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Capital Flows in Risky Times: Risk-on / Risk-off and Emerging Market Tail Risk

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ABSTRACT

This paper characterizes the implications of risk-on/risk-off shocks for emerging market capital flows and returns. We document that these shocks have important implications not only for the median of emerging markets flows and returns but also for the left tail. Further, while there are some differences in the effects across bond vs. equity markets and flows vs. asset returns, the effects associated with the worst realizations are generally larger than that on the median realization. We apply our methodology to the COVID-19 shock to examine the pattern of flow and return realizations: the sizable risk-off nature of this shock engenders reactions that reside deep in the left tail of most relevant emerging market quantities.

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1 Introduction

While portfolio flows to emerging markets offer well-documented benefits (Bekaert, Harvey and Lundblad (2005); Chari and Henry (2004, 2008); Henry (2007)), tail events such as sudden stops present challenges that prove particularly pressing for investors and policy makers (Forbes and Warnock (2012, 2019); Rey (2013); Miranda-Agrippino and Rey (2020)). There is, of course, a large literature on cross-border capital flows and their implications for financial market returns.[1] However, extant research has largely focused on the first moment of the relevant distributions of these important quantities. In sharp contrast, building on Gelos et al. (2019), we focus on the full distributions of emerging market capital flows and returns; most important, we characterize the manner in which extreme capital flow and returns realizations are tied to global risk appetite ("risk-on/risk-off" or RORO).

Despite still being somewhat imprecisely defined, the RORO terminology has come into pervasive use in the financial press and among policy makers in the years since the global financial crisis. In this paper, we focus on RORO shocks as a reflection of variation in global investor risk aversion. As investors rebalance their portfolios away from risk assets and toward safe assets in the face of risk aversion shock, RORO variation has important implications for asset price determination, particularly for so-called "risk assets". Jotikasthira, Lundblad, and Ramadorai (2012), for example, document this shock transmission mechanism to emerging market capital flows and asset prices. In response to funding shocks from their investor base (possibly linked to RORO), global funds substantially alter their portfolio alloca-

[1] See for example a non-exhaustive list of papers, Alfaro, L., S. Kalemli-Ozcan, and V. Volosovych (2008, 2014); Avdjiev, S., L. Gambacorta, L. S. Goldberg, and S. Schiaffi (2017); Ammer, J., M. De Pooter, C. J. Erceg, and S. B. Kamin (2016); Baskaya, Y. S., J. di Giovanni, S. Kalemli-Ozcan, J.-L. Peydro, and M. F. Ulu (2017); Bauer, M. D., & Neely, C. J. (2014); Broner, F., Didier, T., Erce, A., & Schmukler, S. L. (2013); Bruning, F. and V. Ivashina (2019); Bruno, V. and H. S. Shin (2014, 2015); Burger, J., R. Sengupta, F. Warnock, and V. Warnock (2015); Calvo, G. A., L. Leiderman, and C. M. Reinhart (1993, 1996).; Cerutti, E., S. Claessens, and D. Puy (2019); Chari, A., K. Dilts Stedman, and C. Lundblad (2020); Chen, J., Mancini Griffoli, T., & Sahay, R. (2014); Clark, John, Nathan Converse, Brahima Coulibaly, and Steve Kamin (2016); Dedola, L., G. Rivolta, and L. Stracca (2017); Dilts Stedman, K. (2019); Eichengreen, B. and P. Gupta (2017); Forbes, K. J. and F. E. Warnock (2012, 2019); Fratzscher, M. (2012); Fratzscher, M., Duca, M. L., & Straub, R. (2016, 2018); Georgiadis, G., & Grab, J. (2015); Ghosh, A. R., Kim, J., Qureshi, M., and Zalduendo, J. (2012); Gilchrist, S., Yue, V., & Zakrajsek, E. (2014, November); Gourinchas, P. O., & Obstfeld, M. (2012); Karolyi, G. A., & McLaren, K. J. (2016); Kim, S. (2001); Kroencke, T. A., Schmeling, M., & Schrimpf, A. (2015); Jotikasthira, P., C. Lundblad, and T. Ramadorai (2012); McCauley, R. N., McGuire, P., & Sushko, V. (2015); Miranda-Agrippino, S. and H. Rey (2019); Milesi-Ferretti, G., & Tille, C. (2011); Mishra, P., Moriyama, K., N'Diaye, P. M. B., & Nguyen, L. (2014); Moore, J., Nam, S., Suh, M., & Tepper, A. (2013); Neely, C. J. (2010); Obstfeld, M. (2015); Obstfeld, M., J. D. Ostry, and M. S. Qureshi (2018); Rogers, J.H., Scotti,C., & Wright,J.H.(2014); Reinhart, C. and V. Reinhart (2009); Rey, H. (2013).

tions to emerging markets with important implications for local asset prices.

In this project, we first build a multi-faceted RORO index to capture realized variation in global investor risk appetite. We employ daily data from both the United States and the Euro area to capture signals about global risk appetite. We summarize the risk-on and risk-off states of the world using an amalgam of four broad categories that reflect variation in advanced economy credit risk, equity market volatility, funding conditions, and currencies and gold. With an eye to inferring the risk bearing capacity of international investors, our RORO index comprises the first principle component of daily changes in these series. Our index, along with several associated sub-indices reflecting these four constituent groups, exhibits interesting distributional features in the sense that it is well characterized by significant skewness and fat tails. With fat tails, extreme events become both more probable and potentially more destabilizing. As examples, we observe sharp risk-off movements during the global financial crisis, the European debt crisis, the taper tantrum, and the COVID-19 crisis.

In recognition that our RORO measure reflects a largely statistical approach to measuring risk appetite, we also consider the variance risk premium from Bekaert at al. (2020). A complementary approach to measure risk aversion is to use a structural model to separate the price of risk (or risk aversion) from the amount of physical uncertainty. The latter object is a forecast of the variance, and the level of risk aversion is inferred from the amount over and above that uncertainty that investors are willing to pay to avoid it. As with our headline RORO index, these measures are also highly right-skewed and fat tailed, and they too spike during the global financial and COVID-19 crises.

Understanding the implications of variation in RORO for emerging market capital flow and return distributions is the focus of our paper. We focus on the extent to which RORO shocks alter the range of the distribution versus shift the distribution. As an example, an adverse, risk-off shock can make the whole emerging market capital flow or return distribution wider by pulling out both of the tails. Alternatively, a risk-off shock could simply fatten the left tail. These differences have important implications for how investors and policy makers should consider downside risk.

Using a panel quantile regression approach as in Machado and Santos Silva (2019), we characterize the distributional implications of RORO shocks for emerging market capital flows and returns. In order to obtain a multilateral, high frequency proxy of capital flows into and out of emerging markets, 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, collectively with more than 8 trillion U.S. dollars of capital under management. To measure returns on emerging market assets, we use country level USD and local currency equity return indices from MSCI, and our fixed income returns come from Bloomberg local currency bond indices and the Emerging Market Bond Index from JP Morgan. Due to the availability of EPFR data, the sample runs from January 7, 2004 to Apr. 9, 2020.

We find that RORO shocks do have important implications, not only for the median of emerging market flows and returns, but also for the left tail. We conclude that the focus in the literature on measures of central tendency is incomplete. In particular, we find that the effects associated with the worst realizations, say the fifth quantile, are often more heavily affected by risk-off shocks, then the median realization.

We first consider the distributional implications for portfolio flows associated with EPFR bond and equity mutual funds. For bond funds, risk-off shocks increase the worst portfolio outflow realizations more than they decrease median flows, and therefore risk-off shocks significantly fatten the left tail of the portfolio flow distribution. The net effect on bond flows from a risk-off event is that the entire distribution moves to the left. In the equity fund space, in contrast, while we observe that a risk-off shock negatively affects the overall distribution, we also observe that a risk-off shock brings in both the tails. Further, our complementary variance risk premium estimates suggest that the reactions we observe in the equity flow distribution emanate more from changes in risk aversion than to uncertainty.

Next, we turn to the distributional implications for emerging market returns. We find that risk-off shocks negatively affect the worst return realizations more than they affect the median return realization. Further, that are important differences across asset class and currency denomination. First, the left-tail implications for equity returns, in particular, are more severe than for bond returns. Second, within asset classes, U.S. dollar indices are more sensitive than local currency indices for both fixed income and equity.

Finally, we apply our framework to the COVID-19 shock. We examine the distributional pattern of the flow and returns realizations in the face of the sizable risk-off nature of this shock. In the COVID-19 era, a one standard deviation RORO shock pulls (compresses) the tail realizations of the weekly bond (equity) distribution by $25 ($16.1) million. A shock equal in magnitude to the largest observation in the COVID-19 sample pulls (compresses) the tails realizations of the weekly bond (equity) distribution by $92 ($59.5) million.

2 Data and Methodology

2.1 Measuring Risk-on/Risk-off

To measure changes in risk attitudes, we construct a Risk-On, Risk-Off (RORO) index similar to that described in Datta et al (2017). Our RORO index comprises the z-score of the first principal component of daily changes in several standardized variables. First, we normalize components such that positive changes imply risk-off behavior. Then, before taking the first principal component, we scale these normalized changes by their respective historical standard deviations.

Our headline measure incorporates several series. To capture changes related to credit risk, we use the change in the ICE BofA BBB Corporate Index Option-Adjusted Spread for the United States and for the Euro Area. To capture changes in risk aversion emanating from advanced economy equity markets, we use the additive inverse of daily total 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, we include the daily average change in the G-spread on 2-, 5-, and 10-year Treasuries, along with the change in the TED spread. Finally, we include growth in the trade-weighted U.S. Dollar Index against advanced foreign economies and the change in the price of gold. Figure 1 displays the time series and histogram of the headline measure.

To shed light on differing sources of risk, we also construct four sub-indices. These groupings, chosen to maximize the total explained variation of the components, fall into the four categories above: (1) spreads (credit risk), (2) advanced economy equity returns and implied volatility, (3) funding liquidity, and (4) currency and gold. As in the headline index, the subindices comprise the first principal component of the normalized series. Table 1 displays summary statistics for the headline measure and subindices. Since they are expressed as z-scores, we omit their means and standard deviations from the table.

Defining a risk measure comprising multiple sources of risk confers several advantages. First, agglomerating multiple sources of risk allows us to abstract from any one source of risk-off behavior in our baseline analysis. Elevating any particular asset price in the measurement of risk sentiment hazards the possibility that the relationship between the measure-asset and the risk-affected-asset arises from a particular set of market participants, the actions of whom may not be generalizable across time and across assets. The group of market participants who take out, for example, S&P 500 options to hedge against U.S. equity volatility have characteristics such as U.S. home bias that may not extend equally to all other risk assets we might want to measure in the face of a risk-off shock. Second, our multivariate measure of risk-on/risk-off further permits the decomposition of baseline results into underlying drivers, offering insights into the source of a given risk-on or risk-off event, which itself may differentially drive emerging market capital flows and returns. Third, our measure recognizes sources outside of the United States which may drive risk-on/risk-off changes.

In recognition that a statistical approach such as ours does not structurally distinguish the price of risk (risk aversion) from the amount of risk (economic uncertainty), we also use a micro-founded variance risk premium and uncertainty index from Bekaert, Engstrom, and Xu (2020; BEX). BEX filter a utility-based risk aversion index from a wide set of macro and financial risk variables, given asset pricing implications derived at the equilibrium, "... reflecting the time-varying relative risk aversion coefficient of the representative agent in a generalized habit-like model with preference shocks".

Visualizing the time series of our chosen measures in Figures 1 and 2, along with Tables 1 and 2, reveals (risk-off) skewness, excess kurtosis, and time varying volatility in nearly all measures.[2] Each measure particularly spikes during the global financial, the European debt, and the COVID-19 crises.

[2]Only the funding liquidity and currency/commodities measures show low skewness, but these also show excess kurtosis and time varying volatility.

2.2 Data

2.2.1 Capital Flows and Returns

In order to obtain a multilateral, high frequency proxy of capital flows into and out of emerging markets, 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 and Country Weightings data to track the flow of money into world equity and bond markets. While fund flow data reports the amount of cash flowing into and out investment funds, the country weightings report tracks fund manager allocations to each of the various markets in which they invest. Combining country allocations with fund flows produces aggregate fund flows into and out of emerging markets (see Jotikasthira, Lundblad, and Ramadorai (2012)). Because the country flows comprise the sum of fund-level aggregate re-allocations, they come cleansed of valuation effects and therefore represent real quantities.

To measure returns on emerging market 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, while we measure country-level equity returns using the Morgan Stanley Capital International (MSCI) local currency and USD indices. Table 4 displays summary statistics for return and flow measures.

Reflecting the availability of EPFR data, the sample runs from January 7, 2004 to Apr. 15, 2020.[3] The sample of countries comprises emerging markets appearing in each of the flow and return data sets. Of these, we include countries with widespread recognition as emerging market economies.[4] The list of included countries can be found in Table 5.[5]

[3] The exception is local currency bond returns, which only become available in 2008.

[4] We exclude China due to its unique characteristics, including its size relative to other emerging market economies and measurement issues.

[5] EM classifications considered include the IMF, BRICS + Next 11, FTSE, MSCI, S&P, EMBI, Dow Jones, Russell, Columbia University EMPG and BBVA.

2.2.2 Control variables

The literature on patterns of international capital flows separates determinants into common, global "push" factors associated with external shocks, and "pull" country-specific factors. Our control variables include both "push" and "pull" variables suggested by the literature on capital flows.

Following the literature on capital flow determinants (see, for example, Calvo, Leiderman, and Reinhart 1993; Fratzscher 2012; Fratzscher, Lo Duca, and Straub 2014; Passari and Rey 2015; Milesi Ferretti and Tille 2011; Broner et al. 2013; Forbes and Warnock 2012), the capital flow and return regressions include a measure of advanced market returns (obtained from Kenneth French's website) and a quarterly fixed effect control for global financial conditions, as well as a lag of the left-hand-side variable to account for autocorrelation (since the flows are scaled by a stock). Quarterly time fixed effects account both for slow moving business cycles and structural changes in the market for ETFs and mutual funds.

Country-specific (pull factor) controls (see, for example, Ahmed and Zlate 2014; Forbes and Warnock 2012; Fratzscher 2012; Fratzscher, Lo Duca, and Straub 2013; Eichengreen and Gupta 2014; Moore et al. 2013; Chen, Mancini Griffoli, and Sahay 2014) in the capital flow estimations include local policy rates, average real GDP growth in the previous eight quarters, and the broad real effective exchange rate (REER).

To control for the influence of local macroeconomic news in the intervening week or day, we include the Citigroup Economic Surprise Index (CESI) for emerging markets. The CESI tracks how economic data compare to expectations, rising when economic data exceed economists' consensus forecasts and falling when data come in below forecast estimates.[6] In the return estimates, we use country i's lagged bilateral exchange rate return vis-a-vis the United States (LC/USD) instead of the REER to obtain a higher-frequency measure of exchange rate fluctuations.

All control variables enter with a lag to rule out simultaneity. Both sets of controls affect capital flows and returns, but also likely react directly to changes in risk sentiment. In

[6] Indices are defined as weighted historical standard deviations of data surprises (actual releases vs. Bloomberg survey median) and are calculated daily in a rolling three-month window. The weights of economic indicators are derived from relative high-frequency spot FX impacts of one standard deviation data surprises. The indices also employ a time decay function to replicate the limited memory of markets.

fact, our main "push" variable, advanced economy returns, not only reacts to risk-on/risk-off shocks but likely also drives them. Note that all daily variables enter as the weekly moving average leading up to the week's EPFR reporting date.

2.3 Estimation

With risk indicators in hand, we regress weekly EPFR country-level flows and daily returns onto our risk appetite measures using the panel quantile regression approach of Machado and Santos Silva (2019) with country and quarter-year fixed effects, controlling for the "push" and "pull" factors described previously. Country level flows enter as a percent of the previous week's allocation, while returns are expressed as daily percentage change. As stated in the data description, in the EPFR flow regressions, changes in the risk measures are aggregated by moving average.

$$R_{it}^{(q)} = \alpha_i^{(q)} + \delta_t^{(q)} + \beta_i^{(q)} Risk_t + \gamma_1^{(q)} PUSH_t^R + \gamma_2^{(q)} PULL_{it}^R + \epsilon_{i,t} \tag{1}$$

$$k_{it}^{(q)} = \alpha_i^{(q)} + \delta_t^{(q)} + \rho k_{it-1}^{(q)} + \beta_i^{(q)} Risk_t + \gamma_1^{(q)} PUSH_t^k + \gamma_2^{(q)} PULL_{it}^k + \epsilon_{i,t} \tag{2}$$

$$k_{it}^{(q)} = \left(\frac{K_{it}}{H_{it-1}} * 100 \right)$$

where R_{it} is the EMBI, LC Bond index, MSCI LC or MSCI USD daily total return, $Risk_t$ is either the RORO Index or the variance risk premium, k_{it} is either equity or debt flows (K_{it}) scaled by holdings of the same, H_{it-1}. We cluster bootstrapped standard errors by country to account for serially correlated error terms.

3 Results

In general, risk-on, risk-off shocks have important implications not only for the median of emerging market flows and returns, but also for the tails of the distribution. In each case, a risk-off shock decreases flows and returns across the distribution. In most cases, however, the "worst" realizations (in the left tail) change more than the median realization, and the "best" (right tail) realizations change less than the median, lengthening the tails of the distribution ($|\beta^{(.05)}| > |\beta^{(.5)}| > |\beta^{(.95)}|$). The sole exception is for equity flows; while they decrease in the face of a risk-off shock, the tails of the distribution shorten, with the left tail changing less than the median and the right tail reacting more than the median ($|\beta^{(.05)}| < |\beta^{(.5)}| < |\beta^{(.95)}|$).

We summarize the results in Figures 5 - 8, while Tables 7 - 8 show the full results. Figure 5 summarizes the impact of a one standard deviation risk-off shock on the distribution of our EPFR flow measures and offers an object lesson in the importance of measuring the impact across the distribution. While the risk-off shock affects the median of the distribution in a similar manner across classes, the tails behave differently. We observe that the risk-off shock decreases bond outflow realizations in the left tail more than it decreases the median realization, and in turn decreases the highest inflow realizations less then the median. The net result is a leftward shift in the distribution, with a lengthening of the tails relative to the median. Notably, as we will see in a later exercise, the lengthening in the left tail causes "large" outflow realizations in the unconditional distribution to appear more common in the post-shock distribution.

As aforementioned, the equity flow distribution also shifts to the left in the face of a risk-off shock; however, the largest outflow realizations change less than the median, while the largest inflow realizations change more than the median. The net result is a leftward shift in the distribution, with a shortening of the tails.

Figure 6 summarizes the impact of a one standard deviation risk-off sub-index shock on the EPFR weekly country flows. In the case of both fixed income and equity, credit risk (as measured by corporate spreads) appears to play an influential role in both the median impact and the changes in dispersion from a risk-off shock. Advanced economy equity returns and volatility also play a substantial role in driving both equity and fixed income reallocations.

Most of the subindices follow the patterns induced by the headline index—risk-off shocks pull the distribution leftward, with tails lengthening in the fixed income flow distribution and tails shortening in equities. The only exception arises from funding liquidity, a shock which lengthens the tail of the equity flow distribution. Funding liquidity also contributes substantially to the dispersion of the bond flow distribution, lengthening the left tail while leaving the right tail essentially unchanged. In both asset classes, our currency factor, while statistically significant, evinces a comparatively smaller effect.

Figure 7 summarizes the the impact of a one standard deviation RORO shock on the distribution of fixed income and equity returns. Among all return types, a risk-off shock shifts the distribution to the left and lengthen the tails, worsening the most negative return realizations more than the median. The magnitude and dispersion of the impact, however, differs between fixed income and equity, and between local currency and USD denominated indices. In particular, a risk-off shock impacts the total return on the equity indices at a rate more than five times the impact on fixed income returns. In each asset class, dollar returns react more than local currency returns. Fixed income bears this relationship out strikingly, decreasing three to six times the rate of the local currency index in the face of the risk off shock.[7] MSCI USD total returns decrease 28 - 32% more than the local currency equity returns in the face of a risk-off shock.

Figure 8 summarizes the impact of a one standard deviation risk-off sub-index shock on emerging market returns. As in the case of flows, returns react most, in magnitude and dispersion, to changes in credit risk as measured by corporate spreads. However, the impact of advanced economy equity returns and volatility comes in at a very close second. The currency factor plays more of a role in moving returns compared to the country flows, with USD denominated indices reacting more than local currency indices. Also unlike the country flows, funding liquidity exerts little force on returns whether fixed income or equity.

[7] While the impact on the local currency index is statistically insignificant, the comparison is still a useful one given that USD denominated bonds do react in a statistically significant manner.

3.1 Risk Aversion vs. Uncertainty

Turning to a structural decomposition that facilitates a separates of risk aversion from uncertainty reveals an interesting pattern underlying the heterogeneous reactions of the equity and fixed income distributions. Figure 9 summarizes the changes in the capital flow distributions when we replace our statistical measures of RORO with Bekaert et al's (2020) risk aversion and uncertainty indices.

The impacts of risk aversion and uncertainty on the distribution of fixed income flows follow the same pattern as our headline RORO measure; that is, a risk-off shock shifts the distribution to the left and lengthens the tails relative to the median. Interestingly, uncertainty has a larger impact across the distribution and puts more weight in the left tail compared to risk aversion.

Equity flows react to risk aversion and uncertainty in a manner which sheds light on the distribution's reaction to our statistical risk-off measures. In the fact of an uncertainty shock, the distribution of equity flows reacts in step with the distribution of bond flows in that the distribution shifts left, with tails lengthening relative to the median. In contrast, a risk-off shock to risk aversion causes the equity flow distribution to behave as it does in the baseline, with the range of the distribution shrinking as it shifts left. This suggests that the reaction we observe in the distributional reaction to the headline index emanates from sensitivity to changing risk aversion.

Figures 10 and 11 depict the changes in the capital flow distributions when we replace our statistical measures of risk with Bekaert et al's (2020) risk aversion and uncertainty indices. Here we observe that a risk-off shock to either risk aversion or uncertainty shift the distribution of returns to the left. However, changes in the level of uncertainty dramatically lengthen the tails of the return distribution compared to risk aversion.

3.2 Quantitative Exercise

How has the distribution of capital flow realizations changed in the face of COVID-19 shocks?

$$\hat{k}^q = k^q + \hat{\beta}^q * shock * H \tag{3}$$

where $\hat{k}^q$ is the estimated flow calculated from fitted values, k^q is the qth percentile observed country flow per week in the data since Jan. 2020, H is the average assets under management, and *shock* is the magnitude of either the maximum, one standard deviation, or 10th percentile shock realization in the COVID era (11.56, 3.1, and 5 units, respectively). Table 10 reveals the economic magnitudes underlying the parameter values reported in the results.

Starting with bond flows, in the face of a unit shock, the median reallocation is an outflow of $14.09 million, compared to a pre-shock 2020 median weekly inflow of $3.7 million. This size shock increases outflow realizations in the 5th quantile by $22 million per week, compared to $17.8 million per week at the median. Inflow realizations at the 95th quantile decrease by $14.8 million. A one standard deviation shock, 3.1 units, increases outflow realization by $68.03 million, compared to a change of $55.2 million at the median and $43.5 million at the 95th quantile. In the peak observation of the COVID-19 crisis, the index reached 11.56 standard deviations, suggesting that Q5, Q50 and Q95 would fall by $256.7 million, $205.9 million, and $162.14 million respectively. A shock of this size pulls the tail realizations apart by $92 million.

As aforementioned, equity flows show a shrinking of the tails in the event of a risk-off shock. After a one unit shock, the median reallocation is an outflow of $18.84, compared to a pre-shock 2020 median outflow of $5.8 million. This size shock increases outflow realizations in the 5th quantile by $16.28 million per week, compared to $18.8 million per week at the median. Inflow realizations at the 95th quantile decrease by $21.4 million. A one standard deviation shock, 3.1 units, increases outflow realization by $50.5 million, compared to a change of $58.4 million at the median and $66.3 million at the 95th quantile. In the peak observation of the COVID-19 crisis, the index reached 11.56 standard deviations, suggesting that Q5, Q50 and Q95 would fall by $188.2 million, $217.7 million, and $247.3 million respectively. A shock of this size pulls the tail realizations in by $59 million. Under the peak shock, even the "best" realizations manifest as equity fund outflows.

We also fit a kernel density to the predicted values to visualize changes in the distribution from a 3-unit risk-off shock, displayed in Figures 14 and 15. We show 3-unit shocks because this magnitude represents the 10th percentile of risk-off shocks in 2020. The fitted distribution of fixed income flows has longer tails and is more highly skewed toward outflows compared to the unconditional distribution (-.61 vs. -1.01). In terms of magnitude, in the face of a 3-unit shock, what would be a tail event in the unconditional distribution looks more like a 10th quantile shock, and therefore more probable. The post-shock median now falls in the bottom 25% of pre-shock realizations. The equity flow distribution appears unchanged in terms of skewness, although here as well the post-shock median falls in the bottom 25% of pre-shock realizations.

The return distributions show more dramatic changes still, although the skewness of the distributions show little change. What the unconditional equity distribution would label a tail outcome lay near the median in the post-shock distribution. While our RORO shock affects EMBI returns to a comparatively smaller degree, the pre-shock tail event still falls within the interquartile range of the unconditional distribution.

4 Conclusion and Future Directions

Risk-on/risk-off shocks have important distributional implications for emerging market portfolio flows and returns. In particular, we find that the effects associated with the worst realizations are often disproportionately affected by risk-off shocks. Specifically, while there are some differences in the effects across bond vs. equity markets and flows vs. asset returns, the effects associated with the left tail are generally larger than that on the median realization. We conclude that the focus in the literature on measures of central tendency is incomplete.

A natural next question for our research agenda: do the implications of a RORO shock differ across recipient countries? Given that the mutual fund business exhibits significant variation in manager discretion, the heterogeneity question has two dimensions. The first is country-level heterogeneity, meaning are the effects of an external RORO shock disproportionately experienced across countries along important dimensions. Gelos et al. (2019) show that variation in recipient country economic policy and business fundamentals affect capital flows. In the context of our setting, the question arises whether recipient country conditions impact fund reallocation in the face of risk-off shocks. In particular, we want to be able to address the extent to which fund managers view emerging markets as a single asset class or whether country fundamentals matter for fund allocations.

An important caveat, however, is that the level of discretion fund managers possess varies considerably across fund type. Representing about half of the emerging market fund space towards the end of the sample, passive index funds and ETFs have very little manager discretion. As a consequence, passive index fund and ETF re-allocation in the face of a risk-off shock may induce elevated correlations among countries and minimize the effect of cross-country heterogeneity. Actively managed mutual funds, however, enjoy considerable discretion. Country fundamentals may be central to their allocation decision. Going forward, we will assess the complete effect of tail events on capital flows by closely examining the actual vehicles that investors use to access emerging markets.

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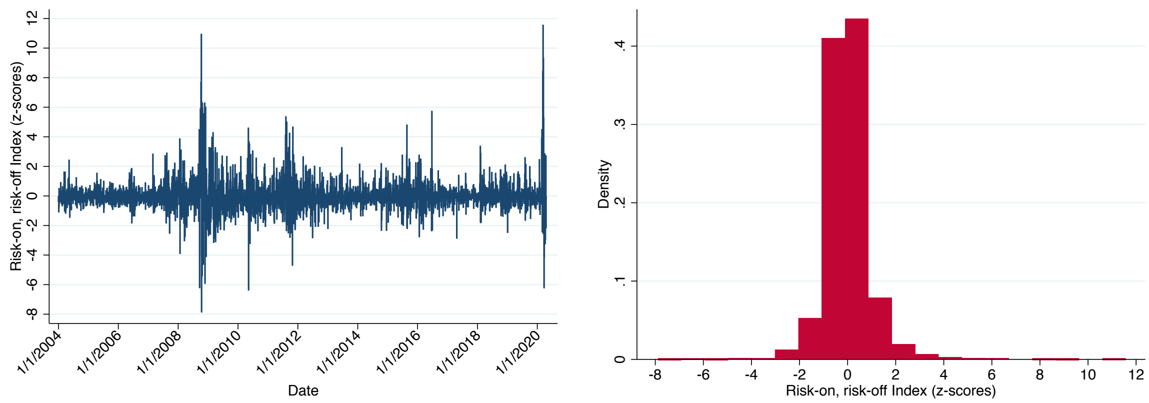
5 Figures & Tables

5.1 Figures

Figure 1: RORO Index



(a) Time Series

(b) Histogram

Figure 2: BEX 2020 Time Series

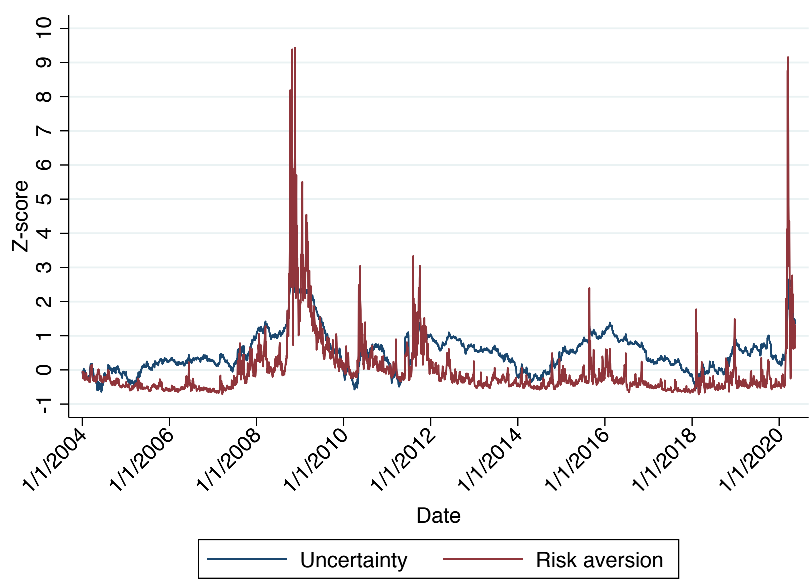


Figure 3: EPFR Country Flows (% of Lagged AUM)

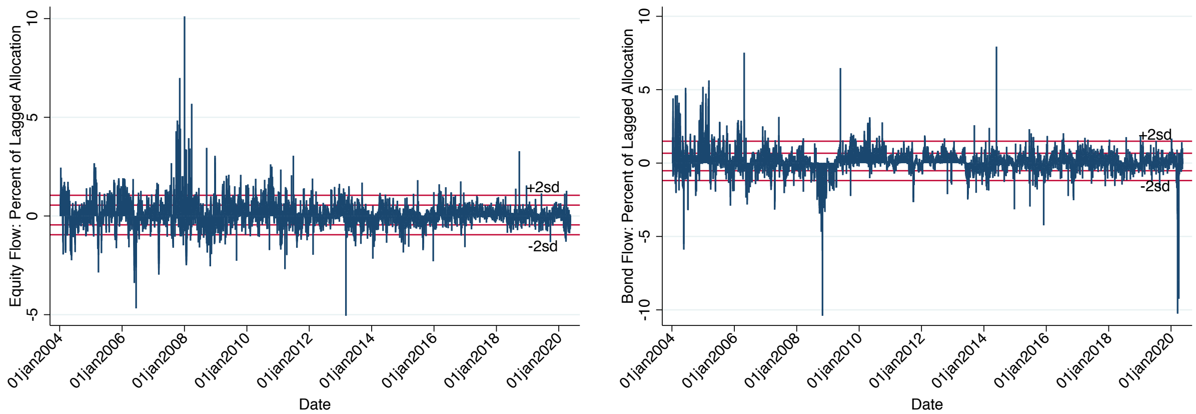
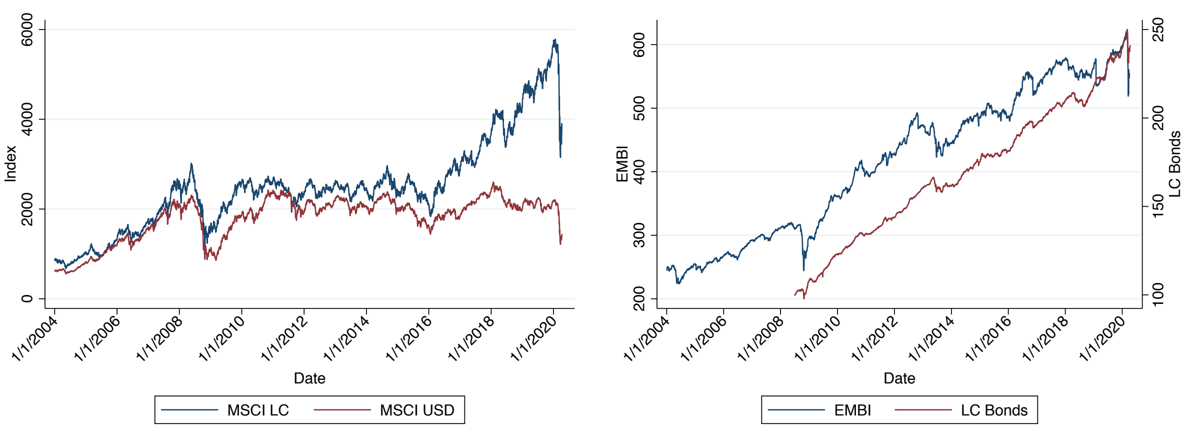


Figure 4: Total Return Indices



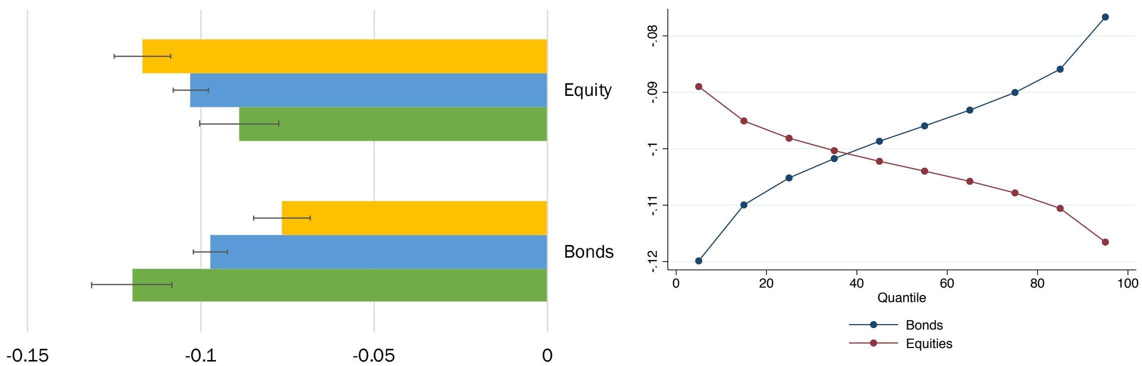


Figure 5: A one standard deviation risk-off (RORO) shock & the distribution of EPFR flows (% of AUM)
Notes: This figure summarizes the impact of a one-standard deviation risk-off shock as measured by our RORO Index. Error bars represent 95% confidence intervals.

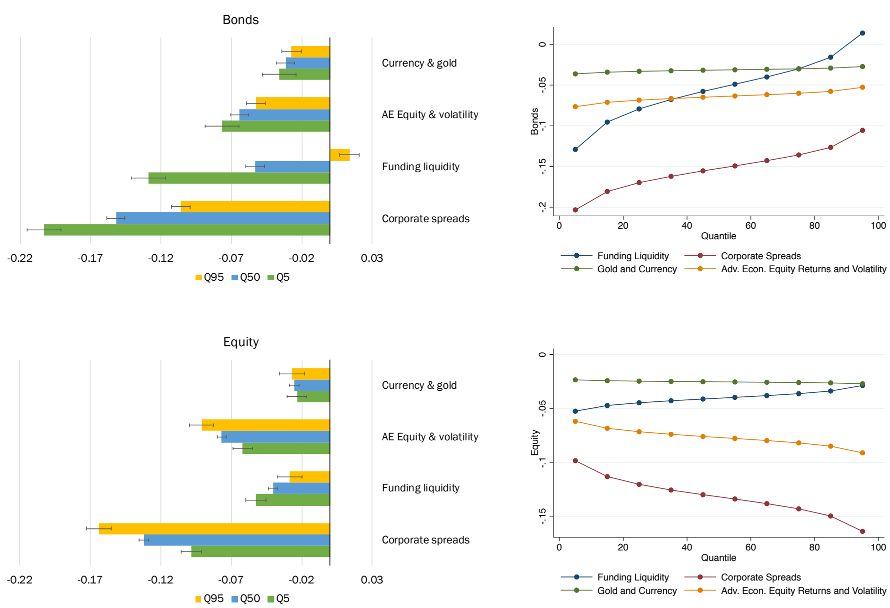


Figure 6: Impact of a one standard deviation risk-off shock on the distribution of EPFR flows (% of AUM)
Notes: This figure summarizes the impact of a one-standard deviation risk-off shock as measured by our constituent sub-indices index. Error bars represent 95% confidence intervals.

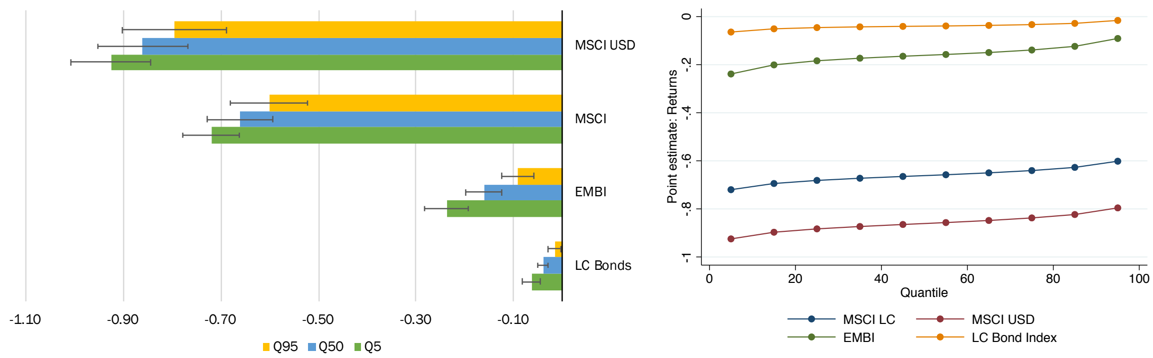
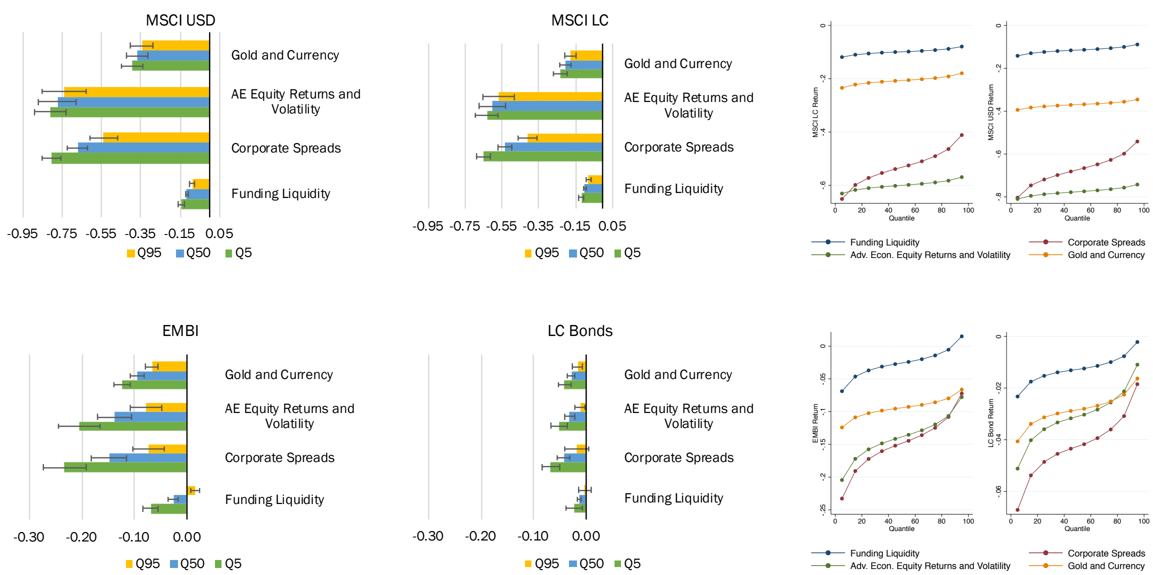
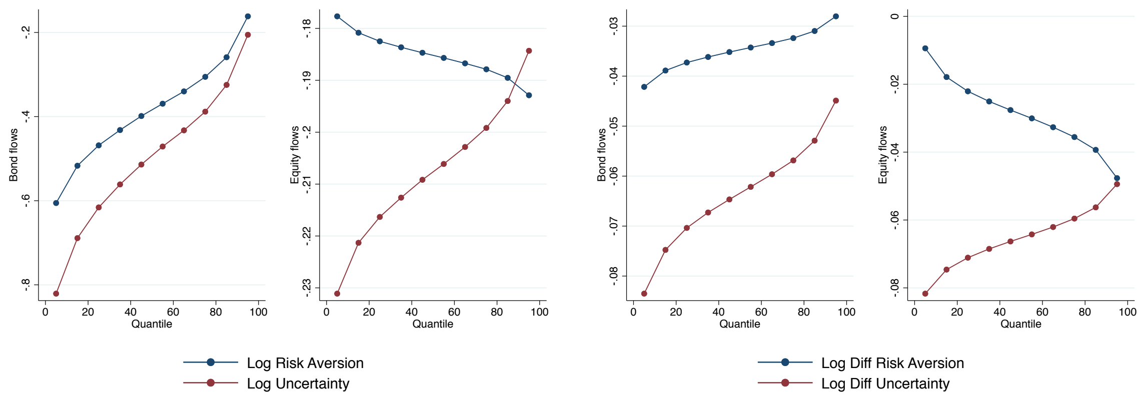


Figure 7: Impact of a one standard deviation risk-off (RORO) shock on the distribution of returns

Notes: This figure summarizes the impact of a one-standard deviation risk-off shock as measured by our constituent sub-indices index. Error bars represent 95% confidence intervals.

Figure 8: Impact of a one standard deviation risk-off shock on the distribution of returns





(a) Log levels (b) Log differences

Figure 9: Impact of a one standard deviation risk-off (BEX 2020) shock on the distribution of EPFR country flows

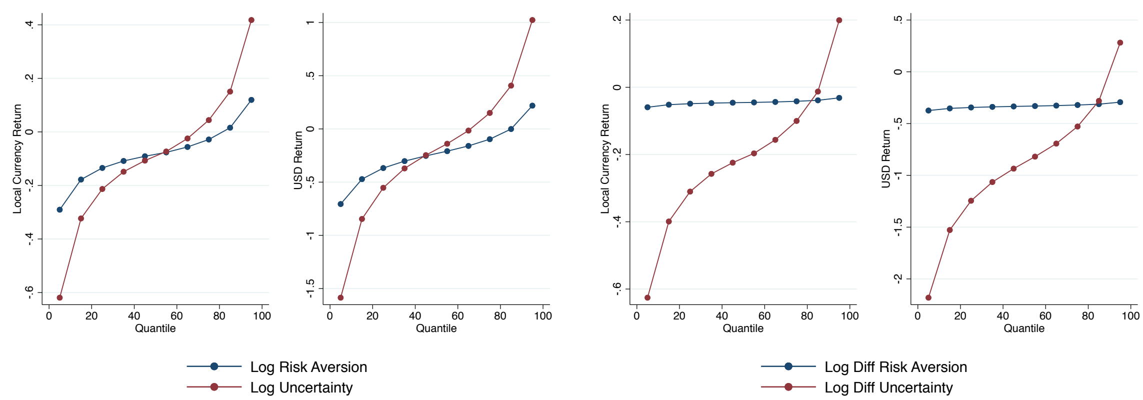


Figure 10: Impact of a one standard deviation risk-off (BEX 2020) shock on the distribution of fixed income returns

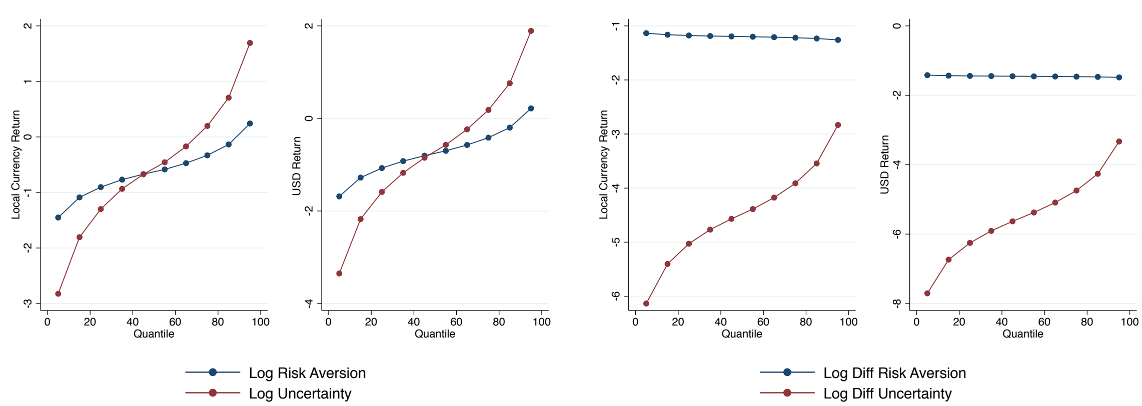
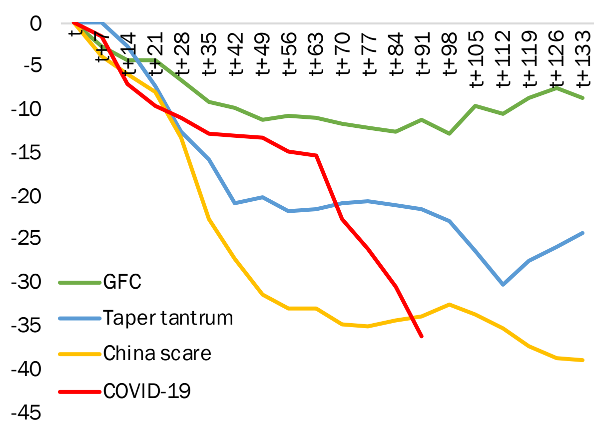
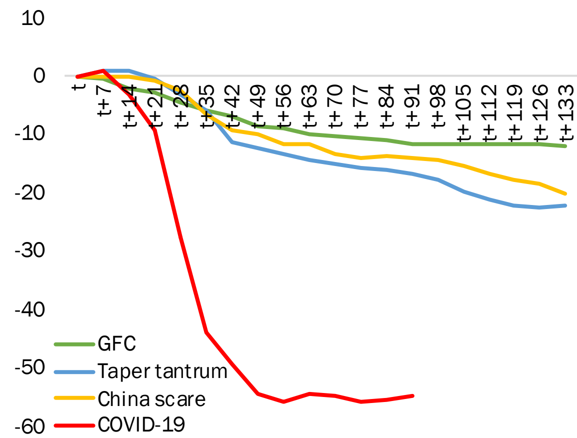


Figure 11: Impact of a one standard deviation risk-off (BEX 2020) shock on the distribution of equity returns

Figure 12: Emerging market capital flows in recent risk-off episodes

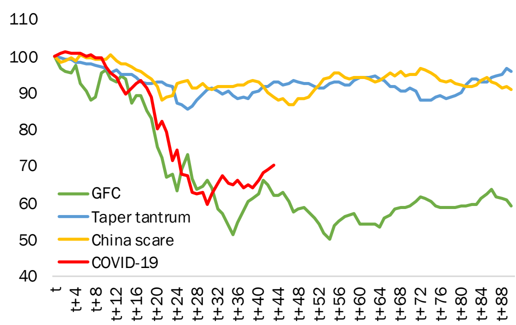


(a) Equity flows (Billions USD)

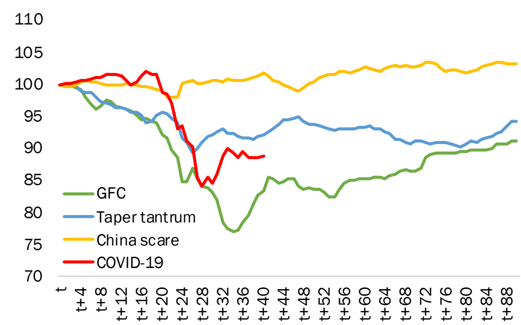


(b) Bond flows (Billions USD)

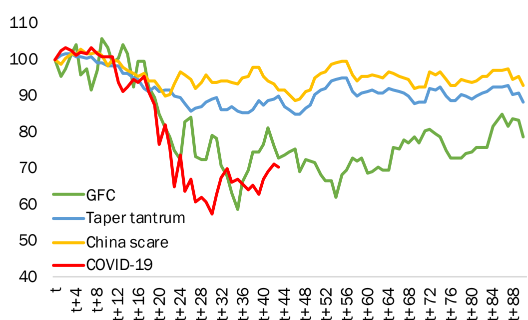
Figure 13: Emerging market returns in recent risk-off episodes



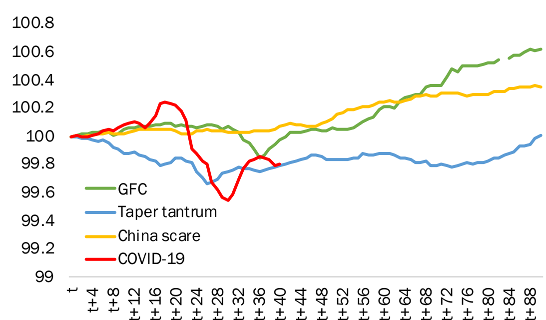
(a) MSCI USD



(b) EMBI

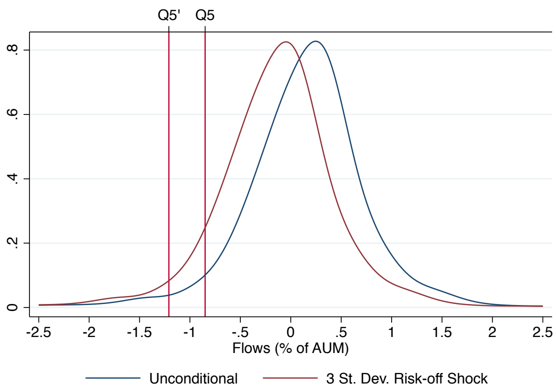


(c) MSCI LC

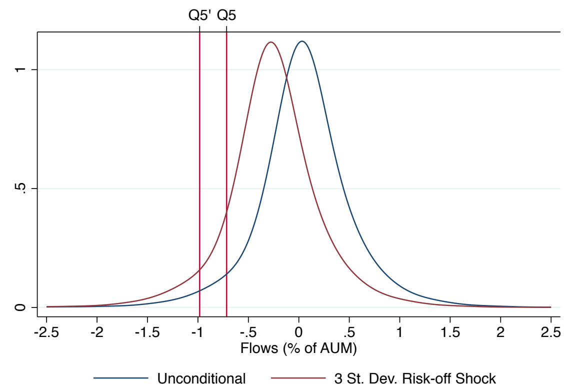


(d) Local currency Bond Index

Figure 14: Effect of a three standard deviation risk-off shock on the distribution of EPFR country flows

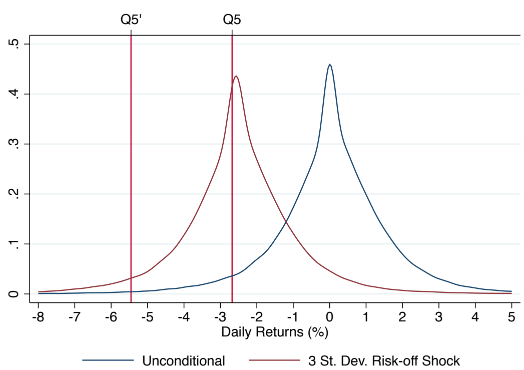


(a) Bonds

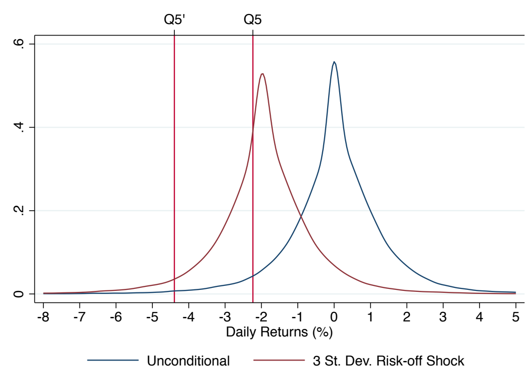


(b) Equity

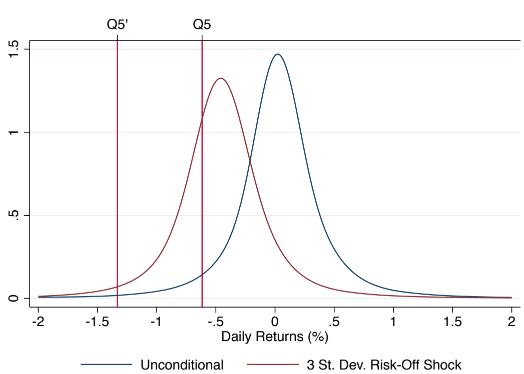
Figure 15: Effect of a three standard deviation risk-off shock on the distribution of returns



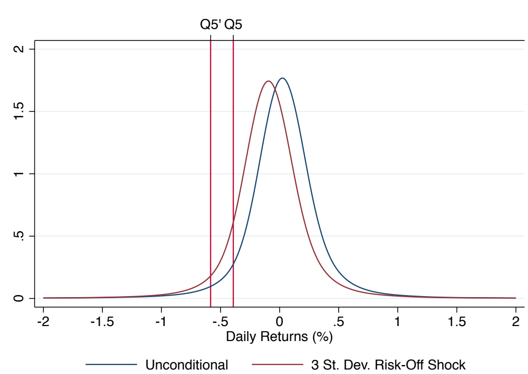
(a) MSCI USD



(b) MSCI LC



(c) EMBI



(d) LC Bond Index

5.2 Tables

Table 1: Headline RORO Index and Subcomponents Summary Statistics

	Q5	Q50	Q95	Skewness	Kurtosis
RORO Index	-1.29	-0.06	1.47	1.57	20.98
Funding Liquidity	-0.99	0.00	0.97	-0.19	47.48
AE Equity Returns/Volatility	-1.30	-0.06	1.48	1.21	19.81
Gold and Currencies	-1.70	-0.02	1.73	0.14	5.78
Corporate Spreads	-1.22	-0.06	1.27	1.74	30.68
Observations	4517				

Table 2: BEX 2020 Summary Statistics

	Q5	Q50	Q95	Skewness	Kurtosis
Log Risk Aversion	-0.60	-0.29	1.34	4.58	33.52
Log Uncertainty	-0.27	0.43	1.54	1.16	5.09
Log Diff. Risk Aversion	-0.21	-0.00	0.21	0.03	112.09
Log Diff. Uncertainty	-0.09	-0.00	0.10	1.36	30.86
Observations	4330				

Table 3: Sub-indices: Correlations Matrix

	RORO	AE Equity and Vol.	Corporate spreads	Funding liquidity	Currency and gold	log(RA)	log(Uncertainty)	Δ log(RA)	Δ log(Uncertainty)
RORO	1.00								
AE Equity and Vol.	0.95	1.00							
Corporate spreads	0.83	0.63	1.00						
Funding liquidity	0.29	0.26	0.22	1.00					
Currency and gold	0.32	0.30	0.15	-0.12	1.00				
log(RA)	0.28	0.17	0.40	0.00	0.02	1.00			
log(Uncertainty)	0.03	-0.01	0.11	-0.06	-0.04	0.72	1.00		
Δ log(RA)	0.70	0.80	0.38	0.28	0.24	-0.01	-0.12	1.00	
Δ log(Uncertainty)	0.70	0.68	0.60	0.19	0.11	0.22	0.07	0.55	1.00

Table 4: Summary Statistics

(a) EPFR Country Flows

	Mean	St. Dev.	Q5	Q50	Q95	Skewness	Kurtosis
Equity Flow: % of Lagged AUM	0.05	0.49	-0.71	0.04	0.81	0.76	21.93
Equity Flows (Millions USD)	6.52	117.79	-124.53	1.19	161.34	0.22	38.56
Equity AUM (Billions USD)	18.64	27.13	0.39	6.42	82.84	2.23	7.88
Bond Flow: % of Lagged AUM	0.14	0.69	-0.85	0.18	1.08	-1.01	20.39
Bonds Flows (Millions USD)	6.37	85.76	-63.06	1.98	93.64	-18.46	862.13
Bonds AUM (Billions USD)	8.15	10.75	0.08	3.91	35.14	2.03	7.04
Observations	18474						

(b) Returns

	Mean	St. Dev.	Q5	Q50	Q95	Skewness	Kurtosis
MSCI LC Return	0.04	1.53	-2.23	0.00	2.26	-0.39	21.07
MSCI USD Return	0.04	1.79	-2.68	0.00	2.63	-0.37	17.81
EMBI Return	0.02	0.62	-0.62	0.02	0.66	-5.11	316.02
LC Bond Return	0.03	0.57	-0.39	0.02	0.47	0.55	1389.67
Observations	92202						

Table 5: Sample Countries

Argentina	Pakistan
Brazil	Peru
Chile	Philippines
Colombia	Poland
Czech Republic	Qatar
Egypt	Russia
Hungary	South Africa
India	Taiwan*
Indonesia	Thailand**
Malaysia	Turkey
Mexico	United Arab Emirates

* Indicates eventual exclusion from EMBI, returns extended using S&P Bond Index.

Table 6: Control Variables Summary Statistics

	Mean	St. Dev.	Q5	Q50	Q95
BIS Policy Rate (t-1)	6.39	6.12	1.00	5.00	15.00
Adv. Market Return	0.02	0.31	-0.51	0.02	0.49
Avg. RGDP Growth (8Q)	0.04	0.03	-0.00	0.04	0.09
Emerging Mkt. News	-0.01	2.81	-4.10	0.00	4.10
Exchange rate return	-0.00	1.53	-0.87	0.00	0.93
REER Growth	0.05	2.12	-3.09	0.14	2.87
Observations	92998				

Table 7: A one standard deviation risk-off (RORO) shock & the distribution of bond flows

	(1) Q5	(2) Q25	(3) Q50	(4) Q75	(5) Q95
RORO Index	-0.120***	-0.105***	-0.0974***	-0.0900***	-0.0767***
	(-10.41)	(-15.92)	(-19.76)	(-18.07)	(-9.24)
Policy Rate (t-1)	-0.00150	-0.000429	0.000141	0.000678	0.00166
	(-0.15)	(-0.12)	(0.11)	(0.19)	(0.17)
REER (t-1)	-0.00189	-0.000901	-0.000377	0.000118	0.00102
	(-0.78)	(-0.95)	(-0.76)	(0.13)	(0.45)
Avg. RGDP Growth (8Q)	-0.0571	0.163	0.280	0.390	0.591
	(-0.07)	(0.43)	(0.95)	(1.06)	(0.84)
Emerging Mkt. News	0.00527*	-0.00620***	-0.0123***	-0.0180***	-0.0285***
	(1.93)	(-4.04)	(-11.33)	(-15.30)	(-13.49)
Adv. Mkt. Index (t-1)	-0.0256***	-0.0148***	-0.00901***	-0.00359***	0.00628***
	(-5.32)	(-5.92)	(-7.00)	(-5.04)	(2.72)
AR(1)	0.503***	0.429***	0.389***	0.352***	0.284***
	(12.18)	(14.64)	(15.00)	(14.22)	(9.76)
Observations	17680	17680	17680	17680	17680

t statistics in parentheses

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table summarizes the results of quantile regressions of EPFR country bond flows on our headline RORO index. Bootstrapped standard errors are clustered by country. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8: A one standard deviation risk-off (RORO) shock & the distribution of equity flows

	(1) Q5	(2) Q25	(3) Q50	(4) Q75	(5) Q95
RORO Index	-0.0890***	-0.0981***	-0.103***	-0.108***	-0.117***
	(-15.20)	(-29.43)	(-33.65)	(-28.18)	(-17.72)
Policy Rate (t-1)	-0.0000549	0.000324	0.000531	0.000726	0.00109
	(-0.01)	(0.14)	(0.30)	(0.43)	(0.43)
REER (t-1)	-0.000532	-0.000789**	-0.000930**	-0.00106^{+}	-0.00131
	(-0.66)	(-2.09)	(-2.06)	(-1.54)	(-1.06)
Avg. RGDP Growth (8Q)	-0.848	0.00202	0.467**	0.904**	1.714**
	(-1.34)	(0.01)	(2.38)	(2.31)	(2.07)
Emerging Mkt. News	-0.0242***	-0.0194***	-0.0167***	-0.0142***	-0.00964***
	(-7.58)	(-12.30)	(-13.72)	(-9.18)	(-3.05)
Adv. Mkt. Index (t-1)	-0.0141***	-0.00457***	0.000633	0.00552***	0.0146***
	(-7.18)	(-4.27)	(0.51)	(2.99)	(4.64)
AR(1)	0.275***	0.305***	0.322***	0.338***	0.367***
	(4.92)	(9.27)	(11.26)	(10.22)	(6.70)
Observations	17732	17732	17732	17732	17732

t statistics in parentheses

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table summarizes the results of quantile regressions of EPFR country equity flows on our headline RORO index. Bootstrapped standard errors are clustered by country. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9: A one standard deviation risk-off (RORO) shock & the distribution of USD equity returns

	(1) Q5	(2) Q25	(3) Q50	(4) Q75	(5) Q95
Risk-on, Risk-off Index	-0.925***	-0.883***	-0.860***	-0.837***	-0.795***
	(-11.36)	(-9.92)	(-9.26)	(-8.59)	(-7.42)
Exchange rate return (t-1)	-0.0326	-0.0147	-0.00517	0.00481	0.0227
	(-0.41)	(-0.37)	(-0.24)	(0.24)	(0.41)
BIS Policy Rate (t-1)	-0.0302***	-0.00983***	0.00108	0.0125*	0.0329**
	(-3.15)	(-2.95)	(0.30)	(1.80)	(2.33)
Emerging Mkt. News	0.0140***	0.00559***	0.00110	-0.00359	-0.0120***
	(5.27)	(3.55)	(0.60)	(-1.39)	(-2.72)
Adv. market index (t-1)	-0.0358***	-0.0184***	-0.00912***	0.000609	0.0180***
	(-5.13)	(-5.95)	(-4.58)	(0.23)	(2.87)
Observations	89536	89536	89536	89536	89536

t statistics in parentheses

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table summarizes the results of quantile regressions of MSCI USD daily total returns on our headline RORO index. Bootstrapped standard errors are clustered by country. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 10: A one standard deviation risk-off (RORO) shock & the distribution of local currency equity returns

	(1) Q5	(2) Q25	(3) Q50	(4) Q75	(5) Q95
Risk-on, Risk-off Index	-0.720***	-0.681***	-0.661***	-0.640***	-0.601***
	(-12.28)	(-10.60)	(-9.83)	(-9.03)	(-7.56)
Exchange rate return (t-1)	-0.0134	-0.00544	-0.00132	0.00302	0.0110
	(-0.28)	(-0.26)	(-0.16)	(0.25)	(0.28)
BIS Policy Rate (t-1)	-0.0264**	-0.00915*	-0.000225	0.00918***	0.0266***
	(-2.17)	(-1.65)	(-0.09)	(3.32)	(2.90)
Emerging Mkt. News	0.0122***	0.00455***	0.000602	-0.00355+	-0.0112***
	(5.03)	(3.08)	(0.37)	(-1.60)	(-2.94)
Adv. market index (t-1)	-0.0300***	-0.0145***	-0.00638***	0.00212	0.0178***
	(-4.43)	(-4.72)	(-3.05)	(0.77)	(2.85)
Observations	89557	89557	89557	89557	89557

t statistics in parentheses

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table summarizes the results of quantile regressions of MSCI LC daily total returns on our headline RORO index. Bootstrapped standard errors are clustered by country. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 11: A one standard deviation risk-off (RORO) shock & the distribution of USD bond returns

	(1) Q5	(2) Q25	(3) Q50	(4) Q75	(5) Q95
Risk-on, Risk-off Index	-0.238***	-0.184***	-0.161***	-0.139***	-0.0908***
	(-5.45)	(-4.83)	(-4.42)	(-3.95)	(-2.74)
Exchange rate return (t-1)	-0.0739***	-0.0362***	-0.0207***	-0.00543	0.0275**
	(-3.20)	(-3.35)	(-2.83)	(-0.86)	(1.99)
BIS Policy Rate (t-1)	-0.0145*	-0.00487***	-0.000866	0.00305	0.0115
	(-1.79)	(-3.30)	(-0.53)	(0.71)	(1.11)
Emerging Mkt. News	0.00768***	0.00287***	0.000883	-0.00106	-0.00527***
	(7.81)	(3.83)	(1.01)	(-0.95)	(-2.98)
Adv. market index (t-1)	-0.00900*	-0.00479**	-0.00305***	-0.00134	0.00234
	(-1.73)	(-2.47)	(-3.09)	(-1.04)	(0.59)
Observations	76240	76240	76240	76240	76240

t statistics in parentheses

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table summarizes the results of quantile regressions of EMBI daily total returns on our headline RORO index. Bootstrapped standard errors are clustered by country. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 12: A one standard deviation risk-off (RORO) shock & the distribution of local currency bond returns

	(1) Q5	(2) Q25	(3) Q50	(4) Q75	(5) Q95
Risk-on, Risk-off Index	-0.0640***	-0.0455***	-0.0397***	-0.0331***	-0.0157
	(-3.57)	(-3.84)	(-3.72)	(-3.22)	(-1.21)
Exchange rate return (t-1)	-0.0672**	-0.0322***	-0.0211**	-0.00851	0.0244
	(-2.28)	(-2.86)	(-2.31)	(-1.17)	(1.29)
BIS Policy Rate (t-1)	-0.0381***	-0.0100***	-0.00107	0.00901*	0.0354***
	(-3.33)	(-3.02)	(-0.30)	(1.73)	(3.06)
Emerging Mkt. News	0.00148	-0.00213*	-0.00329**	-0.00458***	-0.00798**
	(0.81)	(-1.85)	(-2.51)	(-2.77)	(-2.25)
Adv. market index (t-1)	-0.00743***	-0.00104	0.000999	0.00329***	0.00930***
	(-2.68)	(-0.95)	(1.36)	(3.44)	(3.06)
Observations	51714	51714	51714	51714	51714

t statistics in parentheses

$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table summarizes the results of quantile regressions of local currency daily total returns on our headline RORO index. Bootstrapped standard errors are clustered by country. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 13: Effect of a COVID-era risk-off shock on the distribution of country EPFR flows

	Panel A: Bonds	Q5	Q50	Q95	**Panel B: Equity**	Q5	Q50	Q95
	Observed flows	-473.56	3.73	178.13	Observed flows	-258.62	-5.79	109.69
β (unconditional)								
$\sigma = 1$	% of AUM/week	-0.12	-0.10	-0.08	% of AUM/week	-0.09	-0.10	-0.12
	Millions USD	-495.50	-14.09	164.11	Millions USD	-274.90	-24.62	88.30
β*Covid1Stdev								
$\sigma = 3.1$	% of AUM/week	-0.37	-0.30	-0.24	% of AUM/week	-0.28	-0.32	-0.36
	Millions USD	-541.59	-51.49	134.65	Millions USD	-309.08	-64.18	43.36
β*CovidPeak								
$\sigma = 11.56$	% of AUM/week	-1.39	-1.13	-0.89	% of AUM/week	-1.03	-1.19	-1.35
	Millions USD	-727.24	-202.18	15.99	Millions USD	-446.77	-223.53	-137.65