)	(0.000409)
Openness	-0.00777	-0.00769	-0.00854	-0.00833
	(0.0139)	(0.0137)	(0.0111)	(0.0113)
Inst. Quality	-0.00300	-0.00300	-0.00227	-0.00213
	(0.00200)	(0.00199)	(0.00165)	(0.00170)
Global				
AE Monetary Stance (t-1)	-0.0551***	-0.0551***	-0.0534***	-0.0533***
	(0.00734)	(0.00740)	(0.00646)	(0.00643)
AE IP Growth (t-1)	3.444***	3.442***	3.118***	3.177***
	(0.493)	(0.493)	(0.465)	(0.461)
AR(1)	0.464***	0.464***	0.475***	0.475***
	(0.0188)	(0.0188)	(0.0166)	(0.0167)
Constant	0.427***	0.428***	0.368***	0.354**
	(0.150)	(0.149)	(0.130)	(0.134)
# Countries	***44***	***44***	***56***	***55***
R-squared	***0.397***	***0.396***	***0.409***	***0.407***

Notes: Portfolio bond flows are the percent change in weekly flows based on EPFR data . See Appendix Table B for details on variable definitions and sources. The top of the table reports the coefficients for the *MP Stance shock, Risk* , and their *Interaction* . The remainder of the table reports coefficients for the control variables. All specifications include country and time fixed effects. Bootstrapped standard errors clustered by country are reported in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 3
Key Coefficients and Marginal Effects across the Risk Distribution
Bond Flows and the Macroprudential Stance across the Global Financial Cycle

	Broad Index (1)	Narrow Index (2)	Country-Relative (3)	Time-Relative (4)
Unconditional Regressions				
MP Stance	-0.000826	0.000631	-0.0100	-0.0103
	(0.00722)	(0.00674)	(0.0105)	(0.0120)
Risk	-0.0922***	-0.0922***	-0.0991***	-0.0986***
	(0.00530)	(0.00531)	(0.00514)	(0.00515)
Regressions with interaction between risk and the macroprudential stance				
MP Stance	-0.000808	0.000535	-0.00887	-0.0101
	(0.00730)	(0.00681)	(0.0105)	(0.0120)
Risk	-0.0921***	-0.0922***	-0.0982***	-0.0983***
	(0.00416)	(0.00434)	(0.00465)	(0.00517)
Interaction of MP	-0.0196***	-0.0125***	-0.0245***	-0.00916
stance and risk	(0.00419)	(0.00334)	(0.00713)	(0.0106)
Marginal effects of tighter macroprudential policy at different risk levels				
(Extreme risk-on)				
Risk @ 0.5%	0.0506***	0.0334***	0.0552***	0.0139
	(0.0148)	(0.0126)	(0.0209)	(0.0298)
Risk @ 1%	0.0399***	0.0265**	0.0418**	0.00884
	(0.0128)	(0.0111)	(0.0177)	(0.0246)
Risk @ 5%	0.0252**	0.0171*	0.0235*	0.00199
	(0.0104)	(0.00916)	(0.0137)	(0.0181)
Risk @ 10%	0.0166*	0.0116	0.0128	-0.00202
	(0.00909)	(0.00819)	(0.0120)	(0.0149)
Risk @ 25%	0.00777	0.00601	0.00181	-0.00613
	(0.00802)	(0.00738)	(0.0108)	(0.0126)
Risk @ median	0.00108	0.00174	-0.00652	-0.00925
	(0.00743)	(0.00691)	(0.0105)	(0.0120)
Risk @ 75%	-0.00795	-0.00402	-0.0178	-0.0135
	(0.00701)	(0.00655)	(0.0109)	(0.0128)
Risk @ 90%	-0.0211***	-0.0124*	-0.0341***	-0.0196
	(0.00733)	(0.00665)	(0.0131)	(0.0166)
Risk @ 95%	-0.0302***	-0.0182**	-0.0454***	-0.0238
	(0.00813)	(0.00713)	(0.0154)	(0.0203)
Risk @ 99%	-0.0693***	-0.0432***	-0.0941***	-0.0421
	(0.0143)	(0.0116)	(0.0275)	(0.0395)
Risk @ 99.5%	-0.0931***	-0.0584***	-0.124***	-0.0532
(Extreme risk-off)	(0.0189)	(0.0151)	(0.0357)	(0.0519)

Notes: Portfolio bond flows are the percent change in weekly flows based on EPFR data . See Appendix Table B for details on variable definitions and sources. The top section of this table reports coefficients excluding the interaction of the macroprudential stance and risk. While not reported in this table, these regressions include all other controls in Table 2. The second section of the table reports the main coefficients of interest from Table 2. The third section of this table reports the marginal effects of a 1 unit increase in the MP Stance as measured using policy shocks (listed in the center section) when interacted with Risk at different points in the Risk distribution. In each specification, Risk is measured using the RORO index, and MP Stance is measured using the estimated policy shock of the index or dummy measure listed at the top of the column. All specifications include country and time fixed effects. Bootstrapped standard errors clustered by country are reported in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 4

Key Coefficients from OLS Estimates

Bond Flows and the Macroprudential Stance across the Global Financial Cycle

MP Stance	Broad Index (1)	Narrow Index (2)	Country-Relative (3)	Time-Relative (4)
Unconditional Regressions				
MP Stance	-0.00861**	-0.00536	-0.0133	-0.00420
	(0.00409)	(0.00337)	(0.00871)	(0.0108)
Risk	-0.0933***	-0.0933***	-0.0992***	-0.0993***
	(0.00430)	(0.00430)	(0.00417)	(0.00417)
Regressions with interaction between risk and the macroprudential stance				
MP Stance	-0.00734*	-0.00453	-0.0129	-0.00372
	(0.00429)	(0.00355)	(0.00869)	(0.0108)
Risk	-0.0902***	-0.0912***	-0.0941***	-0.0818***
	(0.00433)	(0.00443)	(0.00619)	(0.00713)
Interaction of MP	-0.0120***	-0.00699***	-0.0101	-0.0254***
stance and risk	(0.00339)	(0.00254)	(0.00686)	(0.00778)
Marginal effects of tighter macroprudential policy at different risk levels				
(Extreme risk-on)				
Risk @ 0.5%	0.0242**	0.0138	0.0134	0.0629***
	(0.0114)	(0.00880)	(0.0189)	(0.0221)
Risk @ 1%	0.0176*	0.00994	0.00789	0.0489***
	(0.00963)	(0.00752)	(0.0156)	(0.0185)
Risk @ 5%	0.00859	0.00472	0.000373	0.0299**
	(0.00738)	(0.00586)	(0.0117)	(0.0141)
Risk @ 10%	0.00331	0.00166	-0.00404	0.0188
	(0.00617)	(0.00496)	(0.00992)	(0.0122)
Risk @ 25%	-0.00208	-0.00148	-0.00855	0.00739
	(0.00508)	(0.00415)	(0.00881)	(0.0110)
Risk @ median	-0.00618	-0.00386	-0.0120	-0.00128
	(0.00443)	(0.00366)	(0.00862)	(0.0108)
Risk @ 75%	-0.0117***	-0.00708**	-0.0166*	-0.0130
	(0.00394)	(0.00325)	(0.00935)	(0.0114)
Risk @ 90%	-0.0198***	-0.0117***	-0.0233*	-0.0300**
	(0.00427)	(0.00336)	(0.0119)	(0.0141)
Risk @ 95%	-0.0253***	-0.0150***	-0.0280*	-0.0418**
	(0.00511)	(0.00389)	(0.0143)	(0.0167)
Risk @ 99%	-0.0493***	-0.0289***	-0.0480*	-0.0924***
	(0.0108)	(0.00795)	(0.0265)	(0.0302)
Risk @ 99.5%	-0.0639***	-0.0374***	-0.0602*	-0.123***
(Extreme risk-off)	(0.0147)	(0.0108)	(0.0345)	(0.0392)

Notes: in this table, measures of the MP Stance are included as lags (instead of using the estimated policy shock based on first-stage estimates, as done in the baseline regressions). Portfolio bond flows are the percent change in weekly flows based on EPFR data . See Appendix Table B for details on variable definitions and sources. The top of the table reports the coefficient estimates for the controls for *Risk* and the *MP Stance* from the unconditional regressions predicting portfolio flows, which exclude the *Interaction of MP Stance and Risk but include all other control variables* . The middle of the table reports the coefficients for the *MP Stance shocks, Risk* , and their *Interaction* . The bottom of the table reports the marginal effects of a 1 unit increase in the *MP Stance* (listed at the top) when interacted with *Risk* at different points in the *Risk* distribution. In each specification, *Risk* is measured using the RORO index, and *MP Stance* is measured using the index or dummy measure listed at the top of the column. All specifications include country and time fixed effects. Bootstrapped standard errors clustered by country are shown in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 5

More Granular Measures of the Macroprudential Stance

Bond Flows and the Macroprudential Stance across the Global Financial Cycle

	Bonds				
MP Stance	**LTV**	**CCyB**	**FX Measures**	**Demand Measures**	**Supply Measures**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Unconditional Regressions					
MP Stance	-0.00351	0.00135	-0.00175	-0.00975	-0.0130
	(0.00707)	(0.00408)	(0.00219)	(0.0131)	(0.00934)
Risk	-0.0922***	-0.0987***	-0.0988***	-0.0986***	-0.0986***
	(0.00531)	(0.00515)	(0.00490)	(0.00515)	(0.00515)
Regressions with interaction between risk and the macroprudential stance					
MP Stance	-0.00324	0.00131	-0.00157	-0.00968	-0.0124
	(0.00705)	(0.00407)	(0.00218)	(0.0130)	(0.00934)
Risk	-0.0918***	-0.0988***	-0.0985***	-0.0986***	-0.0971***
	(0.00430)	(0.00500)	(0.00459)	(0.00515)	(0.00468)
Interaction of MP	-0.0132***	-0.00276	-0.00799***	-0.00301	-0.0276***
stance and risk	(0.00424)	(0.00217)	(0.00289)	(0.0108)	(0.00736)
Marginal effects of tighter macroprudential policy at different risk levels					
(Extreme risk-on)					
Risk @ 0.5%	0.0314**	0.00855	0.0194**	-0.00181	0.0598***
	(0.0127)	(0.00842)	(0.00766)	(0.0293)	(0.0200)
Risk @ 1%	0.0241**	0.00703	0.0150**	-0.00346	0.0447***
	(0.0109)	(0.00736)	(0.00615)	(0.0242)	(0.0165)
Risk @ 5%	0.0142	0.00497	0.00900**	-0.00570	0.0241*
	(0.00869)	(0.00600)	(0.00421)	(0.0179)	(0.0123)
Risk @ 10%	0.00846	0.00376	0.00550*	-0.00702	0.0120
	(0.00775)	(0.00527)	(0.00319)	(0.0150)	(0.0104)
Risk @ 25%	0.00253	0.00252	0.00192	-0.00837	-0.000394
	(0.00716)	(0.00460)	(0.00241)	(0.0132)	(0.00935)
Risk @ median	-0.00197	0.00158	-0.000802	-0.00939	-0.00980
	(0.00704)	(0.00418)	(0.00217)	(0.0129)	(0.00924)
Risk @ 75%	-0.00805	0.000308	-0.00448*	-0.0108	-0.0225**
	(0.00733)	(0.00376)	(0.00251)	(0.0142)	(0.0101)
Risk @ 90%	-0.0169**	-0.00154	-0.00982**	-0.0128	-0.0409***
	(0.00856)	(0.00359)	(0.00387)	(0.0183)	(0.0130)
Risk @ 95%	-0.0230**	-0.00282	-0.0135***	-0.0142	-0.0537***
	(0.00981)	(0.00381)	(0.00503)	(0.0222)	(0.0156)
Risk @ 99%	-0.0493***	-0.00832	-0.0294***	-0.0202	-0.109***
	(0.0168)	(0.00666)	(0.0105)	(0.0415)	(0.0287)
Risk @ 99.5%	-0.0654***	-0.0117	-0.0391***	-0.0238	-0.142***
(Extreme risk-off)	(0.0216)	(0.00900)	(0.0140)	(0.0541)	(0.0373)

Notes: Portfolio bond flows are the percent change in weekly flows based on EPFR data. See Appendix Table B for control variables and Tables 2 and 3 for interpretation of different sections of table. The *MP Stance* is measured using the variable listed at the top of the column. *LTV* is the loan-to-value ratio. *CCyB* is the countercyclical capital buffer. *FX Measure* s is the aggregate changes in any macroprudential measures related to foreign currency exposures, transactions or liquidity. *Demand Measures* is the aggregate changes in macroprudential tools focused on the demand for loans, including debt-service-to-income and LTV regulations. *Supply Measures* is the aggregate changes in a broad range of tools focusing on banks' ability to supply credit, excluding those aimed at foreign exchange. The last three measures are the aggregate changes in the category of tools since 2000. All specifications include country and time fixed effects. Bootstapped standard errors clustered by country are reported in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 6: Equity Portfolio Investment

Portfoliio Flows and the Macroprudential Stance across the Global Financial Cycle

MP Stance	Main indices				Alternative measures				
	Broad Index (1)	Narrow Index (2)	Country-Relative (3)	Time-Relative (4)	LTV (5)	CCyB (6)	FX Measures (7)	Demand Measures (8)	Supply Measures (9)
Unconditional Regressions									
MP Stance	0.000723	0.00526*	-0.0129	-0.00414	0.0138**	0.00115	-0.00221	0.0129	-0.0251***
	(0.00360)	(0.00279)	(0.00890)	(0.00928)	(0.00553)	(0.00134)	(0.00253)	(0.0102)	(0.00890)
Risk	-0.0813***	-0.0814***	-0.0818***	-0.0818***	-0.0814***	-0.0840***	-0.0840***	-0.0818***	-0.0818***
	(0.00298)	(0.00298)	(0.00294)	(0.00294)	(0.00298)	(0.00290)	(0.00290)	(0.00294)	(0.00294)
Regressions with interaction between risk and the macroprudential stance									
MP Stance	0.000790	0.00524*	-0.0121	-0.00396	0.0138**	0.00111	-0.00214	0.0127	-0.0248***
	(0.00357)	(0.00280)	(0.00894)	(0.00925)	(0.00550)	(0.00138)	(0.00256)	(0.0101)	(0.00879)
Risk	-0.0818***	-0.0817***	-0.0813***	-0.0817***	-0.0814***	-0.0843***	-0.0840***	-0.0818***	-0.0811***
	(0.00299)	(0.00297)	(0.00293)	(0.00292)	(0.00296)	(0.00296)	(0.00294)	(0.00294)	(0.00293)
Interaction of MP	-0.0115***	-0.00701***	-0.0251***	-0.0111	-0.00559***	-0.00354**	-0.00311*	0.00560	-0.0154***
stance and risk	(0.00284)	(0.00206)	(0.00509)	(0.00693)	(0.00210)	(0.00166)	(0.00175)	(0.00513)	(0.00521)
Marginal effects of tighter macroprudential policy at different risk levels									
(Extreme risk-on)									
Risk @ 0.5%	0.0310***	0.0236***	0.0536***	0.0251	0.0285***	0.0104***	0.00600	-0.00193	0.0155
	(0.00803)	(0.00550)	(0.0161)	(0.0161)	(0.00712)	(0.00354)	(0.00455)	(0.0141)	(0.0143)
Risk @ 1%	0.0247***	0.0198***	0.0398***	0.0190	0.0254***	0.00844**	0.00430	0.00114	0.00702
	(0.00687)	(0.00507)	(0.0132)	(0.0168)	(0.00704)	(0.00364)	(0.00453)	(0.0146)	(0.0136)
Risk @ 5%	0.0161***	0.0145***	0.0211*	0.0107	0.0212***	0.00580**	0.00198	0.00533	-0.00446
	(0.00521)	(0.00390)	(0.0108)	(0.0129)	(0.00620)	(0.00251)	(0.00353)	(0.0122)	(0.0109)
Risk @ 10%	0.0110**	0.0114***	0.0101	0.00587	0.0188***	0.00425**	0.000615	0.00778	-0.0112
	(0.00442)	(0.00335)	(0.00974)	(0.0110)	(0.00585)	(0.00193)	(0.00305)	(0.0112)	(0.00973)
Risk @ 25%	0.00583	0.00831***	-0.00110	0.000890	0.0163***	0.00266*	-0.000778	0.0103	-0.0181**
	(0.00383)	(0.00295)	(0.00909)	(0.00962)	(0.00562)	(0.00146)	(0.00268)	(0.0105)	(0.00897)
Risk @ median	0.00190	0.00592**	-0.00964	-0.00289	0.0144***	0.00145	-0.00184	0.0122	-0.0233***
	(0.00364)	(0.00283)	(0.00897)	(0.00923)	(0.00556)	(0.00133)	(0.00254)	(0.0102)	(0.00878)
Risk @ 75%	-0.00341	0.00269	-0.0212**	-0.00800	0.0118**	-0.000177	-0.00327	0.0148	-0.0304***
	(0.00378)	(0.00293)	(0.00932)	(0.00966)	(0.00562)	(0.00154)	(0.00257)	(0.0104)	(0.00909)
Risk @ 90%	-0.0111**	-0.00199	-0.0379***	-0.0154	0.00808	-0.00254	-0.00534*	0.0185	-0.0407***
	(0.00468)	(0.00357)	(0.0108)	(0.0119)	(0.00600)	(0.00234)	(0.00304)	(0.0116)	(0.0106)
Risk @ 95%	-0.0165***	-0.00524	-0.0495***	-0.0206	0.00549	-0.00418	-0.00678*	0.0211	-0.0478***
	(0.00564)	(0.00425)	(0.0123)	(0.0143)	(0.00646)	(0.00306)	(0.00358)	(0.0130)	(0.0122)
Risk @ 99%	-0.0394***	-0.0192**	-0.0994***	-0.0427	-0.00563	-0.0112*	-0.0130**	0.0323	-0.0784***
	(0.0108)	(0.00790)	(0.0207)	(0.0268)	(0.00940)	(0.00632)	(0.00658)	(0.0210)	(0.0211)
Risk @ 99.5%	-0.0535***	-0.0277***	-0.130***	-0.0562***	-0.0124	-0.0155***	-0.0167***	0.0391**	-0.0971***
(Extreme risk-off)	(0.00930)	(0.00648)	(0.0190)	(0.0198)	(0.00794)	(0.00458)	(0.00516)	(0.0163)	(0.0169)

Notes: Portfolio equity flows are the percent change in weekly flows based on EPFR data. See Appendix Table B for details on variable definitions and sources. See Tables 3 and 5 for comparable estimates for bond investment flows, including variable definitions and the different sections of the table. The MP Stance continues to be measured using the the policy shock estimated for each index listed at the top of the column. All specifications include country and time fixed effects. Bootstrapped standard errors clustered by country are shown in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 7
Extensions and Sensitivity Tests
Portfolio Flows and the Macroprudential Stance across the Global Financial Cycle

	AE v. EMDE		USD		Non-USD		Capital Controls		Ex-COVID		VIX	
	Bonds	**Equity**	**Bonds**	**Equity**	**Bonds**	**Equity**	**Bonds**	**Equity**	**Bonds**	**Equity**	**Bonds**	**Equity**
Unconditional Regressions	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
MP Stance	-0.000808	0.000723	0.00721	0.00349	0.00359	0.00219	-0.0334	-0.00952	-0.00108	0.00242	-0.00183	0.00195
	(0.00730)	(0.00360)	(0.00789)	(0.00538)	(0.00890)	(0.00749)	(0.0422)	(0.0458)	(0.00473)	(0.00417)	(0.00485)	(0.00419)
Risk	-0.0921***	-0.0813***	-0.113***	-0.0910***	-0.0721***	-0.0526***	-0.0771***	-0.0974***	-0.0720***	-0.0939***	-0.0438***	-0.0401***
	(0.00416)	(0.00298)	(0.00530)	(0.00613)	(0.0110)	(0.00510)	(0.00396)	(0.00479)	(0.00302)	(0.00264)	(0.00263)	(0.00228)
Regressions with interaction between risk and the macroprudential stance												
MP Stance	-0.00829	-0.000496	0.00724	0.00353	0.00362	0.00221	-0.0365	-0.0138	-0.00130	0.00223	-0.00192	0.00194
	(0.00654)	(0.00504)	(0.00788)	(0.00539)	(0.00889)	(0.00750)	(0.0423)	(0.0455)	(0.00473)	(0.00417)	(0.00485)	(0.00419)
Risk	-0.0784***	-0.0588***	-0.113***	-0.0909***	-0.0719***	-0.0525***	-0.0762***	-0.0956***	-0.0722***	-0.0941***	-0.0435***	-0.0400***
	(0.00431)	(0.00330)	(0.00448)	(0.00538)	(0.00964)	(0.00485)	(0.00372)	(0.00430)	(0.00302)	(0.00264)	(0.00263)	(0.00228)
Interaction of MP stance	-0.0563***	-0.0565***	-0.0212***	-0.0159***	-0.0343***	-0.00879	-0.0401***	-0.0653***	-0.0187***	-0.0177***	-0.00796***	-0.000691
and risk	(0.00657)	(0.00510)	(0.00551)	(0.00536)	(0.00806)	(0.00619)	(0.0118)	(0.0173)	(0.00332)	(0.00295)	(0.00256)	(0.00224)
Interaction of country grouping	-0.00832*	0.000811										
and risk (EM DE vs. AE)	(0.00437)	(0.00342)										
Interaction of MP stance, risk,	0.00612	0.000519										
and country group (EMDE vs. AE)	(0.00748)	(0.00589)										
(Extreme risk-on)												
Risk @ 0.5%	0.0138	0.00457	0.0629***	0.0450***	0.0934***	0.0252	0.0687	0.157***	0.0478***	0.0486***	0.0189**	0.00375
	(0.0182)	(0.0144)	(0.0191)	(0.0148)	(0.0224)	(0.0181)	(0.0477)	(0.0598)	(0.00987)	(0.00874)	(0.00826)	(0.00719)
Risk @ 1%	0.0126	0.00530	0.0512***	0.0363***	0.0746***	0.0204	0.0466	0.121**	0.0375***	0.0388***	0.0146**	0.00337
	(0.0154)	(0.0121)	(0.0164)	(0.0121)	(0.0184)	(0.0151)	(0.0449)	(0.0540)	(0.00831)	(0.00736)	(0.00717)	(0.00623)
Risk @ 5%	0.0110	0.00629	0.0354***	0.0245***	0.0490***	0.0138	0.0166	0.0725	0.0235***	0.0256***	0.00862	0.00285
	(0.0119)	(0.00940)	(0.0128)	(0.00868)	(0.0135)	(0.0113)	(0.0424)	(0.0481)	(0.00643)	(0.00568)	(0.00590)	(0.00512)
Risk @ 10%	0.0100	0.00687	0.0260**	0.0176**	0.0340***	0.00999	-0.000953	0.0439	0.0153***	0.0179***	0.00513	0.00255
	(0.0103)	(0.00810)	(0.0109)	(0.00700)	(0.0111)	(0.00946)	(0.0417)	(0.0460)	(0.00555)	(0.00490)	(0.00534)	(0.00462)
Risk @ 25%	0.00904	0.00747	0.0165*	0.0104*	0.0186**	0.00605	-0.0189	0.0147	0.00688	0.00996**	0.00155	0.00224
	(0.00911)	(0.00718)	(0.00916)	(0.00577)	(0.00937)	(0.00807)	(0.0417)	(0.0451)	(0.00493)	(0.00435)	(0.00497)	(0.00430)
Risk @ median	0.00829	0.00792	0.00928	0.00505	0.00691	0.00306	-0.0326	-0.00756	0.000495	0.00393	-0.00116	0.00201
	(0.00871)	(0.00686)	(0.00812)	(0.00539)	(0.00888)	(0.00755)	(0.0421)	(0.0453)	(0.00473)	(0.00417)	(0.00486)	(0.00420)
Risk @ 75%	0.00728	0.00853	-0.000489	-0.00224	-0.00885	-0.000984	-0.0511	-0.0376	-0.00812*	-0.00420	-0.00482	0.00169
	(0.00893)	(0.00703)	(0.00727)	(0.00582)	(0.00952)	(0.00775)	(0.0433)	(0.0468)	(0.00489)	(0.00431)	(0.00495)	(0.00427)
Risk @ 90%	0.00581	0.00942	-0.0147*	-0.0128	-0.0318**	-0.00686	-0.0779*	-0.0812	-0.0206***	-0.0160***	-0.0101*	0.00123
	(0.0106)	(0.00839)	(0.00753)	(0.00792)	(0.0125)	(0.00966)	(0.0461)	(0.0511)	(0.00586)	(0.00518)	(0.00554)	(0.00480)
Risk @ 95%	0.00480	0.0100	-0.0245***	-0.0202**	-0.0476***	-0.0109	-0.0965**	-0.111**	-0.0293***	-0.0242***	-0.0138**	0.000909
	(0.0125)	(0.00985)	(0.00867)	(0.00988)	(0.0154)	(0.0117)	(0.0487)	(0.0554)	(0.00688)	(0.00609)	(0.00620)	(0.00538)
Risk @ 99%	0.000422	0.0127	-0.0668***	-0.0517***	-0.116***	-0.0284	-0.176***	-0.241***	-0.0666***	-0.0594***	-0.0297***	-0.000466
	(0.0227)	(0.0180)	(0.0174)	(0.0197)	(0.0300)	(0.0226)	(0.0641)	(0.0804)	(0.0125)	(0.0111)	(0.0102)	(0.00888)
Risk @ 99.5%	-0.00225	0.0143	-0.0926***	-0.0710***	-0.157***	-0.0391	-0.225***	-0.321***	-0.0894***	-0.0809***	-0.0394***	-0.00130
(Extreme risk-off)	(0.0297)	(0.0235)	(0.0237)	(0.0260)	(0.0394)	(0.0298)	(0.0756)	(0.0986)	(0.0163)	(0.0145)	(0.0130)	(0.0114)

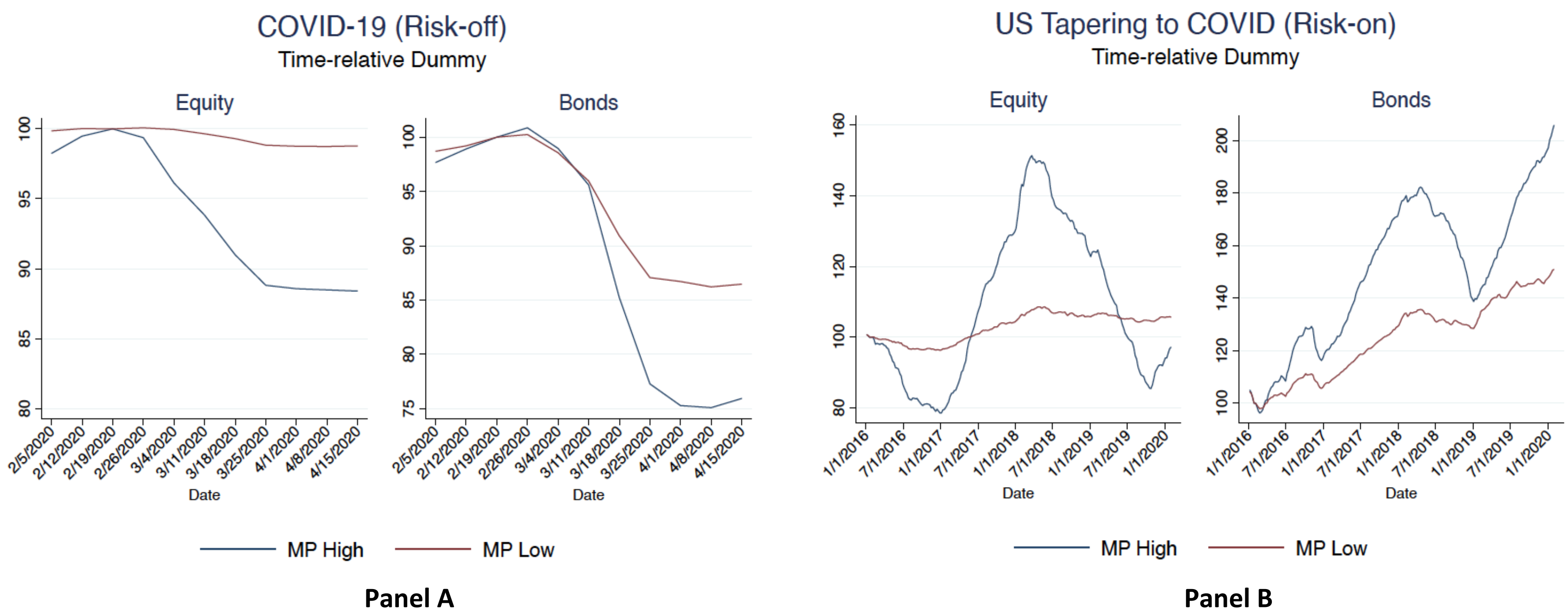
Notes: Portfolio flows are the percent change in weekly flows based on EPFR data and the MP stance is measured using the *Broad Intensity Index* . See Appendix Table B for details on variable definitions and sources and interpretations of the different sections of the table. One difference with Table 3 is the additional interactions with an EM dummy (in the middle of the table for columns 1 and 2), and that the marginal effects at the bottom of the table in columns 1 and 2 reflect the marginal effects of the triple interaction between the macroprudential stance, risk, and the EM dummy at each level of risk, thereby capturing any difference in this marginal effect for EMs relative to AEs. Columns 3 and 4 report results for investment flows in USD, and columns 5 and 6 in non-USD. Columns 7 and 8 replace the measure of the macroprudential stance with a measure of the capital controls stance. Columns 9 and 10 exclude the COVID window from Feb. 15, 2020 through the end of the sample. Columns 11 and 12 use the VIX instead of the ROR meassure of risk. See Table 3 for other details. All specifications include country and time fixed effects. Robust standard errors clustered by country are reported in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 8: International Capital Flows
Capital Flows and the Macroprudential Stance across the Global Financial Cycle

	Debt		Equity		Bank		Total	
Controls	**Macro**	**Finance**	**Macro**	**Finance**	**Macro**	**Finance**	**Macro**	**Finance**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Unconditional Regressions								
MP Stance	-0.017	-0.026	-0.044	-0.082	-0.014	-0.011	-0.041	-0.076
	(0.137)	(0.130)	(0.158)	(0.168)	(0.092)	(0.095)	(0.108)	(0.113)
Risk	0.445	0.643***	0.512	0.465	-0.512**	-0.562**	-0.006	-0.071
	(0.308)	(0.236)	(0.460)	(0.477)	(0.251)	(0.257)	(0.143)	(0.138)
Regressions with interaction between risk and the macroprudential stance								
MP Stance	-0.012	-0.023	-0.037	-0.077	-0.015	-0.012	-0.040	-0.076
	(0.135)	(0.128)	(0.158)	(0.169)	(0.092)	(0.095)	(0.109)	(0.114)
Risk	0.449	0.644***	0.519	0.467	-0.513**	-0.562**	-0.005	-0.071
	(0.306)	(0.233)	(0.461)	(0.477)	(0.252)	(0.259)	(0.142)	(0.138)
Interaction of MP	-0.294	-0.285	-0.430	-0.493	0.068	0.087	-0.038	-0.012
stance and risk	(0.189)	(0.180)	(0.374)	(0.388)	(0.176)	(0.187)	(0.129)	(0.130)
Marginal effects of tighter macroprudential policy at different risk levels								
(Extreme risk-on)								
Risk @ 1%	0.299	0.279	0.418	0.445	-0.087	-0.104	0.001	-0.064
	(0.244)	(0.211)	(0.413)	(0.432)	(0.196)	(0.209)	(0.218)	(0.222)
Risk @ 5%	0.083	0.070	0.102	0.083	-0.037	-0.040	-0.027	-0.072
	(0.149)	(0.131)	(0.191)	(0.203)	(0.102)	(0.106)	(0.137)	(0.142)
Risk @ 10%	0.047	0.035	0.049	0.023	-0.029	-0.030	-0.032	-0.074
	(0.141)	(0.127)	(0.169)	(0.180)	(0.094)	(0.098)	(0.126)	(0.130)
Risk @ 25%	0.027	0.015	0.020	-0.011	-0.024	-0.024	-0.035	-0.075
	(0.138)	(0.126)	(0.162)	(0.173)	(0.092)	(0.095)	(0.120)	(0.124)
Risk @ median	-0.002	-0.012	-0.022	-0.059	-0.017	-0.015	-0.038	-0.076
	(0.135)	(0.127)	(0.158)	(0.168)	(0.091)	(0.095)	(0.112)	(0.117)
Risk @ 75%	-0.029	-0.039	-0.062	-0.105	-0.011	-0.007	-0.042	-0.077
	(0.135)	(0.130)	(0.162)	(0.172)	(0.094)	(0.097)	(0.105)	(0.110)
Risk @ 90%	-0.147	-0.154	-0.235	-0.303	0.016	0.028	-0.058	-0.082
	(0.159)	(0.163)	(0.244)	(0.254)	(0.130)	(0.136)	(0.090)	(0.095)
Risk @ 95%	-0.230	-0.234	-0.356	-0.442	0.035	0.052	-0.068	-0.085
	(0.192)	(0.199)	(0.332)	(0.344)	(0.169)	(0.178)	(0.095)	(0.100)
Risk @ 99%	-0.347	-0.347	-0.527	-0.638	0.062	0.086	-0.084	-0.089
(Extreme risk-off)	(0.251)	(0.259)	(0.468)	(0.485)	(0.231)	(0.244)	(0.123)	(0.127)

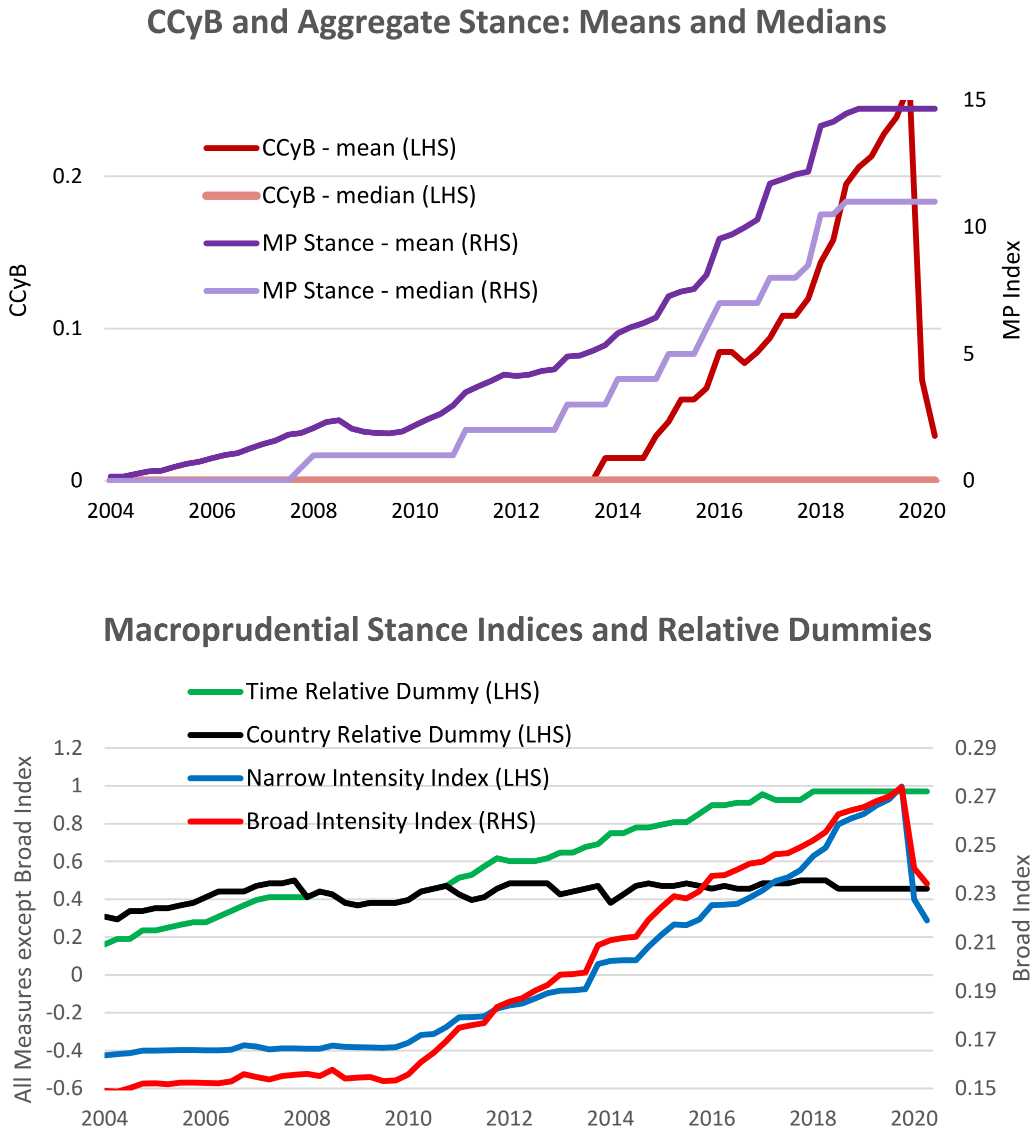
Notes: Capital flows are the percent change in quarterly flows based on data from Forbes and Warnock (2020). *MP Stance* is measured using the *Broad Intensity Index* , which is an equally-weighted index of the normalized CCyB, LTV and FX measures. *Risk* is measured with the RORO risk-on/risk-off index. *Macro* (at the top of the column) indicates the regression includes standard macro controls in capital flow regresssion: AE monetary stance, global growth, domestic growth, financial openness and institutional quality. *Finance* at the top indicates the controls also include the US interest rate differential, the US$ exchange rate and FX volatility. All pull/domestic variables are lagged by one quarter. See Appendix Table B for full definitions and sources. Each equation estimated with fixed effects and robust standard errors, clustered by country. See Appendix Table E for the full set of results.

Figure 1: Bond and Equity Fund Flows During Risk-off and Risk-on Periods



Notes: *MP High* and *MP Low* are countries with a tighter or looser macroprudential stance, respectively. A tighter macroprudential stance is defined based on the *Time-relative Dummy,* which is equal to one if the country had tightened macroprudential policy more than once, after aggregating across all macroprudential tools and adjustments up to that date since 2000. The figures show show differences in portfolio equity and bond flows based on EPFR data for countries that have a tighter or loser macroprudential stance. The left panels show larger portfolio outflows for equities, and especially bonds, during the risk-off phase of the COVID pandemic. The right panels show greater volatility in countries with a tighter macroprudential stance for both equity and bond flows during a relatively more tranquil period.

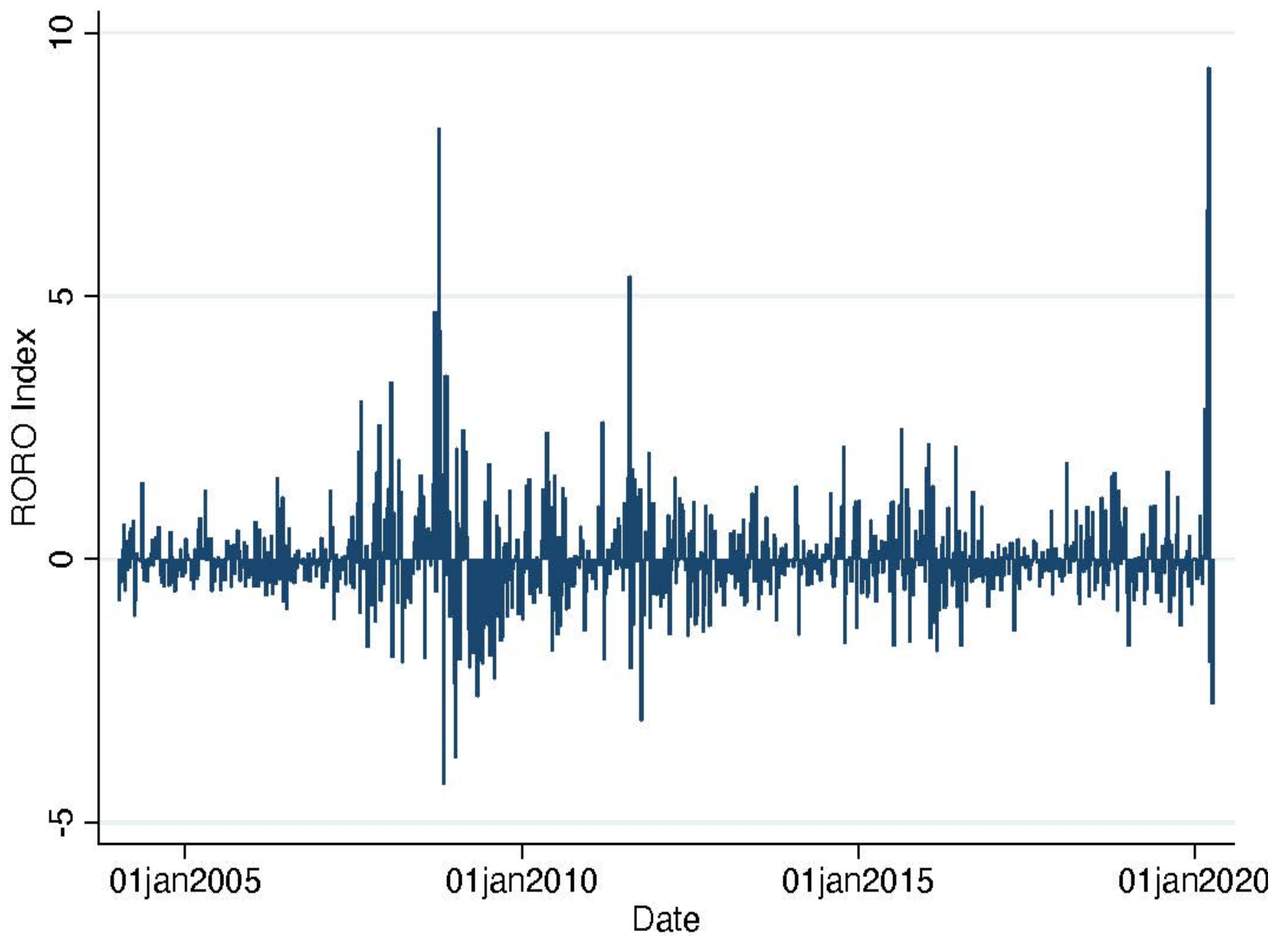
Figure 2: Measuring the Macroprudential Stance



Notes: *CCyB* is the countercyclical capital buffer. *MP Stance* is the sum of changes in all macroprudential measures, cumulated each quarter starting in 2000. The *Broad Intensity Index* is an equally-weighted index of normalized values of the CCyB, LTV ratio and FX stance, with the FX stance calculated as the cumulated sum of changes in FX-related macroprudential regulations since 2000. The *Narrow Intensity Index* is the principal component of the CCyB and LTV ratios. The *Country Relative Dummy* is a dummy equal to one for countries with a tighter *MP Stance* than the sample median each quarter. The *Time Relative Dummy* is a dummy equal to one for countries that have an *MP Stance* of more than one tightening as of the given quarter (so that most of the variation in the sample is over time).

Source: CCyB data is from the BIS and ESRB, both datasets accessed as of 11/2020. The data used to calculate the *MP Stance*, including for the LTV and FX Stance, are from Alam et al. (2018) with data updated through 2018.

Figure 3
RORO Measure of Risk-on/Risk-off



Notes: The risk-on/risk-off (RORO) index is calculated following the methodology in Chari et al. (2020). This index captures the realized variation in global investor risk appetite using the first principal component of a multi-faceted set of daily changes in several standardized asset market variables. See text for details on individual components.

Appendix Table A
Variables for First-stage of Policy Shock Regressions

Variable	Description	Source
CRISIS VARIABLES		
Crisis in last 12 months	Dummy equal to one if the country experienced a banking, currency, or sovereign debt crisis in the previous 12 months	Laeven and Valencia (2020)
Distance to default of banking system	Average Z-score of individual banks in a country	Global Financial Development Database
Romer and Romer crisis count	In a given half-year: 1.) Cross-country sum of financial crisis index; 2.) count of countries in crisis	Romer and Romer (2019)
Romer and Romer crisis intensity		
Sovereign crisis count	Count of countries in a sovereign debt crisis in a given year	Laeven and Valencia (2020)
Currency crisis count	Count of countries in a currency crisis in a given year	Laeven and Valencia (2020)
Banking crisis count	Count of countries in a banking crisis in a given year	Laeven and Valencia (2020)
CREDIT VARIABLES		
Cross border ratio	External claims on nonbank sector of banks as a percentage of total claims on public non-financial corporations	BIS
Domestic credit growth	Annual growth of private sector credit to GDP	IMF International Financial Statistics
Property prices	Real residential property prices, Y/Y percent change	BIS
GROWTH VARIABLES		
REER growth	REER appreciation, M/M	Bruegel Broad Datasets
Growth forecast	5 quarter ahead forecast annual GDP growth rate, October W	IMF World Economic Outlook
Inflation	Lagged Y/Y inflation	Haver
Real GDP growth	Quarterly real GDP growth	Haver
OTHER MACRO AND INSTITUTIONAL CHARACTERISTICS		
Openness	Chinn-Ito Index of financial openness	Chinn and Ito (2006)
FX volatility	30-day variance of the daily exchange rate against USD	Haver
Institutional quality	ICRG composite score	ICRG
Policy rate	Central bank policy rate	Haver
*i - i**	Central bank policy rate less US federal funds rate	Haver
Exchange rate regime	Dummy equal to one if Ilzetzki et al score is in the four least-free-floating designation	Ilzetzki, Reinhart, and Rogoff (2018)

Appendix Table B
Variables for Baseline Regressions

Variable	Description	Source
MP MEASURES		
Broad Index	Equally-weighted average of LTV, CCyB and index of foreign exchange measures	iMapp, BIS, ESRB
Narrow Index	First principal component of LTV and CCyB	BIS, ESRP
Time-relative Index	Dummy equal to one if the cumulative aggregate index summing all macroprudential measures in the cross-section is at least one	iMapp
Country-relative Index	Dummy equal to one if the cumulative aggregate index summing all macroprudential measures in the cross-section is above the sample median each quarter	iMapp
LTV	Z-score of 100 less the loan-to-value ratio	iMapp
CCyB	Z-score of the countercyclical capital buffer	BIS, ESRP
FX Measures	Z-score of cumulative aggregate changes in any macroprudential measures related to foreign currency exposures, transactions or liquidity.	iMapp
Demand Measures	Cumulative index aggregating measures aimed at demand for loans, including debt-service-to-income (DSTI) and loan-to-value limits (LTV); results report country-relative treatment.	iMapp
Supply Measures	Cumulative index aggregating measures aimed at supply of loans, including reserve requirements, liquidity requirements, capital requirements, conservation buffers, the leverage ratio, capital surcharges for systemi- cally important financial institutions, countercyclical capital buffers, limits on credit growth, loan loss provisions, and loan restrictions; results report country-relative treatment.	iMapp
DOMESTIC/PULL VARIABLES		
Exchange Rate (t-1)	Bilateral exchange rate with the US dollar	Haver
i - i (t-1)*	Central bank policy rate less US federal funds rate	Haver
Real Growth (t-1)	Quarterly real GDP growth	Haver
FX Volatility	30-day variance of the daily exchange rate against USD	Haver
Financial openness	Chinn-Ito Index	Chinn and Ito (2006)
Inst. Quality	ICRG composite score	ICRG
GLOBAL/PUSH VARIABLES		
AE Monetary Stance (t-1)	GDP-weighted average of Krippner SRTSM shadow rate estimates for US, UK, Japan and Euro area	Haver
AE IP Growth (t-1)	GDP-weighted average of industrial production growth for US, UK, Japan and Euro area	Haver

Appendix Table C
Country Coverage

Emerging and Developing (EMDE)			*Advanced (AE)*
Argentina	Kuwait	Tanzania	Australia
Bahrain	Latvia	Thailand	Austria
Bangladesh	Lebanon	Tunisia	Belgium
Brazil	Lithuania	Turkey	Canada
Bulgaria	Malaysia	Uganda	Finland
Chile	Mexico	Ukraine	France
Colombia	Morocco	United Arab Emirates	Germany
Croatia	Nigeria	Vietnam	Greece
Czech Republic	Oman	Zambia	Ireland
Denmark	Pakistan		Israel
Dominican Republi	Peru		Italy
Estonia	Philippines		Korea
Ghana	Poland		Netherlands
Hong Kong	Romania		New Zealand
Hungary	Russia		Norway
India	Saudi Arabia		Portugal
Indonesia	Slovenia		Spain
Kazakhstan	South Africa		Sweden
Kenya	Sri Lanka		United Kingdom

Appendix Table D
Summary Statistics

	Mean	St. Dev.	Min.	Max.	Obs.
Portfolio Flows					
Bond flows (% of AUM)	0.103	0.620	-4.057	3.830	43,100
Equity flows (% of AUM)	0.0242	0.563	-5.401	5.350	47,483
Risk and Macroprudential Measures					
RORO	0.0160	1.020	-4.278	9.348	47,483
Broad intensity index	0.219	0.947	-1.198	6.484	40,586
Narrow intensity index	0.250	1.124	-1.296	4.069	40,586
Time-relative dummy	0.668	0.471	0	1	47,483
Country-relative dummy	0.476	0.499	0	1	47,483
AFX	0.151	1.329	-3.029	8.689	47,483
CCYB	0.218	1.854	-0.0947	16.24	47,483
LTV	0.240	1.281	-0.934	9.627	40,586
Other Control Variables					
AE monetary stance (change)	-0.120	1.877	-3.111	4.172	47,483
Global growth (AE IP)	0.000418	0.00801	-0.0724	0.0172	47,483
Domestic growth	0.0328	0.0342	-0.151	0.251	47,483
Financial openness	1.069	1.444	-1.920	2.334	47,483
Institutional quality	73.70	7.560	53.38	92.38	47,483
US interest rate differential	3.306	5.380	-3.250	83.70	47,483
Exchange rate vs. US$	599.9	2,798	0.265	23,628	47,483
FX volatility	2.643	16.84	0	885.7	47,483

Note: Summary statistics for full sample of countries listed in Appendix C.

Appendix Table E
Full Regression Results: Quarterly International Capital Flows

	Debt		Equity		Bank		Total	
Controls	**Macro**	**Finance**	**Macro**	**Finance**	**Macro**	**Finance**	**Macro**	**Finance**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
MP Stance	-0.012	-0.023	-0.037	-0.077	-0.015	-0.012	-0.040	-0.076
	(0.135)	(0.128)	(0.158)	(0.169)	(0.092)	(0.095)	(0.042)	(0.114)
Risk	0.449	0.644***	0.519	0.467	-0.513**	-0.562**	-0.056	-0.071
	(0.306)	(0.233)	(0.461)	(0.477)	(0.252)	(0.259)	(0.119)	(0.138)
Interaction of MP	-0.294	-0.285	-0.430	-0.493	0.068	0.087	0.079	-0.012
stance and risk	(0.189)	(0.180)	(0.374)	(0.388)	(0.176)	(0.187)	(0.076)	(0.130)
Push/Global Variables								
AE monetary stance	-0.150	-0.218	0.184	0.183	0.155	0.116	-0.096*	0.044
(change)	(0.241)	(0.257)	(0.259)	(0.265)	(0.227)	(0.245)	(0.055)	(0.112)
Global growth	-11.508	-2.536	-1.059	0.719	-36.139*	-36.982*	7.602	10.573
(AE IP)	(21.632)	(19.026)	(22.579)	(23.316)	(18.741)	(20.086)	(7.890)	(9.580)
Pull/Domestic Variables								
Domestic	-0.017	-0.028	-0.019	-0.005	0.047	0.048	0.011	0.022
growth	(0.034)	(0.034)	(0.026)	(0.028)	(0.030)	(0.032)	(0.015)	(0.025)
Financial	0.363*	0.270	-0.164	-0.095	-0.090	-0.176	0.057	0.073
openness	(0.195)	(0.188)	(0.302)	(0.301)	(0.195)	(0.194)	(0.038)	(0.088)
Institutional	0.001	0.011	-0.011	-0.002	0.057	0.052	-0.010	-0.003
quality	(0.024)	(0.029)	(0.037)	(0.042)	(0.035)	(0.033)	(0.018)	(0.022)
US interest rate		-0.033		0.072		-0.022		-0.012
differential		(0.046)		(0.072)		(0.060)		(0.026)
Exchange rate		-0.000		0.000**		0.000		-0.000
vs. US$		(0.000)		(0.000)		(0.000)		(0.000)
FX volatility		0.009		0.004		-0.014		0.001
		(0.010)		(0.004)		(0.015)		(0.001)
Constant	-0.573	-1.131	1.090	-0.022	-4.416*	-3.888	0.662	0.054
	(1.767)	(2.181)	(2.854)	(3.324)	(2.550)	(2.476)	(1.342)	(1.654)
Observations	***2,096***	***2,031***	***2,096***	***2,031***	***2,096***	***2,031***	***2,096***	***2,031***
# Countries	***38***	***38***	***38***	***38***	***38***	***38***	***38***	***38***
R-squared	***0.006***	***0.008***	***0.002***	***0.004***	***0.005***	***0.006***	***0.005***	***0.005***

Notes: Capital flows are the percent change in quarterly flows based on data from Forbes and Warnock (2020). *MP Stance* is measured using the *Broad Intensity Index*, which is an equally-weighted index of the normalized CCyB, LTV and FX measures. *Risk* is measured by risk-on/risk-off (RORO) index. *Macro* (at the top of the column) indicates the regression includes standard macro controls in capital flow regresssion: AE monetary stance, global growth, domestic growth, financial openness and institutional quality. *Finance* at the top indicates the controls also include the US interest rate differential, the US$ exchange rate and FX volatility. All pull/domestic variables are lagged by one quarter. Each equation estimated with fixed effects and robust standard errors, clustered by country.