Spillovers at the Extremes: Macroprudential Tools and Vulnerability to the Global Financial Cycle

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I. Introduction

Macroprudential policies are being used more widely by countries around the world 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 a wide range of macroprudential policies and suggests that certain polices can accomplish specific domestic goals that should improve financial stability (such as moderating credit growth or foreign currency-denominated borrowing).[1] Nevertheless, there is limited evidence about whether the same policies can accomplish broader goals, such as stabilizing capital flows and improving country resilience to the global financial cycle (as proposed in Rey, 2013). The evidence also suggests that while macroprudential tools can reduce vulnerabilities in the banking sector, spillovers and leakages can cause risks to shift elsewhere in the economy —particularly to bond markets and private sector capital flows. If the magnitude of these spillovers and leakages is large enough and risks shift to markets that are more vulnerable to shocks, macroprudential regulations could threaten, rather than mitigate, financial sector vulnerabilities.

Another rapidly growing body of literature examines extreme events in capital flows, returns, and global risk shocks, with increased focus on the entire distribution of outcomes rather than average relationships that may pertain only to "normal" times.[2] Certain policies may have minimal impact during stable periods, but be highly effective at mitigating vulnerabilities during extreme events (or just extreme adverse events). Macroprudential policies could be one such policy; they could reduce the likelihood of extreme tail events but have little measurable impact on mean outcomes. The spillovers and leakages from macroprudential policies may also be more important during certain phases of the financial cycle, especially if they shift financial intermediation outside the regulated banking sector to

[1] For recent surveys of the empirical literature assessing the impact of macroprudential policies, see Forbes (2021) and Araujo et al (2020).

[2] See Chari, Dilts-Stedman and Lundblad (2020), Eguren-Martin, Sokol and Berge (2020) and Gelos, Gornicka, Koepke, Sahay and Sgherri (2019).

entities that are 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 window from 2010-2019 when macroprudential regulations were more widely adopted corresponded to a paucity of extreme events.

This paper builds on the sharp movements during the Covid-19 crisis to link these two branches of the academic literature. It analyzes if different macroprudential policies have affected countries' sensitivities to the global financial cycle during extreme events, as well as in more normal times. This analysis begins by briefly considering the direct effects of macroprudential regulations on broad categories of capital flows (for comparison with the existing literature), and then focuses on the less-studied, indirect effects on portfolio flows. Major international financial institutions, central banks, and several academic papers have raised concerns that tighter regulations on banks have spurred growth in international corporate bond markets and other parts of the "shadow" financial system as entities adjust to the regulations.[3] There has been little systematic analysis, however, of what these spillovers and leakages imply over different phases of the global financial cycle.

The results in this paper suggest that concerns about financial intermediation shifting outside the regulated financial sector have merit. Countries with a tighter macroprudential policy stance have portfolio flows that are significantly more sensitive to extreme movements in the global financial cycle—especially during "risk-off" episodes, and to a lesser extent during "risk-on" episodes. This does not imply that macroprudential regulations should be reversed, but highlights some of their costs and corresponding vulnerabilities they introduce—all of which should be considered when designing an optimal macroprudential policy package.

As a first look at whether macroprudential regulations may aggravate—or mitigate—the impact of extreme negative risk shocks on portfolio flows, Figure 1 graphs private-sector capital flows into bond funds (panel A) and equity funds (panel B) during the Covid shock, with capital flows normalized to 100 on February 19, 2020.[4] Each panel reports the average capital flow for a sample of 72 advanced economies and emerging markets divided in two groups[5]: those with tighter and looser macroprudential policy stances at the start of 2019.[6] Countries with a tighter macroprudential stance have had meaningfully larger capital outflows than those with a more relaxed stance during this period of heightened risk aversion. Specifically, countries with tighter macroprudential policy experienced a collapse of about 25% in bond flows and 10% in equity flows through mid-April, as compared to a decline of 15% and 2%, respectively, for countries with looser macroprudential policies. The greater sensitivity of portfolio flows to the Covid shock in countries with tighter macroprudential policy could simply reflect different characteristics (i.e., countries with more volatile capital flows also tend to have tighter macroprudential stances), or a direct effect of macroprudential policy, such as shifting more financial intermediation to riskier debt and equity flows.

[3] See ECB (2020), IMF-FSB_BIS (2016), CGFS (2010), Ahnert et al. (2020), and Forbes (2019).

[4] Using EPFR data we cumulatively sum fund flows and rebase to 100 before the onset of financial market volatility associated with COVID-19. We describe the EPFR data in more detail below.

[5] Table 3 in the appendix presents the list of countries in the sample.

[6] 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 one time since 1990.

To understand if the correlation between macroprudential stances and capital flow volatility occurs during more stable times than the 2020 Covid shock, Figure 2 graphs bond and equity flows to the same two groups of countries over the same windows (with the index set to 100 on the first Wednesday of February in each year) over the preceding four more tranquil years (2016-2019). Even during these calmer periods, capital flows appear to be relatively more volatile in countries with a tighter macroprudential policy stance (albeit substantially less volatile than during 2020), including during some windows when there is no relationship between the level of capital flows and macroprudential stance. This supports an important insight from the more formal analysis below; the impact of a country's macroprudential policy stance on capital flows appears to 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 test if macroprudential regulations affect country sensitivity to different phases of the global financial cycle, the paper focuses on the Risk-on-Risk-off (RORO) measure of the global financial cycle developed in Chari, Dilts-Stedman and Lundblad (2020).[7] The measure captures the 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. This measure of the global financial cycle exhibits significant skewness and fat tails. Chari, Dilts-Stedman and Lundblad (2020) illustrate that negative RORO shocks reduce not only median emerging market capital flows and returns, but also shift their distributions to the left, especially for the left tail (i.e., weaker flows and returns). We use a similar framework to assess if macroprudential regulations mitigate the impact the global financial cycle by moderating these effects of different RORO shocks on different asset classes.

To begin the analysis of how macroprudential regulations affect country sensitivity to different phases of the global financial cycle, the paper confirms other work that tighter macroprudential regulations generally have small and insignificant effects on cross-border capital flows. Macroprudential policy also does not appear to be significantly correlated with how risk shocks affect capital flows on average. The power of these tests is limited, however, due to the lower frequency of the quarterly capital flow data and lack of detail within the categories of capital flows.

Therefore, the paper next moves to its primary contribution: a deeper analysis of how macroprudential regulations affect the resilience of portfolio capital flows during different phases of the global cycle. This analysis uses weekly, EPFR data, which allows more detailed portfolio-level analysis of the effects of regulations on prices (returns) as well as volumes (flows), two key aspects of the global financial cycle highlighted in Rey (2013). This data also allows us to analyze different effects in US dollar and local currency investments, as well as in equities and bonds, for different types of macroprudential tools. This detailed analysis of the interaction between macroprudential regulations and portfolio flows is a significant addition to the existing literature (which has focused primarily on how macroprudential regulations affect banks) in order to better understand the spillovers of regulations and their implications for financial stability.

The results from this portfolio-level analysis support the aggregate results that tighter macroprudential regulations (using a broad index of measures) do not significantly affect portfolio flows (for equity or debt), and higher risk aversion corresponds to lower portfolio flows (for equity and debt). Macroprudential regulations, however, also appear to amplify the effects of risk shocks on capital flows and returns in this more detailed data. During extreme risk-on and risk-off episodes, macroprudential

[7]Results are robust to other measures of the global financial cycle, such as the VIX or the Variance Risk Premium.

regulations correspond to a significantly greater sensitivity of debt flows (and in some cases equity flows) to changes in the global financial cycle, i.e., heighten the effect of changes in risk aversion on portfolio inflows and outflows. The effects are meaningful and large in magnitude. Other analysis that just uses aggregate, lower-frequency capital flow data, or that focuses on the average relationships between macroprudential regulations, capital flows and risk shocks over time, can fail to capture the significant relationships at the extremes of the global financial cycle.

These results have important implications for the use of macroprudential policy. Although tighter macroprudential policy can yield important benefits (such of improving the resilience of a country's banking system and reducing the volatility of cross-border bank flows), it also appears to increase the sensitivity of portfolio flows (especially debt), to extreme risk shocks. In fact, tighter macroprudential regulation appears to amplify the effects of the global financial cycle at both extremes—corresponding to greater inflows during "risk-on" periods and especially to greater outflows during "risk-off" periods. Any cost-benefit analysis of macroprudential regulation needs to carefully consider these effects at the extremes, as well as during more stable periods.

This paper builds on several areas of academic research. First, it adds to the rapidly growing literature assessing the use and effectiveness of macroprudential regulations (Cerutti et al, 2017; Araujo et al, 2020; and Forbes, 2021). Second, it builds on a literature focusing on the spillovers and unintended consequences of policy choices (Agénor and da Silva, 2018; Avdjiev et al, 2016; and Ahnert et al, 2020). Third, it links to the new focus of some papers on the distribution of outcomes (Chari et al., 2020; Eguren-Martin et al., 2020; and Gelos et al., 2019). Finally, it relates to the long-standing literature on the determinants of capital flow movements during normal times (Rey, 2013), as well as during extreme capital flow episodes (Forbes and Warnock, 2012).

The remainder of the paper is as follows. Section II discusses the underlying data. Section III provides initial analysis using quarterly gross capital flow data in order to put our results in the context of the existing literature and highlight the limits of this low-frequency and less detailed data to understand the effects of macroprudential regulations at the extremes of the global financial cycle. Section IV is the key contribution of the paper and uses detailed, weekly portfolio data to show how macroprudential regulations amplify the effect of risk shocks on portfolio flows at the extremes of the risk distribution. This section analyses the impact on equity and bond flows and returns, as well as for flows in US$ relative to local currencies. This section closes with two approaches for addressing potential endogeneity and selection bias. Section V provides more details on these relationships, assessing the effects in different country groups, for of different types of macroprudential instruments, and using different measures of the macroprudential policy stance. This section also evaluates different effects of macroprudential regulations versus capital controls at the extremes of the distribution. Section VI concludes.

II. The Data

This section discusses the key data used in the remainder of the paper: the macroprudential policy stance, the RORO measure of risk, the capital flow data, and other control variables.

(i) The Macroprudential Policy Stance

We focus on a measure of a country's macroprudential policy stance that is constructed from the IMF's Integrated Macroprudential Policy (iMaPP) database, described in Alam et al. (2019) and recently updated through end-2018.[8] This is the most comprehensive cross-country, time-series data on a broad set of macroprudential regulations available today. This database combines information from a number of 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 on a monthly basis from 1990-2018. It groups these tools into 17 different types of policy instruments (with subcategories) and tracks when the tools are tightened or loosened using dummy variables.[9] It can also be used to group macroprudential policies into those focused on the demand for credit, supply of credit, and international exposures based on the currency of the transaction (such as limits on FX lending and FX positions).[10]

Although the iMaPP data only reports policy changes and does not measure the overall macroprudential policy stance in each country, it is possible to construct a proxy for the macroprudential stance by aggregating the changes in each country's policies since the data starts in 2000 —a year when the use of these tools was fairly limited so each country can be assumed to start from a relatively 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 higher value indicating a tighter stance, and a panel median of 0 and mean of 2.3. The distribution is asymmetric with a long right tail, reflecting a few countries that have tightened macroprudential policy frequently (especially near the end of the sample), while the majority have made more limited net changes.[11] There were only modest net tightening over the 2000s, so that on the eve of the 2008 Global Financial Crisis, the median macroprudential policy stance was only one net tightening per country. Countries began to tighten macroprudential policy more frequently after 2010, so that in 2018 the median net macroprudential stance was nine tightenings. AEs had a looser macroprudential stance on average than EMDEs, although the gap was closing by the end of the sample, with the looser stance for AEs reflecting their greater tendency to loosen more during recessions, rather than a hesitation to tighten during stable times.

While macroprudential policy has become tighter on average, this masks important differences across countries, especially in recent years. This increased variation in macroprudential stances could help identify if these policies improve a country's resilience to global shocks in empirical analysis. Forbes (2021) provides a detailed analysis and highlights that some of these differences in macroprudential stances (especially near the end of the sample) may reflect different approaches toward adjusting macroprudential policy rather than fundamentally different policy intensities. For example, China tends

[8] Available at: https://www.elibrary-areaer.imf.org/Macroprudential/Pages/Home.aspx

[9] It also includes quantitative LTV ratios.

[10] Policies targeting the demand for credit include limits on debt-service to income and loan to value (LTV). 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.

[11] China has the tightest stance (72), followed by South Korea (41), Russia and Hong Kong (40). Iceland has the loosest stance (-7) and India and Argentina (-6). These numbers reflect the highest and lowest stance across the sample period, not necessarily the current stance.

to make frequent, but small, adjustments to its macroprudential tools, which aggregate to a large number of net tightenings, and a very tight macroprudential stance. In contrast, other countries (such as the UK) tend to adjust macroprudential policy less frequently, but then in larger increments, which would suggest a significantly weaker stance. Moreover, even if the measures adjusted for the intensity of the policy changes, any impact on a country's sensitivity to the global financial cycle could be non-linear and vary based on the country's characteristics.

Therefore, we will use several different measures of a country's macroprudential policy stance. First, $MP_{i,\,BC}$ is a dummy variable equal to 1 if the country has tightened macroprudential policy on net since 2000. Second, we define the dummy with tighter thresholds—such as if the country tightened policy five times or more. Third, we measure the stance relative to other countries each month (instead of on an absolute basis over the full sample), so that the dummy is equal to one if the country's macroprudential policy stance is tighter than the sample median over the year. Fourth, we focus on differences in countries loan-to-value (LTV) regulations, which is one of the more common macroprudential tools to be adjusted and is quantifiable in a way that is relatively comparable across countries. Finally, we create different "bins" capturing rough groups of countries that have tighter or looser stances. For example, for our base case, we create one bin for countries with a modestly tight stance (between the median and the 75th percentile within the year) and another for countries with more aggressive tightening (at or above the 75th percentile within the year). We also create narrower sets of bins. In each case, the omitted bin is countries that have made no change or loosened macroprudential policy since 2000 (8% of the sample).

(ii) The RORO Measure of Risk

To compute our primary measure of risk, the risk-on/risk-off (RORO) index, we follow the method developed in Chari et al. (2020). This index captures the realized variation in global investor risk appetite using the first principle component of a multi-faceted set of daily changes in several standardized asset market variables. Briefly, the method is as follows. The index sub-components are normalized, such that positive changes in the index imply risk-off behavior, and the normalized changes are scaled by their respective historical standard deviations. Next, we extract the first principle component and compute the z-score, which serves as the RORO measure.

Specifically, the RORO index incorporates several series. To capture changes related to credit risk, it incorporates 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 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 adds the growth in the trade-weighted U.S. Dollar Index against advanced foreign economies and the change in the spot gold price.

Figure 3 displays the time series of the headline RORO index. There is a sharp increase in the index around the 2008 global financial crisis and 2020 Covid crisis (as would be expected), and more moderate swings in risk-on as well as risk-off in other windows. The distribution skews toward risk-off with long tails, indicating that large risk-off events occur more frequently than large risk-on events.

(iii) Capital Flow Data

To assess the relationship between macroprudential regulations, risk shocks, and capital flows, we use two sources of data on international capital flows: the International Monetary Fund's (IMF) *Balance of Payments Statistics* (BOP) and the Emerging Portfolio Fund Research (EFPR) data. [12]

The IMF's BoP data is the most comprehensive and detailed source of data on quarterly capital flows for a large sample of countries over time. The BoP disaggregates flows into several components, including foreign direct investment (FDI), portfolio debt flows, portfolio equity flows, and bank flows, and thereby allows an analysis of how capital flows shift across components.[13] The data has much broader country coverage than other capital flow data, but the quarterly frequency can make it difficult to capture relationships and interactions that occur at a high frequency (which can be important when assessing the impact of risk shocks). The data also does not differentiate between the currencies of the flows.

To obtain a higher frequency proxy for capital flows into and out of a broad range of countries, we use the Country Flows dataset from EPFR Global. 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). The combination of these two datasets allows us to track a large proportion of the flow of money into world equity and bond markets by portfolio investors (see 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 therefore represent real quantities. Although this dataset does not include all portfolio investment (i.e., many hedge funds are not included), the flows mirror movements in the lower frequency, aggregate data on portfolio flows in the BoP (Koepke and Paetzold, 2020).

To measure returns on portfolio assets, we collect daily total returns from a number of well-known indices. Individual country returns on USD and local currency bonds come from J.P. Morgan's Emerging Market Bond Index (EMBI) and the Bloomberg Barclay's Local Bond Index. Country-level equity returns are measured using the Morgan Stanley Capital International (MSCI) local currency and USD indices. Reflecting the availability of EPFR data, the sample runs from January 7, 2004 to Apr. 15, 2020.[14] After merging the EPFR data with the iMaPP data on macroprudential regulations, the resulting sample includes 72 advanced and emerging markets. Also, we exclude the United States, Japan, and Switzerland from our sample as these countries play a unique role as safe havens in the global financial system. The relationships between risk shocks and capital flows that is the focus of this analysis would be expected to be different for these countries. A list of countries in the baseline sample is in the appendix.

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. $k(t) = K(t)/H(t-1)$. We also include the lag of the resulting scaled variable as an additional control in our benchmark specifications. This scaling and control for lagged flows ensures that the larger countries with larger capital flows do not mechanically drive the analysis. The EPFR flows are

[12] See Koepke and Paetzold (2020) for an excellent discussion of the pros and cons different capital flow data sets.
[13] 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.
[14] The exception is local currency bond returns, which only become available in 2008.

winsorized at the 0.5% and 99.5% levels to prevent several large outliers (that appear to be errors) from driving the results.

(iv) Other Control Variables

Finally, for our main analysis we include several standard "push" and "pull" variables as controls to capture factors that have been shown to affect capital flows and are available at the high frequency of our capital flow data. For "push" variables that reflect global conditions, we include the short-run shadow interest rate and industrial production growth of advanced economies.[15] The shadow rate should capture changes in monetary policy that occur through changes in the policy interest rate as well as "unconventional" tools, such as quantitative easing. To control for other slow-moving aspects of the business cycle and to control for changes to the mutual fund and ETF industries over time, we also include year fixed effects.

For "pull" variables that capture country-specific conditions, we include the bilateral exchange rate with the US$, the interest rate differential with the U.S. interest rate, and the volatility of the exchange rate over the past thirty days. We also include two slow moving structural variables: each country's financial openness (measured using the Chinn-Ito index) and its institutional quality (measured using the ICRG index).[16] All control variables with the exception of FX volatility are entered as lagged values in the benchmark specifications to reduce the potential for simultaneity. Finally, all specifications include a country fixed effect.

III. Macroprudential Policy and Risk: Aggregate Effects by Flow Type

To begin our analysis of how macroprudential policy and risk measures affect broad categories of capital flows, this section begins by estimating relationships using data from the IMF's Balance of Payments. This highlight the importance of using high frequency measures, especially to capture relationships at the extremes of the risk distribution (for risk-on as well as risk-off periods).

First, we estimate the unconditional relationship between changes in the macroprudential policy stance and the RORO measure of risk with the volume of five types of capital flows (total capital flows, foreign direct investment, portfolio equity, portfolio debt, and banking flows):

$$k_{it} = \alpha_i + \beta_0 k_{i,t-1} + \beta_1 MP_{i,t-1} + \beta_2 RORO_t + \boldsymbol{\beta_3 \gamma_{it}} + \varepsilon_{i,t} \,, \qquad (1)$$

where k_{it} is 4-quarter capital flows for country i in quarter t; α_i is a country fixed effect; $MP_{i,t-1}$ is a lagged measure of the macroprudential policy stance (as discussed above, equal to one for countries with a tighter stance); and $RORO_t$ is the risk-on, risk-off measure as discussed above, with a higher value indicating risk-off. The specification also includes a matrix of control variables ($\boldsymbol{\gamma_{it}}$) to capture

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

[16] For more information on the Chinn-Ito index, China 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/

other "push" and "pull" variables that have been shown to affect capital flows (and as discussed in the last section).

The results support the existing literature on capital flow movements: tighter macroprudential policy has no significant effect on quarterly movements in capital flows (for aggregate capital flows, bank flows, portfolio debt flows, and equity flows). Higher risk is negatively correlated with capital flows, although the significance of this effect varies based on the type of flow and time period.

Next, in order to test if a tighter macroprudential policy stance affects how risk shocks affect capital flows, we add an interaction term between $MP_{i,t-1}$ and $RORO_{i,t}$.

$$k_{it} = \alpha_i + \beta_0 k_{i,t-1} + \beta_1 MP_{i,t-1} + \beta_2 RORO_t + \beta_3 (MP_{i,t-1} * RORO_t) + \boldsymbol{\beta_4 \gamma_{it}} + \varepsilon_{i,t} \qquad (2)$$

The interaction term β_3 in equation (2), simply tests whether the macroprudential stance affects the transmission of risks shocks to capital flows when risk levels are at the average for the sample. As discussed above, however, tighter macroprudential policy may play a different role in mitigating (or aggravating) the impact of risks shocks during extreme risk-on and risk-off events, even if it has little role during average levels of risk. To test for these differential effects at different stage of the global financial cycle, we estimate the marginal effects of tightening macroprudential policy (moving from a weak stance to strong stance) at different points in the distribution of the RORO measure.

[RESULTS ARE IN PROGRESS]

IV. Macroprudential Policy and Risk: Portfolio Flows and Returns during Extreme Risk Episodes

To better understand these patterns, it is necessary to shift to more detailed and higher frequency data on portfolio flows. To perform this analysis, we follow the same specification and order of empirical tests as in the last section, except now use the EPFR weekly data on bond and equity flows to estimate relationships at a higher frequency. After the initial analysis of portfolio flows, this section also explores the interaction between macroprudential policy and risk for additional dimensions—on returns and based on the currency composition of the capital flows. The section ends by using two approaches to address any endogeneity and selection bias in a country's macroprudential policy stance (by instrumenting for the macroprudential stance and using propensity-score matching).

(i) Portfolio Flows at the Extremes

First, we estimate the unconditional effects of changes in the risk-on/risk-off index and macroprudential policy stance on weekly bond and equity flows using equation (1). For our baseline analysis, we focus on four types of macroprudential tools: (1) "All MP", which includes all macroprudential measures in the iMaPP database; (2) "All FX", which comprises all macroprudential measures focused on foreign exchange (FX) transactions and exposures;[17] (3) "Demand"-related macroprudential measures, which

[17] More specifically, these tools are: limits on net or gross open FX positions; limits on FX exposures and FX funding and currency mismatch regulations; and limits on foreign currency (FC) lending, rules or recommendations on

focus on the demand for loans and include debt-service-to-income and loan-to-value limits; and (4) "Supply"-related measures, which are a broad range of measures focusing on the bank's ability to supply credit.[18] The results are in Table 1, Panel A, with standard errors clustered by country.

The coefficient estimates suggest that higher values of RORO (i.e., risk-off shocks) are associated with sizable and significant declines in bond and equity flows (across all macroprudential measures). The relationship between capital flows and macroprudential measures, however, appears to vary based on the type of policy and capital flow. Tighter macroprudential policies targeting the supply of credit are associated with significantly lower bond and equity flows, while tighter policies targeting FX exposures are associated with lower bond inflows (although only marginally significant at the 10% level).

Next, Panel B of Table 1 estimates equation (2) by introducing an interaction term between the RORO measure and a dummy that takes the value of one for countries with a tighter macroprudential policy stance. This regression also includes the full set of controls for push and pull factors. The signs and significance of the coefficients on the RORO and macroprudential measures are the same as for the unconditional correlations, but the additional interaction term between these measures is now negative and significant for bond flows across all macroprudential measures. In other words, tighter macroprudential policy (using all four measures) appears to amplify bond outflows during risk-off shocks and amplify bond inflows during risk-on shocks. Moreover, to put the magnitude of these estimates in context, countries with a tighter macroprudential stance (using the aggregate measure) have almost 40% greater outflows than countries with a weak stance when the RORO index increases by 1 (which is a moderate and fairly common increase in risk, as shown in Figure 4). The largest marginal effects from the interaction of macroprudential policy with risk occur for FX-targeted measures, and the smallest marginal effects from demand-targeted measures. Shifting to equity flows, the interaction between macroprudential policy is weaker than for bonds, with only FX-targeted measures significantly amplifying the impact of risk shocks on equity flows (at the 10% level).

The estimates in Table 1b, however, capture the average effects across the full distribution of the risk index. As discussed above, tighter macroprudential policies could mitigate or amplify the impact of risk shocks at the extremes of the risk distribution in ways that are different than around the mean of the RORO index. To capture these different effects across the global financial cycle, we calculate the marginal effects (relative to the base rate), which is the coefficient estimate on the RORO index multiplied by the size of the shock, with the macroprudential dummy set to zero. Then we can compute the marginal effect from the risk shock when the macroprudential stance shifts from loose to tight (i.e., the dummy moves from zero to one). The results are shown in Table 1, Panel C for bonds and Panel D for equities. (Each regression includes the full set of controls shown in Table 1B.)

Starting with the results for bond flows in Table 1C, the first column for each macroprudential tool shows the impact of the risk shock (from the RORO value listed on the left) for countries with looser macroprudential stances (MP=0), and the second column shows the impact for countries with tighter stances (MP=1). The key result is the third column in each set, which shows the differential effect

foreign currency loans, capital requirements for banks (including risk weights, systemic risk buffers, and minimum capital requirements) targeting FX loans.

[18] More specifically, these tools are: reserve requirements, liquidity requirements, limits on foreign exchange positions, capital requirements, conservation buffers, the leverage ratio, capital surcharges for systemically-important financial institutions, countercyclical capital buffers, limits on credit growth, loan loss provisions, loan restrictions, and limits on foreign currency loans.

between the two macroprudential stances. These differential effects are positive for risk-off shocks (RORO>0) and negative for risk-on shocks (RORO<0). In other words, tighter macroprudential policy amplifies the effects of risks shocks at both ends of the distribution by increasing capital outflows during risk-off periods and increasing capital inflows during risk-on episodes. Moreover, the magnitude of these amplification effects grows with the size of the risk shock, with larger marginal effects as the size of the risk-on and risk-off shocks grow. These amplification effects are highly significant for risk-off episodes for all macroprudential measures (i.e., aggravating capital outflows during risk-off shocks), and significant for risk-on episodes for most measures (with the primary exception demand-based macroprudential tools).

To help unpack the magnitude of these effects, Table 2 shows the quantile cut-off values of our capital flow measures in the EPFR data. Beginning with capital outflows during risk-off episodes (the left side of the capital flow distribution), the 10th percentile cutoff is -0.49% and -0.46% of AUM for bond and equity funds, respectively. A four to five standard deviation risk-off shock[19] generates bond outflows worse than this 10th percentile and deep into the left tail for countries with tighter macroprudential policy stances. In contrast, it would take a six to seven standard deviation risk-off shock to generate the same magnitude of bond outflows for countries with weaker macroprudential stances. Converting these parameters into dollar values using the AUM average for 2020, a one standard deviation risk-off shock is associated with weekly bond outflows of $74.4 - $95.2 million in countries with tighter macroprudential policy (on average, with the range based on the different macroprudential tools), compared to outflows of $53.6 - $63.8 million in countries with no macroprudential measures in place on net.

To better understand the frequency of these events and put the magnitudes of these risk shocks in context, Figure 3 shows the time series of the RORO index. This graph suggests that the magnitude of the shocks required to push the countries with tighter macroprudential stances into the 10th percentile of bond outflows has occurred during every crisis since 2003, major and minor. These include the global financial crisis, the Euro crisis, sporadic periods after 2015 as the US tightened monetary policy, and most notably during the COVID crisis. These large movements in capital flows can generate significant disruptions in financial and economic activity. These effects could be overlooked by focusing on the central tendency of the risk distribution. We can capture them using the complete distribution of risk and a closer look at extreme events.

Finally, the estimates of the comparable marginal effects of different macroprudential stances for equity flows are shown in Table 1d. Most measures of macroprudential policy do not seem to amplify how risk shocks affect equity flows in the same way as for bond flows. More specifically, for the broad measure incorporating all macroprudential policies, or for measures focusing on demand- or supply-side policies, the marginal effects of moving from a loose macroprudential stance to a tighter stance on the relationship between the RORO index and equity flows are usually insignificant. The exception is for FX macroprudential regulations; a tighter FX regulatory stance significantly amplifies the impact of risk-off shocks on equity flows (as for bond flows), although the effect for risk-on shocks (the left side of the distribution) is insignificant, albeit still positive.

[19] The distribution of the RORO index is heavily left-skewed, similar to its underlying components and other risk measures (such as the VIX).

(ii) Portfolio Returns at the Extremes

While the analysis above and in the last section focused on the relationship between portfolio flows and the interaction between macroprudential policy and risk shocks, the detailed EPFR data also allows us to evaluate these interactions with respect to portfolio returns. We repeat the analysis in Tables 1a-1d for bond returns and equity returns, using the data sources described above.

[TABLES IN PROGRESS]

(iii) Portfolio Flows in Different Currencies at the Extremes

Most analyses of capital flows are based on flow data that aggregates across flows denominated in different currencies. There has recently been increased attention, however, to how the currency denomination can influence various relationships (Hoffman et al., 2020). One benefit of the EPFR data, however, is that it breaks portfolio flows into those in US$ from those in other currencies. We utilize this breakdown to repeat the above analysis for bond and equity flows in US$ and then in other currencies.

[WORK IN PROGRESS]

(iv) Addressing Selection Bias and Endogeneity in the Macroprudential Policy Stance

Two challenges in the literature assessing the impact of macroprudential policies are: endogeneity and selection bias. When capital flows are more volatile, policymakers may be more likely to tighten macroprudential policy, and certain types of countries that are more prone to volatile capital flows are more likely to have a tighter macroprudential policy stance.[20] Either of these relationships could generate a positive correlation between capital flow volatility and the use of macroprudential tools—a relationship that is aggravated during large risk shocks. To address these challenges, most papers lag their measures of macroprudential policy (to reduce endogeneity) and control for relevant country characteristics (to reduce selection bias). These approaches are unlikely to fully address either challenge (see Forbes, 2021 for more details). Therefore, we use two approaches to assess if endogeneity or selection bias are significantly affecting our results: instrumenting for the macroprudential stance and using propensity score matching.

First, we instrument for a country's macroprudential policy stance using several variables that are correlated with changes in macroprudential policy, following Cizel et al. (2019) and Ahnert et al. (2020). This is more likely to lead to unbiased estimates, but the first stage is imprecisely estimated as it is difficult to predict when macroprudential tools are adjusted in the high frequency of the EPFR data. We will also use a Heckman two-stage estimator to incorporate country characteristics that may drive the propensity to adopt macroprudential policies leading to non-randomness in the country-sample selection.

Next, we use propensity score matching, which compares effects for countries with a tighter macroprudential stance with the "nearest neighbor" or a synthetic construct of similar countries that

[20] For evidence that countries which use macroprudential policy more actively have significantly different institutions and macroeconomic characteristics than countries which do not, see Forbes and Klein (2015) or Forbes et al. (2015). For evidence that countries often adjust macroprudential policy in conjunction with other policies, see Akinci and Olmstead-Rumsey (2018).

have a looser macroprudential stance. This approach was first used in Forbes et al. (2015) and Forbes and Klein (2015), with more recent applications in Cizel et al. (2019) and Frost et al. (2020).

[WORK IN PROGRESS]

(v) Macroprudential Policy and Risk: Summary

To summarize, preliminary results suggest that risk-off episodes are correlated with significant declines in bond and equity flows, and tighter macroprudential policy tends to amplify the relationship for bond flows (for all four of our macroprudential measures) and for equity flows (using the FX-macroprudential measure). These effects are significantly stronger at the extremes of the risk distribution. Tighter macroprudential regulations can also amplify the positive impact of risk-on episodes on capital inflows, although the effects are smaller in magnitude and only significant for bonds (when macroprudential policy is measured using the broad index, FX measures, or supply-side measures).

This series of results indicates that although macroprudential tools may be successful in moderating the volatility of cross-border banking flows and their sensitivity to the global financial cycle, they correspond to a large increase in the sensitivity of bond (and in some cases equity) flows. The meaningful increase in the sensitivity of equity and bond flows to risk shocks implies a significant increase in country vulnerability—especially to extreme risk shocks (and risk-off shocks). Although the spillovers from macroprudential regulations on the volume of capital flows, or on average during more stable periods, are generally estimated to be small (especially using aggregate data), this heightened vulnerability during periods of stress should be an important consideration when designing a package of macroprudential policies.

V. Closer look: Different Country Groups, Different Macroprudential Regulations, and Different Measures of the Macroprudential Stance

This section will repeat the baseline analysis but explore several dimensions in more detail:

- Differences for emerging markets versus advanced economies.
- Differences for more detailed macroprudential measures (which FX-related measures are more important? Which supply-side measures?)
- Different measures of the macroprudential policy stance.
- Different effects of capital controls relative to macroprudential policy, using the Fernandez et al. (2015, updated through 2017) measure which allows a detailed disaggregation of different types of capital controls. This builds on recent work (such as Frost, Ito and Stralen, 2020) which suggest that FX-macroprudential measures can affect capital inflows, but capital controls have no significant effect.

VI. Conclusions

[TO BE WRITTEN]

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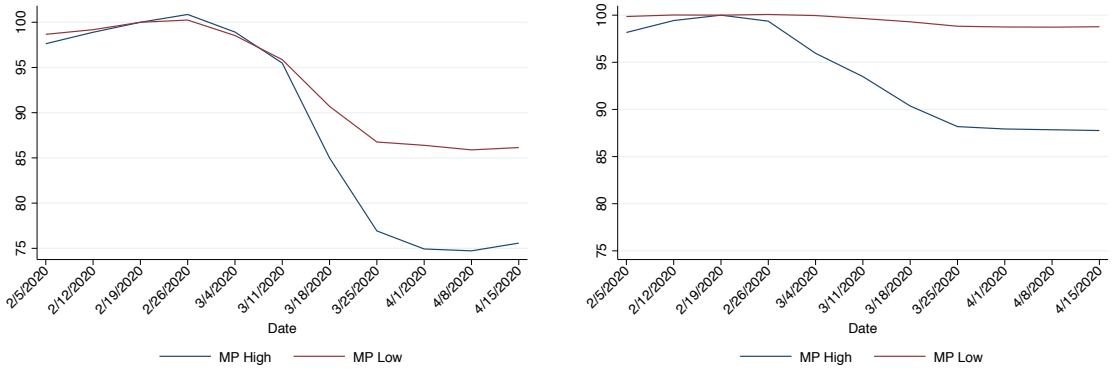
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Appendix

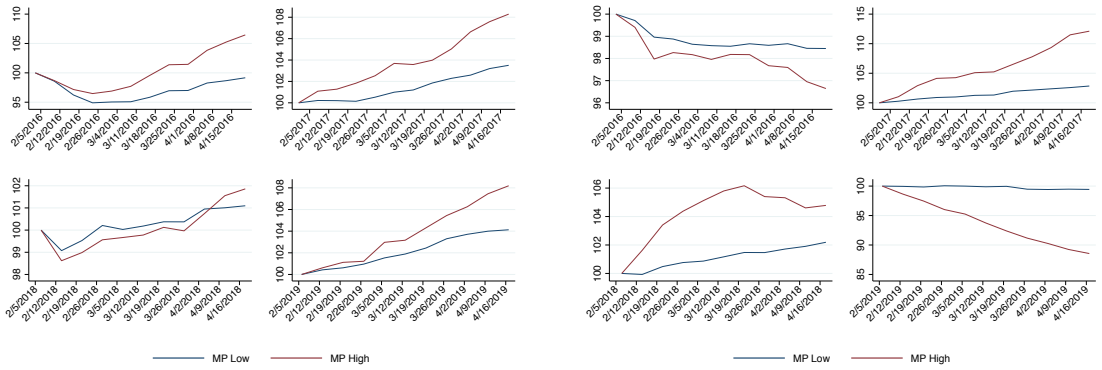
Figures

Figure 1: Fund flows during the Covid-19 episode (Cumulative index, Feb. 19 2020 = 100)



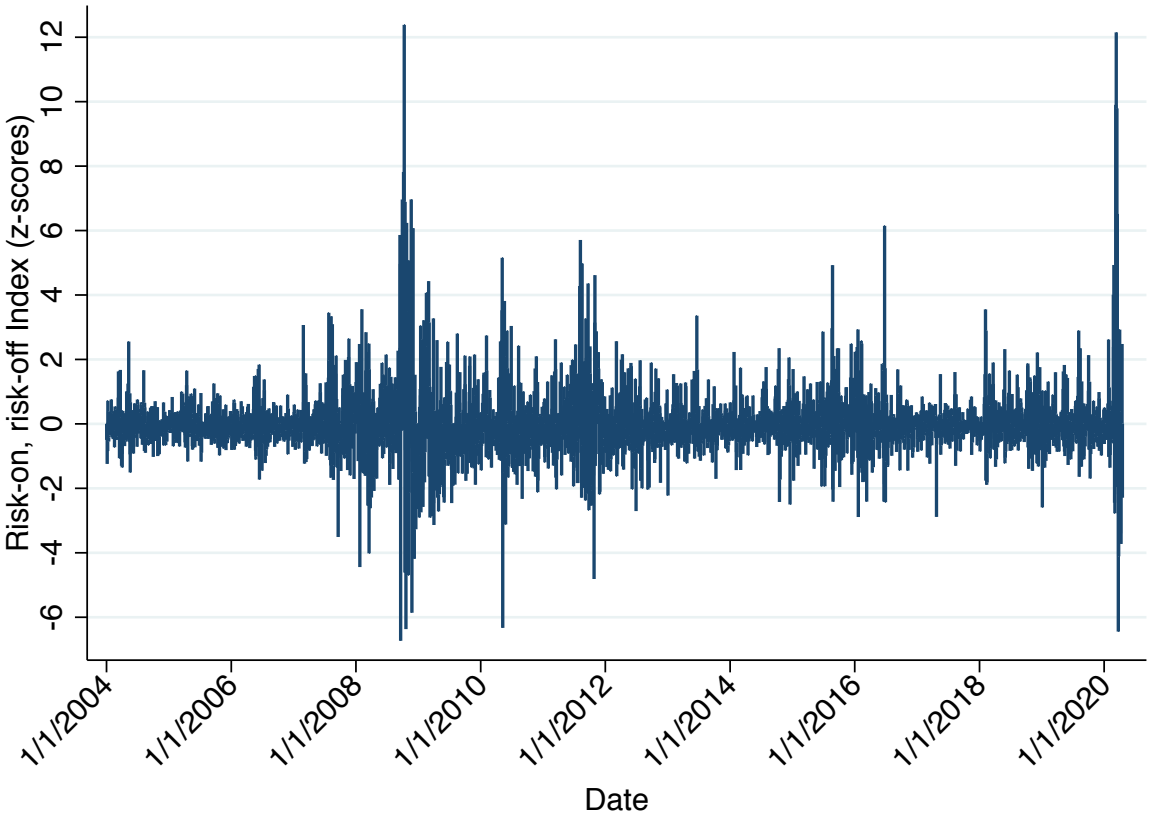
(a) Bond Funds (b) Equity Funds

Figure 2: Fund flows during tranquil periods (Cumulative index, 1^{st} week of Feb = 100)



(a) Bond Funds (b) Equity Funds

Figure 3: Risk-on/Risk-off Measure



Tables

Table 1a: The Baseline Specification, EPFR Flows

	Bonds				Equity			
VARIABLES	(1) All MP	(2) All FX	(3) Demand	(4) Supply	(5) All MP	(6) All FX	(7) Demand	(8) Supply
RORO	-0.0971***	-0.0971***	-0.0971***	-0.0971***	-0.0843***	-0.0843***	-0.0843***	-0.0843***
	(0.00312)	(0.00312)	(0.00313)	(0.00312)	(0.00398)	(0.00398)	(0.0371)	(0.00398)
High MP	-0.00947	-0.0247*	-0.00792	-0.0273***	-0.0110	-0.0107	-0.0111	-0.0265**
	(0.0113)	(0.0125)	(0.00990)	(0.00964)	(0.0146)	(0.0133)	(0.0120)	(0.0120)

Notes: This table summarizes the panel regressions of EPFR country flows on the RORO index and a dummy signifying the imposition of macroprudential measures, controlling for a variety of push and pull factors. All regressions include year and country fixed effects. "All MP" sums across all macroprudential measures in the iMapp database. "All FX" comprises limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, currency mismatch regulations, limits on foreign currency (FC) lending, rules or recommendations on foreign currency loans, capital requirements for banks (including risk weights, systemic risk buffers, and minimum capital requirements) targeting FX loans. Demand-related includes debt-service-to-income and loan-to-value limits. Supply consists of reserve requirements, liquidity requirements, limits on foreign exchange positions, capital requirements, conservation buffers, the leverage ratio, capital surcharges for systemically important financial institutions, countercyclical capital buffers, limits on credit growth, loan loss provisions, loan restrictions, and limits on foreign currency loans. Standard errors are clustered by country.

Table 1b: The Conditional Effects of Risk-on/Risk-Off and Macroprudential Policies

	Bonds				Equity			
VARIABLES	(1) All MP	(2) All FX	(3) Demand	(4) Supply	(5) All MP	(6) All FX	(7) Demand	(8) Supply
RORO	-0.0774***	-0.0874***	-0.0920***	-0.0806***	-0.0814***	-0.0804***	-0.0867***	-0.0837***
	(0.00525)	(0.00344)	(0.00393)	(0.00503)	(0.00701)	(0.00502)	(0.00522)	(0.00617)
High MP	-0.00882	-0.0239*	-0.00772	-0.0268***	-0.0109	-0.0103	-0.0112	-0.0265**
	(0.0113)	(0.0124)	(0.00989)	(0.00966)	(0.0145)	(0.0133)	(0.0120)	(0.0119)
High MP x RORO	-0.0288***	-0.0321***	-0.0128*	-0.0272***	-0.00438	-0.0132*	0.00633	-0.00105
	(0.00597)	(0.00642)	(0.00668)	(0.00587)	(0.00726)	(0.00680)	(0.00713)	(0.00650)
Exchange Rate (t-1)	-6.67e-06	-5.04e-06	-7.79e-06*	-5.92e-06	-2.49e-05**	-2.46e-05**	-2.61e-05***	-2.44e-05**
	(4.28e-06)	(4.37e-06)	(4.06e-06)	(4.71e-06)	(9.67e-06)	(9.78e-06)	(9.83e-06)	(9.39e-06)
$i - i^*$ (t-1)	-0.00208	-0.00216*	-0.00217*	-0.00191	0.000618	0.000549	0.000484	0.000744
	(0.00127)	(0.00117)	(0.00125)	(0.00125)	(0.000688)	(0.000665)	(0.000672)	(0.000680)
Real Growth (t-1)	0.0215	-0.00780	0.0139	0.0600	0.403**	0.378**	0.387**	0.431**
	(0.0675)	(0.0744)	(0.0700)	(0.0704)	(0.167)	(0.169)	(0.168)	(0.169)
FX Volatility	-0.000535***	-0.000533***	-0.000524***	-0.000546***	-8.07e-06	-3.12e-06	-2.69e-07	-1.67e-05
	(0.000165)	(0.000164)	(0.000167)	(0.000162)	(0.000139)	(0.000141)	(0.000141)	(0.000141)
Openness	0.00594	0.00734	0.00542	0.00537	0.000552	0.00129	-4.87e-05	-1.91e-05
	(0.00725)	(0.00647)	(0.00725)	(0.00755)	(0.00915)	(0.00906)	(0.00926)	(0.00941)
Inst. Quality	-0.000976	-0.000795	-0.000900	-0.000741	-0.00186	-0.00171	-0.00170	-0.00156
	(0.00119)	(0.00122)	(0.00120)	(0.00117)	(0.00169)	(0.00168)	(0.00172)	(0.00165)
AE Monetary Stance (t-1)	-0.0481***	-0.0477***	-0.0478***	-0.0481***	-0.0826***	-0.0825***	-0.0825***	-0.0825***
	(0.00435)	(0.00434)	(0.00436)	(0.00435)	(0.00598)	(0.00603)	(0.00601)	(0.00597)
AE IP Growth (t-1)	3.279***	3.235***	3.217***	3.290***	2.176***	2.174***	2.146***	2.169***
	(0.346)	(0.343)	(0.345)	(0.352)	(0.418)	(0.418)	(0.420)	(0.422)
AR(1)	0.504***	0.503***	0.503***	0.503***	0.423***	0.423***	0.423***	0.422***
	(0.0123)	(0.0123)	(0.0123)	(0.0122)	(0.0133)	(0.0133)	(0.0132)	(0.0133)
Constant	0.215**	0.196**	0.209**	0.198**	0.310**	0.298**	0.299**	0.288**
	(0.0938)	(0.0938)	(0.0942)	(0.0919)	(0.129)	(0.128)	(0.129)	(0.126)
Observations	44,493	44,493	44,493	44,493	47,682	47,682	47,682	47,682

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table summarizes the regressions of EPFR country flows on the RORO index interacted with a dummy signifying the imposition of macroprudential measures, controlling for a variety of push and pull factors. All regressions include year and country fixed effects."All MP" sums across all macroprudential measures in the iMapp database. "All FX" comprises limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, currency mismatch regulations, limits on foreign currency (FC) lending, rules or recommendations on foreign currency loans, capital requirements for banks (including risk weights, systemic risk buffers, and minimum capital requirements) targeting FX loans. Demand-related includes debt-service-to-income and loan-to-value limits. Supply consists of reserve requirements, liquidity requirements, limits on foreign exchange positions, capital requirements, conservation buffers, the leverage ratio, capital surcharges for systemically important financial institutions, countercyclical capital buffers, limits on credit growth, loan loss provisions, loan restrictions, and limits on foreign currency loans. Standard errors are clustered by country.

Table 1c: Marginal Analysis, EPFR Bond Flows

	All MP			All FX			Demand			Supply		
	MP = 0	MP = 1	Diff.	MP = 0	MP = 1	Diff.	MP = 0	MP = 1	Diff.	MP = 0	MP = 1	Diff.
RORO = -4	0.310	0.416	0.106***	0.350	0.454	0.104***	0.368	0.411	0.0436	0.322	0.403	0.0819***
RORO = -3	0.232	0.309	0.0775***	0.262	0.334	0.0723***	0.276	0.306	0.0307	0.242	0.296	0.0547***
RORO = -2	0.155	0.203	0.0487***	0.175	0.215	0.0402**	0.184	0.201	0.0179	0.161	0.188	0.0276*
RORO = -1	0.077	0.097	0.0200	0.087	0.095	0.00818	0.092	0.097	0.00510	0.081	0.081	0.000362
RORO = 0	0.000	0.000	-0.00882	0.000	-0.020	-0.0239*	0.000	0.000	-0.00772	0.000	-0.020	-0.0268***
RORO = 1	-0.077	-0.107	-0.0376***	-0.087	-0.137	-0.0559***	-0.092	-0.112	-0.0205	-0.081	-0.131	-0.0540***
RORO = 2	-0.155	-0.215	-0.0664***	-0.175	-0.255	-0.0880***	-0.184	-0.214	-0.0334*	-0.161	-0.241	-0.0812***
RORO = 3	-0.232	-0.322	-0.0951***	-0.262	-0.382	-0.120***	-0.276	-0.316	-0.0462**	-0.242	-0.342	-0.108***
RORO = 4	-0.310	-0.430	-0.124***	-0.350	-0.500	-0.152***	-0.368	-0.418	-0.0590**	-0.322	-0.452	-0.136***
RORO = 5	-0.387	-0.537	-0.153***	-0.437	-0.617	-0.184***	-0.460	-0.530	-0.0718**	-0.403	-0.563	-0.163***
RORO = 6	-0.464	-0.644	-0.181***	-0.524	-0.734	-0.216***	-0.552	-0.632	-0.0847**	-0.484	-0.674	-0.190***
RORO = 7	-0.542	-0.752	-0.210***	-0.612	-0.852	-0.248***	-0.644	-0.734	-0.0975**	-0.564	-0.774	-0.217***
RORO = 8	-0.619	-0.849	-0.239***	-0.699	-0.979	-0.280***	-0.736	-0.846	-0.110**	-0.645	-0.885	-0.244***

Notes: This table summarizes the marginal effect of having macroprudential in place at various values of the RORO index, based on the analysis in Table 1b. "All MP" sums across all macroprudential measures in the iMapp database. "All FX" comprises limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, currency mismatch regulations, limits on foreign currency (FC) lending, rules or recommendations on foreign currency loans, capital requirements for banks (including risk weights, systemic risk buffers, and minimum capital requirements) targeting FX loans. Demand-related includes debt-service-to-income and loan-to-value limits. Supply consists of reserve requirements, liquidity requirements, limits on foreign exchange positions, capital requirements, conservation buffers, the leverage ratio, capital surcharges for systemically important financial institutions, countercyclical capital buffers, limits on credit growth, loan loss provisions, loan restrictions, and limits on foreign currency loans. Standard errors are clustered by country. *, **, and *** signify a statistically significant difference in the effect of RORO at the 10%, 5%, and 1% levels, respectively.

Table 1d: Marginal Analysis, EPFR Equity Flows

	All MP			All FX			Demand			Supply		
	MP = 0	MP = 1	Diff.	MP = 0	MP = 1	Diff.	MP = 0	MP = 1	Diff.	MP = 0	MP = 1	Diff.
RORO = -4	0.326	0.332	0.00661	0.322	0.364	0.0424	0.322	0.292	-0.0365	0.322	0.302	-0.0223
RORO = -3	0.244	0.246	0.00223	0.241	0.270	0.0292	0.241	0.211	-0.0301	0.241	0.221	-0.0234
RORO = -2	0.163	0.163	-0.00215	0.161	0.177	0.0160	0.161	0.141	-0.0238	0.161	0.141	-0.0244
RORO = -1	0.081	0.081	-0.00653	0.080	0.082	0.00287	0.080	0.070	-0.0175	0.080	0.060	-0.0255*
RORO = 0	0.000	-0.010	-0.0109	0.000	-0.010	-0.0103	0.000	-0.010	-0.0112	0.000	-0.020	-0.0265**
RORO = 1	-0.081	-0.091	-0.0153	-0.080	-0.100	-0.0235	-0.080	-0.080	-0.00483	-0.080	-0.100	-0.0276**
RORO = 2	-0.163	-0.173	-0.0197	-0.161	-0.191	-0.0367**	-0.161	-0.160	0.00150	-0.161	-0.181	-0.0286
RORO = 3	-0.244	-0.264	-0.0240	-0.241	-0.281	-0.0499**	-0.241	-0.234	0.00783	-0.241	-0.261	-0.0297
RORO = 4	-0.326	-0.346	-0.0284	-0.322	-0.382	-0.0630**	-0.322	-0.308	0.0142	-0.322	-0.352	-0.0307
RORO = 5	-0.407	-0.437	-0.0328	-0.402	-0.472	-0.0762**	-0.402	-0.382	0.0205	-0.402	-0.432	-0.0318
RORO = 6	-0.488	-0.518	-0.0372	-0.482	-0.562	-0.0894**	-0.482	-0.456	0.0268	-0.482	-0.512	-0.0328
RORO = 7	-0.570	-0.610	-0.0415	-0.563	-0.663	-0.103**	-0.563	-0.530	0.0331	-0.563	-0.593	-0.0339
RORO = 8	-0.651	-0.691	-0.0459	-0.643	-0.753	-0.116**	-0.643	-0.604	0.0395	-0.643	-0.673	-0.0349

Notes: This table summarizes the marginal effect of having macroprudential in place at various values of the RORO index, based on the analysis in Table 1b. "All MP" sums across all macroprudential measures in the iMapp database. "All FX" comprises limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, currency mismatch regulations, limits on foreign currency (FC) lending, rules or recommendations on foreign currency loans, capital requirements for banks (including risk weights, systemic risk buffers, and minimum capital requirements) targeting FX loans. Demand-related includes debt-service-to-income and loan-to-value limits. Supply consists of reserve requirements, liquidity requirements, limits on foreign exchange positions, capital requirements, conservation buffers, the leverage ratio, capital surcharges for systemically important financial institutions, countercyclical capital buffers, limits on credit growth, loan loss provisions, loan restrictions, and limits on foreign currency loans. Standard errors are clustered by country. *, **, and *** signify a statistically significant difference in the effect of RORO at the 10%, 5%, and 1% levels, respectively.

Table 2: Quantiles of the Fund Flow Distribution (% of AUM)

Quantile	Fixed income	Equity
5	-0.771	-0.749
10	-0.489	-0.460
15	-0.334	-0.320
20	-0.235	-0.235
25	-0.146	-0.172
30	-0.076	-0.124
35	-0.016	-0.082
40	0.036	-0.044
45	0.084	-0.010
50	0.133	0.022
55	0.185	0.056
60	0.236	0.091
65	0.286	0.129
70	0.345	0.173
75	0.403	0.223
80	0.477	0.290
85	0.573	0.381
90	0.711	0.515
95	0.981	0.791

Table 3: Sample Countries

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