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# FLIGHT TO CLIMATIC SAFETY: LOCAL NATURAL DISASTERS AND GLOBAL PORTFOLIO FLOWS

by Fabrizio Ferriani* Andrea Gazzani* and Filippo Natoli*

**Abstract**

Using data from a broad panel of countries at a weekly frequency, we find that local natural disasters have significant effects on global portfolio flows. First, when disasters strike, international investors reduce their net flows to equity mutual funds exposed to affected countries. This only happens when disasters occur in the emerging economies that are more exposed to climate risk. Second, natural disasters lead investors to reduce their portfolio flows into unaffected, high-climate-risk countries in the same region as well. Third, disasters in high-climate-risk emerging economies spur investment flows into advanced countries that are relatively safer from a climate risk standpoint. Overall, this suggests that natural disasters trigger an updating of beliefs about global climate threats that are propagated via a new channel: international investors search for *climatic safety*.

**JEL Classification**: C32, C33, E44, F3, Q54.
**Keywords**: climate change, natural disasters, capital flows, *flight-to-safety*, emerging markets.
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**Contents**



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# 1 Introduction[1]

Weather-related natural disasters are increasing in frequency and intensity worldwide because of climate change (see Figure 1). Their economic consequences are highly heterogeneous across countries, as some are more exposed or more vulnerable than others. Such heterogeneity may have profound financial implications at global scale. However, while the economic analysis of climate change and natural disasters has often adopted a multi-country perspective (Dell et al., 2014; Botzen et al., 2019, for a review of the literature), evidence on the effects of local climate events beyond country borders, notably on investment, is rare at best. We take up this issue by investigating whether natural disasters shape international investors' portfolio flows. We construct a multi-country weekly dataset tracking the occurrence of large natural disasters and net inflows to equity mutual funds by destination country and use it to study the effect of extreme natural events on global financial flows.[2]

While there is lack of empirical evidence on this topic, natural disasters are likely to be a significant determinant of gyrations in international portfolio flows. For illustrative purposes, Figure 2 reports the time series of net inflows to mutual funds investing in the Philippines before and after Typhoon Haiyan in 2013. Whereas prior to the disaster equity flows to that country were fluctuating, after the typhoon a clear and persistent pattern of capital outflows emerged. This paper analyzes whether this channel is generally at work and which are the underlying drivers.

[1]We thank Piergiorgio Alessandri, Michael Bauer, Patrick Bolton, Antonio Di Cesare, Michael Donadelli, Marcin Kacperczyk, Diego Kanzig, Galina Hale, Simona Malovana, Alessandro Moro, Francis Warnock, Fabrizio Venditti, and seminar participants at Bank of Italy, New York Fed, Imperial College, UC Berkeley, European University Institute, European Central Bank, ESCB research cluster on climate change, Bank of Albania, 2023 LTI-Bank of Italy conference, and 2023 Cebra meeting for useful comments. The views expressed in the paper are those of the authors and do not involve the responsibility of the Bank of Italy.

[2]For the ease of exposition, we consider natural disasters and extreme weather events as interchangeable. Robustness tests distinguishing between the two categories of events are presented in the empirical section.

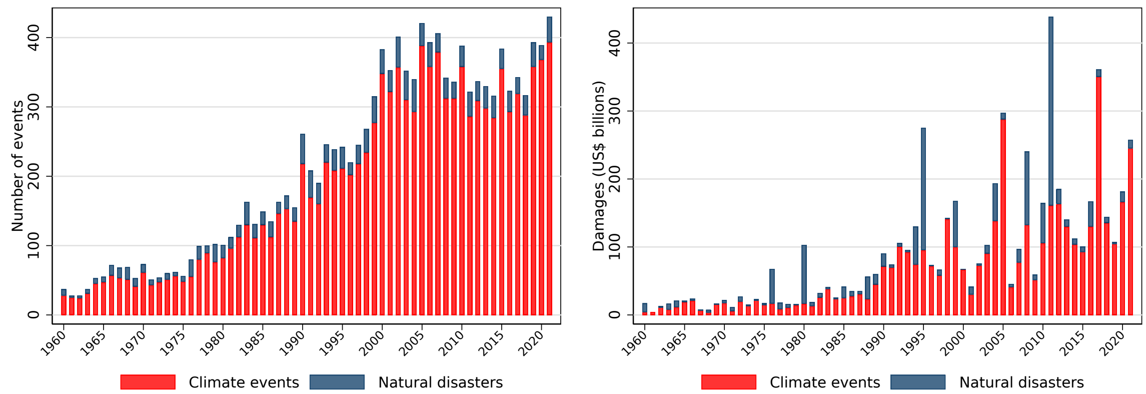


**FIGURE 1:** *Number of events and damages in US$ billions. Data are obtained from the EM-DAT database for the period 1960-2021. Climate events include droughts, extreme temperature events, floods, storms, wildfires, landslides; natural disasters include earthquakes and volcanic activity.*

Our estimates based on local projections (Jordà, 2005) point towards three main results. First, the occurrence of catastrophic events leads to a decrease in net flows to the affected country, which persists at least 12 weeks after the shock. These effects are significant only when disasters occur in emerging economies (EMEs, hereafter) and, among them, only in those ranked at higher climate risk according to leading international classifications.[3] Second, natural disasters in one country induce investors to decrease their equity flows also towards unaffected countries that are also ranked at high climate risk. We obtain this finding by analyzing the response of inflows to high-climate-risk EMEs that belong to the same region of the disaster-hit country but did not suffer any direct damage from the disaster, even when trade linkages with the affected country are accounted for. Third, disasters in EMEs spur net inflows to equity funds investing in the group of advanced economies (AEs, hereafter), notably to those that are relatively less vulnerable to climate events. In particular, when disasters occur in an EMEs at high-climate risk, the increase in net inflows to AEs is bigger the larger the non-life insurance coverage and smaller the

[3]We employ the classification provided by the University of Notre Dame's (ND-Gain) index and the Germanwatch climate risk index.

higher the relative climatic riskiness of the recipient country.

Taken together, such results suggest that international investors fly away from countries that are risky from a climatic standpoint to recompose their portfolios towards safer economies that are also more resilient to future natural disasters. The occurrence of such type of events appears to raise investors' attention towards the global climatic threat, shaping their beliefs about the portfolio risks attached to the invested countries. According to such interpretation, disasters are able to shape mutual funds inflows and outflows by triggering a specific flight-to-safety motive for trading, based on the perceived climate risk of the invested assets: a flight to *climatic safety*. The existence of such specific capital flight motive is corroborated by the absence of any significant increase in net inflows towards Germany, Japan, and Switzerland, which are typical recipient countries in standard flight-to-safety episodes.

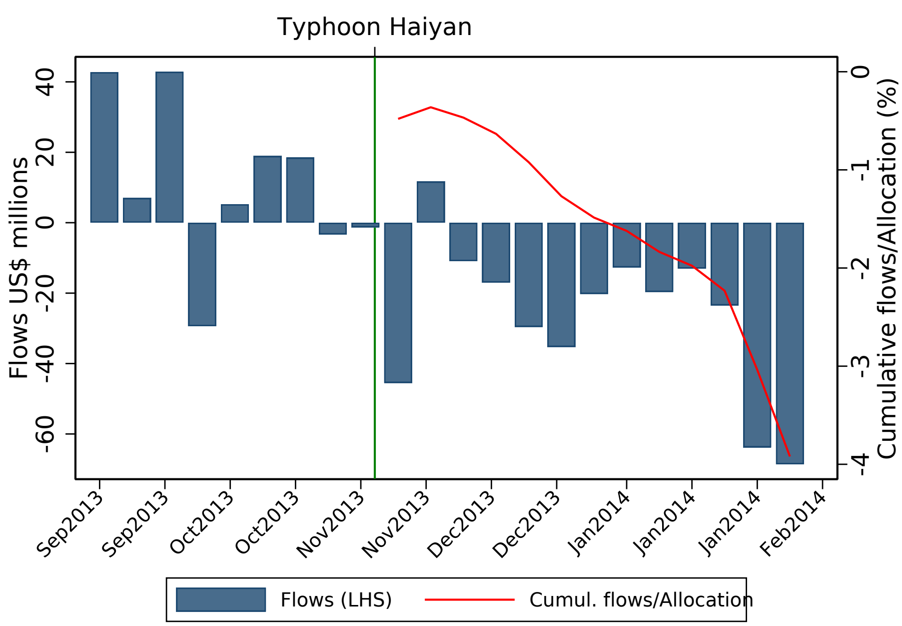


**FIGURE 2:** *Case study Philippines.*

This paper contributes to two strands of the literature. First, it informs the climate economics literature by adding evidence on how natural disasters, which are becoming more and more frequent and intense because of climate change, can shape the dynamics of capital flows worldwide. While the effects of extreme natural events is usually regarded within the country borders, we here add a new perspective on their global repercussions in the short run, adding to a nascent literature on the effects on international markets (Gu and Hale, 2023, Hale, 2022) and, more generally, on the geographic impact of climate change (Jones and Olken, 2010Desmet and Rossi-Hansberg, 2015). In this perspective, this paper also speaks to the analyses of financial investors' behavior facing weather-related shocks (Choi et al., 2020, Alok et al., 2020, Alekseev et al., 2022), offering insights about the international dimension of global portfolio flows. Second, the paper speaks to the international finance literature by uncovering a previously disregarded trigger of capital flight and suggesting a new perspective in defining safe haven countries (for the flight to safety literature, see Caballero and Krishnamurthy, 2008 and Brunnermeier and Pedersen, 2008, among others). The importance of climate vulnerability for global financial flows is new in the literature as, in recent years, the focus has mainly been on the role of push factors such as variations in global investors' risk appetite (see Koepke 2019 for a review).

The paper is organized as follows. Section 2 reviews different strands of literature related to our work highlighting the novelty and contribution of the paper, and illustrates possible transmission mechanisms of natural disasters to portfolio flows. Section 3 describes the data used in the analysis. Section 4 shows the estimated effects of natural disasters on net inflows into equity funds in the hit country and the spillovers to foreign countries. Section 5 presents a set of robustness tests, while Section 6 concludes.

## 2 Related literature

The analysis presented in this paper stands at the intersection of three streams of the literature.

First, we contribute to the strand exploring the macroeconomic implications of natural disasters and extreme weather conditions (see Noy 2009, Raddatz, 2009, Cavallo and Noy 2011, Klomp and Valckx, 2014 and Botzen et al., 2019 offer a meta-analysis and a review of the main findings). An established result from this literature is that natural disasters have, at least in the short run, a negative and significant impact on economic growth in the affected countries, and that developing economies incur into larger output losses than AEs following events of similar relative magnitude.[4] We provide evidence on an amplification mechanism of natural disasters via a (global) financial channel.

Second, we speak to the literature that investigates the determinants of capital flows to emerging markets (see for example Ahmed and Zlate, 2014, Cerutti et al., 2019, Koepke, 2019, Forbes and Warnock, 2021, Burger et al., 2022). We document the relevance of a pull factor - the natural disasters and the related effects on climate beliefs - that is able to shape financial flows, complementing previous evidence on the importance of pull factors in the capital allocation over the medium run (Fratzscher, 2012, Milesi-Ferretti and Tille, 2014, Ananchotikul and Zhang, 2014, Rey, 2015). Quite surprisingly, studies documenting the link between natural disasters and capital flows are scant, with most of them focusing on the implications for real exchange rates (Hale, 2022), foreign direct investments (Gu and Hale, 2023), and foreign aid and remittances (Ebeke and Combes, 2013, Bettin and Zazzaro, 2018), disregarding private portfolio flows (see Osberghaus, 2019 for a review of the

[4] Evidence on longer run effects is more mixed, as some papers argue that the consequences of disasters propagate and persist over time, while others claim the existence of a Schumpeterian creative destruction effect that would eventually reverse the initial negative impact (Cavallo et al., 2013 and Roth Tran and Wilson, 2020, among others).

empirical literature). Two exceptions are Yang (2008) and David (2011), both investigating the effect of disasters on different types of financial flows in a multi-country setting. In these papers, portfolio flows are analyzed in the broader context of public and private capital flows mobilized in the aftermath of natural disasters; regarding equity flows, the authors find that foreign investments fall significantly after a disaster, amplifying the initial negative impact. We add new evidence to the debate by focusing on investors' net flows into mutual funds, which are known to be highly reactive to aggregate shocks, and documenting heterogeneous effects of local disasters that spill over beyond the affected country's border due to climate risk considerations.

Our paper also links to the literature studying the drivers of capital flights and, in particular, flight-to-safety movements. Flight to safety, or risk-off periods, characterize movements in global liquidity in times of crisis or following country-specific shocks (Brunnermeier and Pedersen, 2008, Caballero and Krishnamurthy, 2008, Forbes and Warnock, 2012, Miranda-Agrippino and Rey, 2020, Kekre and Lenel, 2021). This reshuffling in portfolio allocation can occur across markets within the same country- i.e., from stocks to government bonds - or in the form of a global reallocation towards securities traded in safer countries, like the United States. Our analysis provides a new driver for flight to safety, which is the occurrence of natural disasters. Moreover, if this flight away from the hit country is motivated by a fundamental shift in the perceived climate riskiness of the country, we offer a new motive for flight to safety, which is the search for climatic safety. This interpretation speaks to the conclusions in Baker et al. (2020), who find that natural disasters act as an attention device towards the economic prospects of the affected countries: in our perspective, disasters have a wake-up call effect on the portfolio risks related to future climate-related extreme events at global level. As climate change increases the frequency and intensity of adverse natural events over time, the pull factor highlighted in this analysis is set to become an increasingly relevant driver of capital flows in the years to come.

Finally, our paper is also connected to the emerging literature on climate finance (Giglio et al., 2021), in particular to that exploring investors' attitude in response to weather-related shocks (Choi et al., 2020, Alok et al., 2020, Alekseev et al., 2022). Alok et al. (2020) find that fund managers react to disasters by under-weighting disaster zone stocks in their portfolios, and that their reaction is larger the more closely they are physically located in a disaster zone, due to a salience bias. Alekseev et al. (2022) propose a way to construct portfolios to hedge climate change risk by investigating the response of fund managers to some belief shocks related to climate risk, such as heatwaves or language shifts in shareholders reports. They find that different shocks changing climate-related risk appetite stimulate fund managers to trade stocks in some specific industries, which are possibly considered as more or less climate resilient in the longer term. We contribute to this stream of literature by documenting the macroeconomic effects of climate-related disasters on financial investments, in particular on foreign investment demand, disentangling the behavior of different categories of investors and of different types of investment funds.

## 2.1 Transmission channels

Natural disasters might influence international portfolio inflows towards the affected countries through different channels, where the overall sign of the effect is a priori unclear.

In principle, natural disasters might cause an increase in private capital inflows in the damaged country if the reduction in the capital stock due to the disaster had raised the marginal product of capital: in this situation, capital would fly to the damaged country finding profitable investment opportunities to rebuild the capital stock. However, if disasters also deteriorate complementary inputs such as infrastructure and human capital, the returns to physical capital might decrease instead of increasing, inducing no inflows or even outflows. Another reason to observe capital outflows from the damaged country is that natural disasters could shrink total factor productivity of firms, deteriorating their longer-term growth prospects (Loayza et al., 2012), or create political instability. All in all, the latter explanations point to an increase in the risk profile of the investment caused by the disaster: Noy (2009) finds that natural disasters reduce output more in countries with higher degree of capital account openness, suggesting that, overall, private capital flows amplify rather than alleviate the real effects of disasters on economic growth.

An additional mechanism through which financial flows can respond to a natural disaster is the change in risk aversion triggered by the event itself. Natural disasters may cause a significant increase in risk aversion at the local level, inducing people in damaged areas to take sub-optimal investment decisions or refrain to open new business (Bourdeau-Brien and Kryzanowski, 2020). Moreover, after experiencing natural disasters, US-based fund managers that oversee international funds are found to act in a more risk-averse way, reducing funds' volatility across the board (Bernile et al., 2021).

Extreme climate events are also able to raise attention about the financial risks related to climate change and climate policy: as shown by Choi et al. (2020), unusual temperatures induce investors to recompose their portfolios towards low-carbon-intensive firms, irrespective of variations in firms fundamentals. In this perspective, climate-related disasters in one country might trigger a wake-up call effect about the risk of future disasters due to climate change, pushing global investors to divert their funds to safer places. At the root of this mechanism might lie some form of rational inattention on the side of financial investors, as documented by Huang and Liu (2007) and Maćkowiak et al. (2021), or departures from rationality in the form of salience, present bias or projection bias, as shown in Busse et al. (2015) in the case of extreme temperatures.[5]

# 3 Data

We rely on several data sources to study the impact of natural disasters on international portfolio flows. This Section summarizes the main variables used in the empirical analysis, leaving further data characterization to Appendix A.

## 3.1 Disaster data

Data on natural disasters and extreme weather conditions are taken from the Emergency Events Database (EM-DAT) of the University of Louvain, which contains daily records of the largest events occurred worldwide. For a disaster to be included in the EM-DAT database, at least one of the following criteria must apply: 10 or more people died, 100 or more people have been affected, the government of the hit country declared the state of emergency or it called for international assistance.[6] The EM-DAT database offers an internationally comparable record of natural disasters, it is the primary source used to build international data platforms on global climate risk (e.g. the IMF climate change indicators dashboard), and it is commonly used in academic research (Gu and Hale, 2023, Hale, 2022, Avril et al., 2022, Feng and Li, 2021 among others).

Our period of analysis covers the years 2009-2019. This time span includes several volatility episodes in global financial markets (e.g. taper tantrum, sovereign debt crisis, Chinese 2015 sell-off, Brexit..), but explicitly excludes both the global financial crisis and the

[5]Salience, present bias and projection bias have been documented in the behavioral economics literature by Bordalo et al. (2013), Laibson (1997) and Loewenstein et al. (2003), among others.

[6]Affected people are defined as people requiring immediate assistance during a period of emergency, i.e. requiring basic survival needs such as food, water, shelter, sanitation and immediate medical assistance.

Covid-19 crisis where the unprecedented turmoil caused extreme volatilities in portfolio flow data which are difficult to accommodate (Lenza and Primiceri, 2020) and could ultimately muddle the identification of the climatic channel. For the aim of this study we exclude events belonging to the class of "technological" and "complex disasters" and we focus on natural disasters only. Natural disasters are grouped into the following event types: drought, landslide, earthquake, storm, extreme temperature, volcanic activity, flood and wildfire. For each disaster, the EM-DAT specifies the geographical location and the timing of the event; moreover, for most of the events, the EM-DAT also provides details on the number of deaths and on the amount of monetary losses induced by the events, i.e. the damages in real US dollars (US CPI deflated).[7]

Our sample includes 39 countries, of which 16 are classified as AEs (Australia, Austria, Belgium, Canada, France, Germany, Greece, Italy, Japan, Korea, New Zealand, Portugal, Spain, Switzerland, United Kingdom, United States) and the remaining belong to the EMEs aggregate (Argentina, Brazil, Chile, China, Colombia, Czech Republic, Hungary, India, Indonesia, Mexico, Malaysia, Nigeria, Pakistan, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Taiwan, Vietnam). Appendix A provides some graphical evidence on the time-series and geographical distribution of events in our sample.

### 3.2 Equity portfolio flows

We use the Emerging Portfolio Fund Research (EPFR) dataset to retrieve the total financial investors' equity portfolio flows at weekly frequency by destination country, for all

[7] To ensure comparable levels of data reliability and coverage across countries, we only keep those countries affected by at least 10 events in the period 2009-2019 which corresponds to an average of 1 disaster per year. We also exclude from the sample countries where equity portfolio flows and financial variables used as controls in the empirical analysis are either not available or not well-behaved during the period 2009-2019. Countries in this category mainly include less developed countries frequently hit by war and other major conflicts or countries with less developed financial markets.

the economies included in our sample. We retain net flows (i.e. inflows less outflows) and total allocations into equity mutual funds by country to estimate the percentage change of equity portfolio investment into each destination country at weekly frequency. The high frequency of reported data makes this dataset most suitable to analyze sudden shifts in investors' interest towards a specific destination following a major natural disaster. The EPFR dataset is commonly used in academic research (Raddatz and Schmukler, 2012, Jotikasthira et al., 2012, Forbes et al., 2016, Ciminelli et al., 2022, Puy, 2016).[8] For each country we obtain weekly data on the aggregate equity country flows as well as the breakdown of country flows with respect to the portfolio management strategy (active vs passive funds) and the type of investor (institutional vs retail). Figure A.3 in Appendix A displays the yearly total net amount of flows across different years and geographical areas. Notably, we obtain similar results if we employ IMF balance of payments data at the quarterly frequency or their proxy equivalent at the monthly frequency provided by the OECD (see below).

### 3.3 Climate risk indicators

We use the Notre Dame-Global Adaptation Index (ND-GAIN) to rank countries in terms of climatic riskiness. The ND-GAIN index combines 45 indicators to measure a country's *vulnerability* to climate change and assesses its *readiness* to leverage on public and private investments for adaptive actions. We focus on the first dimension of the ND-GAIN (*vulnerability*), defined as the "propensity or predisposition of human societies to be negatively impacted by climate hazards", to proxy country-level vulnerability to natural disasters, where larger values of the index identify countries with high climate risk.[9]

[8] See Koepke and Paetzold (2020) for an analysis on the relationship between EPFR and other capital flows datasets available at lower frequencies.

[9] We refer to the ND-GAIN website (`https://gain.nd.edu/`) for a comprehensive methodological description of the index.

The index is computed at annual frequency and, in terms of the implied country ranking, it is substantially stable over time, reflecting the structural difference in climatic vulnerability across countries. The ND-GAIN has already been applied in the literature to test the impact of climate change and physical risks on: sovereign and firms' cost of capital (Cevik and Jalles, 2020 and Kling et al., 2021), foreign direct investments (FDI) dynamics (Gu and Hale, 2023), and exchange rates (Hale, 2022). For robustness purposes, we also present estimates based on an alternative measure of countries' exposure to climatic risks as proxied by the Climate Risk Index (CRI) developed by Germanwatch and used in Huang et al. (2018), Kling et al. (2021), and Kacperczyk and Peydró (2022) among others.[10]

### 3.4 Additional datasets

We use the database *Refinitiv* to collect financial data on local and global equity markets, exchange rates vis-à-vis the dollar, and macro variables (industrial production and purchasing managers indexes) aimed at capturing the country economic outlook at a high frequency. Trade linkages across countries are measured via inter-country input-output tables from the OECD trade in value-added tables. Country statistics on the level of insurance coverage against natural disasters are proxied via the amount of non-life insurance premium to GDP (%) obtained from the World Bank. The ratio of government debt to GDP (from IMF) is used to measure countries' fiscal capacity in response to natural disasters. Descriptive statistics on the main variables of interest are reported in Table A.1 in Appendix A.

[10]The CRI index analyses to what extent countries and regions have been affected by the impacts of weather-related events both in terms of fatalities and GDP losses, methodological details are available at Germanwatch's website `https://www.germanwatch.org/en/cri`.

# 4 Empirical Analysis

Our empirical analysis, which relies on a panel local projections approach, sheds light on the economic implications of climate change in multifaceted ways. First, we estimate the overall (negative) effect of natural disasters on portfolio equity flows for different group of countries (Section 4.1). Second, we investigate the channels that drive the reduction in inflows to the country by exploiting geographic proximity (Section 4.1). Third, we pinpoint those countries that experience opposite effects (i.e. positive net inflows) when disasters strike somewhere else in the world (4.2). These three complementary parts of the analysis point towards an important role of the climate risk channel.

## 4.1 The impact of natural disasters on portfolio flows

We estimate the dynamic causal effects of natural disaster on portfolio flows via panel local projections (Jordà, 2005).[11] The baseline equation that we estimate at country level and weekly frequency, for each horizon $h$, is as follows:

$$y_{i,t+h} = \frac{\sum_{1:h} f_{i,t+h}}{A_{i,t-1}} = \alpha_{i,h} + \delta_{t,h} + \beta_h D_{i,t} + \gamma_h X_{i,t} + \varepsilon_{i,t+h} \qquad h = 0, 1, 2...24 \tag{1}$$

where $y_{i,t+h}$ are cumulated net flows $f_{i,t}$ to country $i$ from week $t$ to week $t$+$h$ normalized by the total assets under management $A_{i,t-1}$ in the same country one week before the shock; $D_{i,t}$, our main variable of interest, is a dummy equal to 1 if at least one natural disaster occurs in country $i$ during week $t$, $X_{i,t}$ is a set of controls, $\alpha_{i,h}$ and $\delta_{t,h}$ are country-specific and time (week) fixed effects, and $\varepsilon_{i,t}$ is a standard error term. The underlying assumption behind our identification strategy is that the occurrence of natural disasters at

[11] See Dube et al. (2022) for a comparison on the properties of the estimators based on a standard difference-in-difference approach and on the LP approach.

the weekly frequency is hardly predictable, and can be treated as an exogenous driver of investors' portfolio choices. Moreover, as climate change is increasing the frequency and intensity of climatic disasters over time, the incidence of disasters in the past may not be a good proxy for future risk. Time-fixed effects that are common to all countries capture global push factors such as risk-on/off phases or changes in monetary policy stances (e.g. by the Federal Reserve). The set of controls include local (country-level) equity market indexes and their implied volatility, the foreign exchange rate vis-à-vis the dollar and lags of the total asset under management. Impulse responses are estimated for 24 horizons, with $h$ ranging from 0 (impact effect) to 24 weeks ahead. Inference is based on Driscoll-Kraay standard errors that account also for spatial autocorrelation.

**Aggregate effects by country groups.** Figure 3 reports the results of the estimation of the direct effect of natural disasters on net equity inflows by group of countries (advanced vs emerging). Such breakdown shows a fundamentally different behavior: while the effect on net inflows into AEs is substantially null, inflows to EMEs countries drop gradually after the disasters unfold, with inflows remaining persistently subdued for about 3 months. The elasticity of financial flows to natural disasters in EMEs is quite sizable: the cumulated impact of each event at its maximum is, on average, associated with a 0.1 p.p. decrease in net portfolio flows (scaled by asset under management) to emerging market economies.[12] To assess the economic significance of these effects, we compare our findings with those in Ciminelli et al. (2022) who assess the impact of US monetary policy shocks on mutual funds. Based on their estimates relative to EMEs, the occurrence of a natural disaster produces a reduction in inflows that is roughly equivalent to a 5 basis point US monetary shock.

[12] We report in Appendix all the estimated coefficients from our local projection specification for the horizon $h = 8$ (Table B.1), which essentially corresponds the horizon of the largest impact in the right plot of Figure 3.

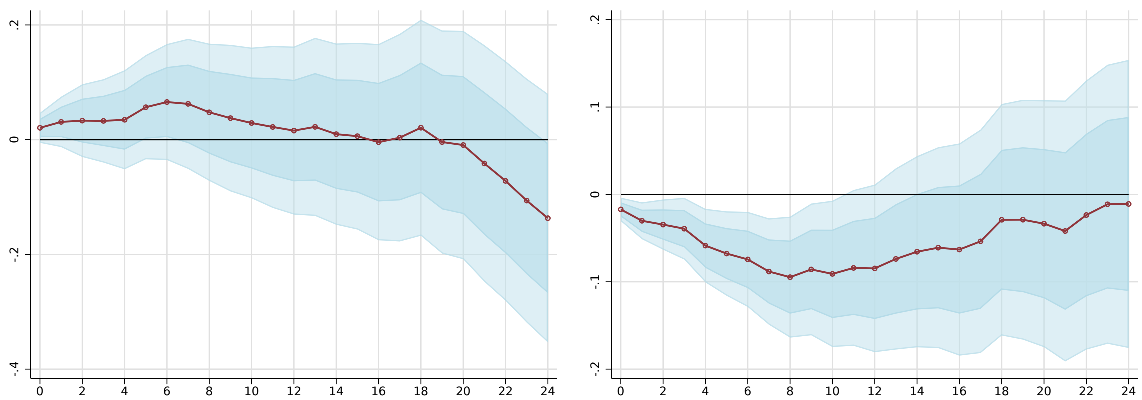


**FIGURE 3:** *Impact of natural disasters on equity portfolio flows, Advanced economies (left panel) vs emerging market economies (right panel). The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

**EMEs and climate risk.** As EMEs are the only ones that experience a reduction in net inflows following a disaster, we then turn to further investigate country-level heterogeneity within this group. For this purpose, we follow the classification developed by the University of Notre Dame (ND-GAIN) and rank EMEs in our sample with respect to the reported vulnerability to climate change. To ensure that the climate risk ranking is not endogenously affected by the occurrence of the disasters we consider in our sample, we employ the ranking based on the average ND-GAIN prior to 2009: according to that measure, we label countries with a value of the index above the median as high-climatic-risk emerging economies (HCR EMEs, henceforth), and the others as low-climatic-risk ones (LCR EMEs). HCR EMEs countries include: CHN, COL, IDN, IND, MEX, NGA, PAK, PER, PHL, THA, TWN, VNM, whereas LCR EMEs are: ARG, BRA, CHL, CZE, HUN, MYS, POL, ROU, RUS, TUR, ZAF.[13] Figure A.4 presents graphical evidence on country classification in terms of climate risk.

Figure 4 presents the impacts of a natural disaster on portfolio flows for the two groups of

[13]TWN is not ranked in the ND-GAIN index and it is conventionally assigned to the HCR group; TWN classification in any of the two groups does not qualitatively alter the empirical results.

EMEs countries. We find that aggregate effect of natural events on emerging economies is totally driven by the subset of countries that are more exposed to climate risk. Therefore, in the next section we focus exclusively on HCR EMEs to dig into the possible transmission mechanisms.

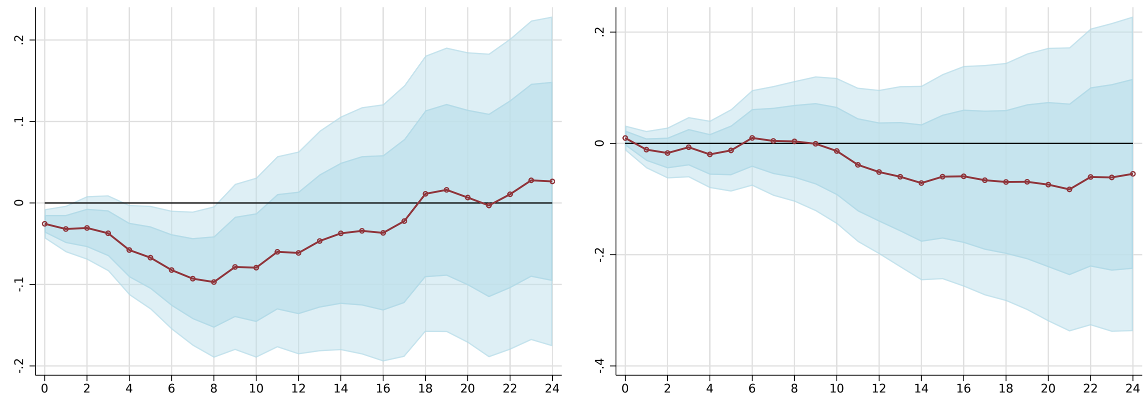


**FIGURE 4:** *Impact of natural disasters on equity portfolio flows, only EMEs classified with respect to country exposure to climate risk. The impact on HCR EMEs countries (CHN, COL, IDN, IND, MEX, NGA, PAK, PER, PHL, THA, TWN, VNM) is reported in the left plot, the impact on LCR EMEs countries (ARG, BRA, CHL, CZE, HUN, MYS, POL, ROU, RUS, TUR, ZAF) is displayed in the right plot. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

### Transmission mechanism

The previous result shows that disasters induce a fall in net inflows by international investors only when they strike high-climatic-risk EMEs. We here investigate which mechanisms described in Section 2.1 can be responsible for this effect. In our context, natural disasters might induce a change in net inflows in the affected country for two main reasons: i) financial investors foresee that the current disaster might itself have severe direct effects on the hit countries (*direct channel*): as a consequence, they may either reduce their inflows (if they expect lower returns from local listed firms) or increase them (if they see investment opportunities for the reconstruction); ii) disasters may trigger an update in investors' beliefs on the climatic riskiness of the country, leading to a reassessment of its current and future financial risk profile and a decrease in net financial inflows (*climatic channel*).

In what follows we focus on the climatic channel, trying to isolate its contribution with respect to the direct effect explained above. For this purpose, we conduct an *ad-hoc* exercise by focusing on the *regional* effects of disasters, i.e. their implications for financial investments in the broader geographic area in which disasters occur. The contribution of the climatic motive is identified, within the same panel local projection framework, using two alternative empirical strategies. First, we estimate the effect of disasters occurring in one high-climate risk country, on net inflows into other high-climate risk neighboring countries that are not directly hit by those disasters. Second, because this strategy may arguably capture some confounding effect due to the existing trade linkages within the region - investors might expect that direct effects might spillover to foreign countries via trade - we propose another specification that augments the previous one with a trade-weighted dummy capturing trade spillovers.

**1) Identification based on neighboring countries.** In this first exercise, we estimate the variation of capital inflows in country $i$ in response to a disaster hitting other economies $j$ in the same geographic area. To this purpose we propose two possible specifications:

$$y_{i,t+h} = \frac{\sum_{1:h} f_{i,t+h}}{A_{i,t-1}} = \alpha_{i,h} + \delta_{t,h} + \beta_h \hat{D}_{i,t} + \gamma_h X_{i,t} + \varepsilon_{i,t+h} \qquad h = 0, 1, 2...24 \tag{2}$$

$$\hat{D}_{i,t} = \begin{cases} 1 & \sum_{j \in G} D_{j,t} > 0 \\ 0 & D_{i,t} > 0 \vee \sum_{j \in G} D_{j,t} = 0 \end{cases} \qquad j \neq i, \{j, i\} \in G \tag{3}$$

where $\hat{D}_{i,t}$ takes value 1 when at least one disaster hits at least one country $j$, in group

$G$, which represents the geographic area Asia or Latin America[14], whereas $\hat{D}_{i,t}$ is equal to zero when a natural disaster occurs only in country $i$ or no events at all occur in the whole country group $G$.[15] The second alternative relies on the following specification:

$$y_{i,t+h} = \frac{\sum_{1:h} f_{i,t+h}}{A_{i,t-1}} = \alpha_{i,h} + \delta_{t,h} + \beta_h \widetilde{D}_{i,t} + \gamma_h X_{i,t} + \varepsilon_{i,t+h} \qquad h = 0, 1, 2...24 \tag{4}$$

$$\widetilde{D}_{i,t} = \begin{cases} 1 & D_{i,t} = 0 \wedge \sum_{j \in G} D_{j,t} > 0 \\ 0 & D_{i,t} > 0 \vee \sum_{j \in G} D_{j,t} = 0 \end{cases} \qquad j \neq i, \{j, i\} \in G \tag{5}$$

where $\widetilde{D}_{i,t}$ now takes value 1 when at least one disaster hits at least one country $j$ in group $G$, but always excluding $i$, even in case of events simultaneously hitting $i$ and one or more countries $j$ in the group G. Figure 5 displays IRFs for the two alternatives, where we again restrict the estimates to the sample of HCR EMEs countries within each region; the left panel displays the results based on the $\hat{D}_{i,t}$ specification reported in Equations 2-3, while the right plot shows the impact for the $\widetilde{D}_{i,t}$ case defined in Equations 4-5. Few considerations are in order. First, the statistical power of the estimation is amplified because for each country we are exploiting information on a larger set of disasters than those hitting one single country. Second, the response at the peak is around three times as large than the baseline reported in Figure 4. Third, the impact is definitely more persistent, especially in the case of $\widetilde{D}_{i,t}$, while it is less pronounced for $\hat{D}_{i,t}$. Such results, showing that disasters induce net inflows to fall more in neighboring than the affected country, suggests that the direct effect of disasters in the hit country may actually be positive, as our high-impact disasters in EMEs might have catalyzed international financial aid, opening

[14] We focus on Asia and Latin America as countries in the EMEA regions are too geographically dispersed.

[15] Note that $\hat{D}_{i,t}$ is equal to 1 if a disaster hits country $i$ and simultaneously one or more countries within the same area $G$.

for profitable investment opportunities.

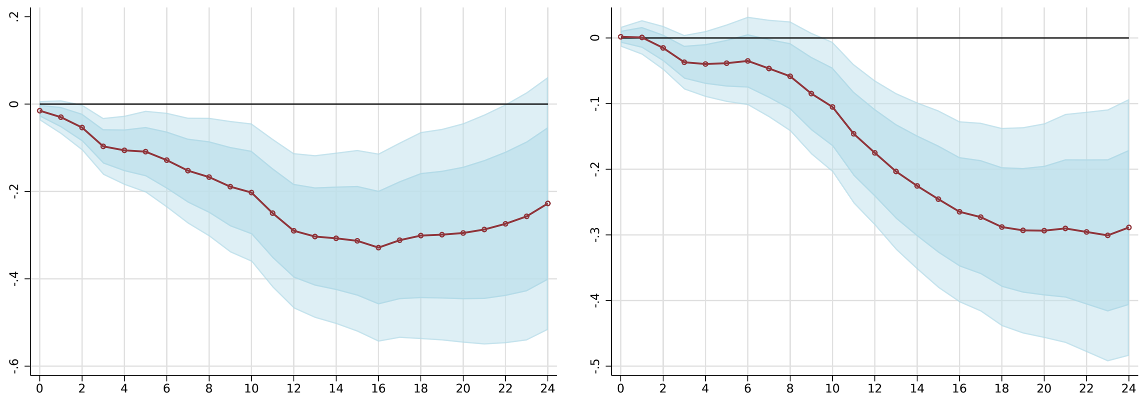


**FIGURE 5:** *Impact of natural disasters on equity portfolio flows, only HCR EMEs in Asia and Latin America (neighboring countries estimation). The left plot is based on the impact dummy $\hat{D}_{i,t}$, the right plot on the impact dummy $\widetilde{D}_{i,t}$; see Equation 3 and 5 respectively for the definition of the two impact dummies. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

**2) Identification based on neighboring countries controlling for trade.** The identification strategy employed in 1) may still capture trade spillovers, which are unrelated to the climate risk channel. To isolate the latter, we repeat the exercise in 1) but we now include a measure of the trade weighted version of $\widetilde{D}_{i,t}$ that we label as $DT_{i,t}$ and include it as a competitor to the original $\widetilde{D}_{i,t}$. To build $DT_{i,t}$ we consider within-area $G$ trade linkages from input-output tables (obtained from the OECD trade in value-added tables) such that $DT_{i,t}$ captures the country specific trade exposure of country $i$ to the disasters in neighbor countries.[16] Our estimation is formally described by:

$$y_{i,t+h} = \frac{\sum_{1:h} f_{i,t+h}}{A_{i,t-1}} = \alpha_{i,h} + \delta_{t,h} + \beta_h \widetilde{D}_{i,t} + \lambda_h DT_{i,t} + \gamma_h X_{i,t} + \varepsilon_{i,t+h} \qquad h = 0, 1, 2...24 \quad (6)$$

[16]We employ data based on 2008 to dispose of a predetermined version of trade exposure, consistently with our predetermined definition of HCR-EMEs.

$$DT_{i,t} = \begin{cases} \sum_{j \in G} w_{j,i} D_{j,t} & D_{i,t} = 0 \\ 0 & D_{i,t} > 0 \end{cases} \qquad j \neq i, \{j, i\} \in G \tag{7}$$

where $w_{j,i}$ are trade weights defined as the share of country $i$ value added exported in country $j$. Figure 6 displays the values of $\beta_h$ (left panel) and of $\lambda_h$ (right panel), now interpreted as the effect of the disasters of net inflows in neighboring countries net of trade linkages (the former), and the marginal effect of the disaster through trade (the latter). The response of $\beta_h$ looks largely unaffected by the inclusion of the trade-related term: the effect of the disaster net of trade linkages is still negative and persistent, while the trade-related effect is non-statistically significant. These results support the view that, net of the direct impact of disasters and of the potential trade-spillovers at work, the climate risk channel contributes significantly to the overall reduction of inflows observed after a natural disaster hits an HCR-EME.

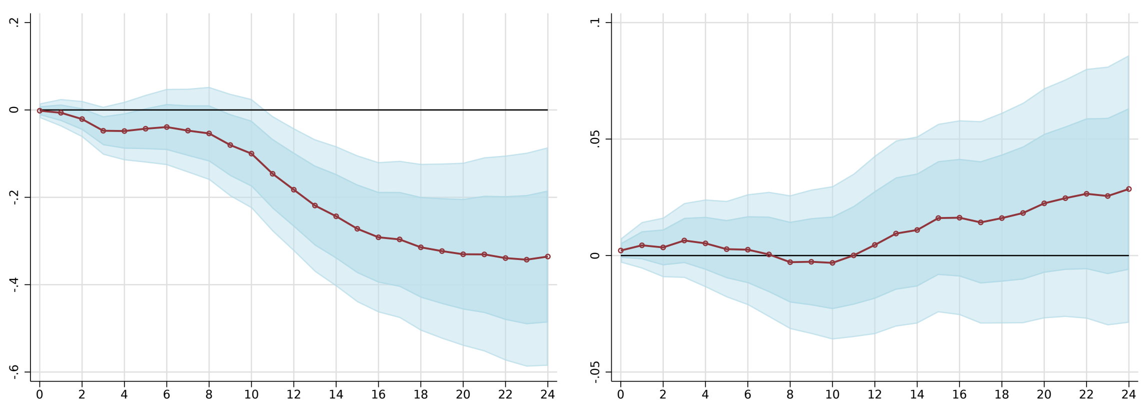


**FIGURE 6:** *Impact of natural disaster on equity portfolio flows, only HCR EMEs in Asia and Latin America (neighbor countries estimation controlling for trade). The left plot displays the IRF of the impact dummy* $\widetilde{D}_{i,t}$ *defined in Equation 5. The right plot displays the IRF of the trade-weighted impact dummy defined in Equation 7. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

## 4.2 Spillover analysis

Results in the previous sections have shown that the occurrence of natural disasters in EMEs, especially in those classified at high climate risk, lead to a slowdown in net equity inflows to the affected country. A natural question that arises is whether these funds are channeled elsewhere, maybe within the same asset class but in a different country. We explore this possibility by evaluating possible spillover effects of natural disasters occurred in a HCR-EMEs towards countries that can be perceived as safer from a financial investment point of view, namely advanced economies. The direction of the spillovers is also a crucial indicator to gauge the relevance of the climatic risk channel.

In our baseline spillover estimation, we rely on local projections in a time series framework by aggregating the spillovers from events in EMEs to AEs. At each horizon $h$ we estimate:

$$y_{t+h} = \frac{\sum_{1:h} f_{t+h}}{A_{i,t-1}} = \alpha_h + \beta_h D_t + \gamma_h X_t + \varepsilon_t \qquad h = 0, 1, 2...24 \tag{8}$$

where $y_{t+h}$ are aggregate net inflows $f_t$ towards a group of countries (AEs, see below for details) in week $t$ normalized by their total asset allocation $A_{t-1}$ observed before the occurrence of the event; $\alpha$ is the constant, $D_t$ is a dummy variable equal to 1 if at least one natural disaster occurs in at least one of the high-risk EME countries during week $t$, $X_t$ is a set of financial controls[17], and $\varepsilon_t$ is a standard error term; as in the previous specification, index $h$ goes from 0 to 24 weeks ahead. As dependent variable, we construct aggregate flows for all AEs, which are the natural target for financial investors that aim at lowering portfolio risks. The first set of results is displayed in Figure 7, where panel (a) shows portfolio spillovers towards AEs from HCR EMEs (left plot) and from LCR EMEs (right plot), respectively. Only in the first case, a gradual increase in net inflows towards

[17] We include the VIX, the dollar index, the S&P 500 equity index, the MSCI EM equity index, a linear and a quadratic trend.

advanced economies shows up: the effect is quite persistent and tends to develop over several weeks (around 0.2 p.p. after 6 months), which is somehow consistent with the assumption that portfolio rebalancing is gradually implemented after the shock.

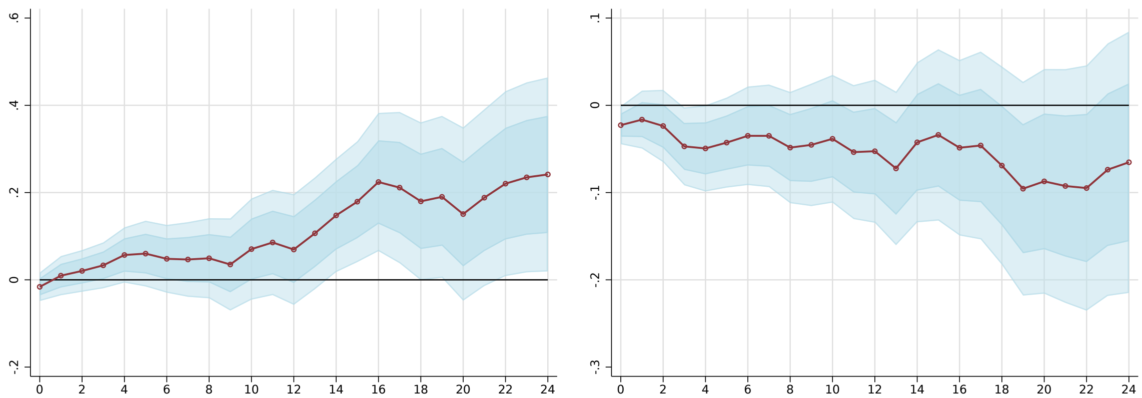

**FIGURE 7:** *Spillover to advanced economies. The left plot displays portfolio flows from HCR EMEs, the right plot from LCR EMEs. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

### Flight to climatic safety

Are inflows to advanced economies heterogeneous across countries? As the previous evidence shows that investors reduce net inflows only when disasters occur in high-climatic-risk EMEs, it is natural to explore whether the same considerations about climate risk are also able to spur positive spillovers in other regions. In order to discriminate between high-climate-risk and low-climate-risk countries within the set of advanced economies, we employ two indicators. One is the Notre-Dame climate risk, already used to rank EMEs based on their climatic risk exposure in the previous Sections. The other one is the average level of non-life insurance premium in percentage of national GDP, retrieved from the World Bank database and also adopted by the IMF Climate Change dashboard, which proxies the insurance coverage of businesses and individuals against adverse climate events. Considering risk exposure and insurance jointly is important to have a complete picture of climate vulnerability in AEs: for example, two of them can have similar exposure but very different level of insurance penetration, as the latter is particularly heterogeneous across advanced countries.[18] We employ both indicators to rank, within the set of AEs, those with relatively higher or lower exposure and insurance against extreme natural events. Using the aforementioned measures, we investigate whether climate risk drive cross-regional spillovers by running two empirical exercises. First, we estimate the dependence of spillovers to AEs on the level of the climatic riskiness and insurance in a panel framework. In a second exercise, described in a more detailed way in Section 5, we focus on climate insurance and re-estimate the spillover effects separately to highly insured vs lowly insured AEs. Notably, the estimation shows that the channel we identify is distinct from a standard flight-to-safety mechanism as safe heavens such as Japan, Germany, and Switzerland (characterized by relatively low insurance premium to GDP) do not receive higher equity inflows after a disaster hits a HCR-EME.

**Explicit dependence of spillovers on climate risk and insurance.**

In a panel estimation, we investigate whether the spillovers from HCR-EMEs towards AEs depend on the climatic vulnerability of the recipients countries and on their insurance penetration. The empirical specification to compute panel local projections is as follows

$$y_{i,t+h} = \frac{\sum_{1:h} f_{i,t+h}}{A_{i,t-1}} = \alpha_{i,h} + \delta_{t,h} + \beta_h D_{j,t} + \eta_h D_{j,t} CR_{i,t} + \theta_h D_{j,t} Ins_{i,t} + \gamma_h X_{i,t} + \varepsilon_{i,t+h} \quad (9)$$

where $y_{i,t+h}$ are net cumulated flows $f_{i,t}$ to country $i$ within the set of AEs, from week $t$ up to week $h$ normalized by the assets under management $A_{i,t-1}$; $D_{j,t}$ is a dummy equal to 1 if at least one natural disaster occurs in one country j within the set of HCR-EMEs;

[18] Conversely, in emerging economies, insurance penetration is generally low, so what drives climatic riskiness among those countries is mainly their exposure to adverse natural events.

$CR_{i,t}$ is the ND-GAIN vulnerability risk index, $Ins_{i,t}$ is the non-life insurance premium normalized by GDP. Parameters $\eta$ and $\theta$ capture the extent of which net inflows to AEs are influenced by the climate risk and insurance penetration in the recipients countries. Figure 8 displays the dynamic behavior of $\eta$ (left plot) and $\theta$ (right plot). The results show that AEs with relatively lower exposure and higher insurance penetration receive larger net equity inflows in the aftermath of a disaster occurred in one HCR-EMEs.

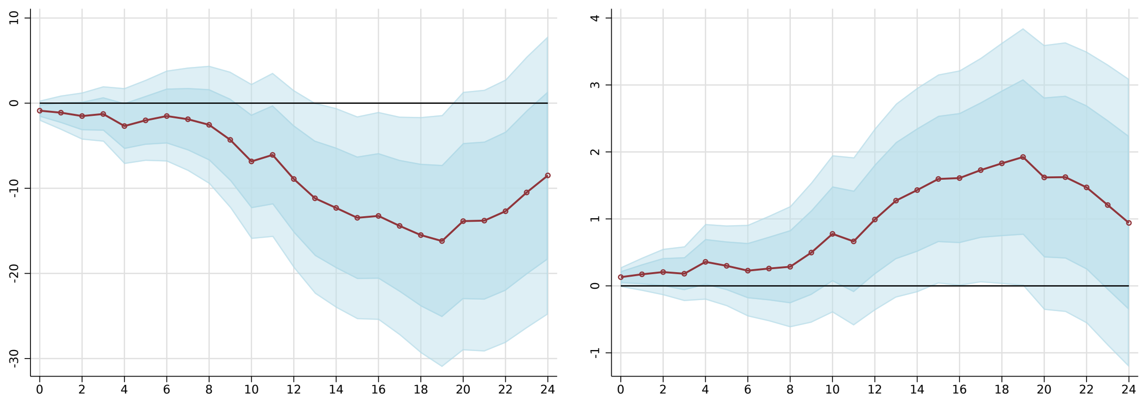

**FIGURE 8:** *Spillover from high risk EMEs to AEs - panel estimation. The left plot displays the IRFs of the interaction term between ND-GAIN vulnerability index and the dummy $D_{j,t}$ for natural events occurrence in HCR EMEs; the right plot displays the IRF of the interaction term between non-life insurance coverage and the dummy $D_{j,t}$ for natural events occurrence in HCR EMEs. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

How advanced economies are positioned as recipient countries in times of disasters? Table A.2 lists them according to our indicators of climatic vulnerability: the insurance premium (from highest to lowest) and climate risk exposure (from lowest to highest). Countries ranked in first positions are the least vulnerable to climate change, while those in the last positions are the most. The table reveals an interesting fact: economies that are usually considered as safe havens in times of financial turmoil are not necessarily the safest in terms of climatic risk. One example is Japan, a commonly known safe haven that, however, may not be the target of disaster-induced portfolio inflows due to its low insurance level coupled with a high climate risk. On the other hand, the UK and, to some extent, Canada, are traditionally known as safe countries for financial investment and are also well placed in terms of climatic vulnerability - they have high insurance levels and low climatic riskiness. The United States and, for opposite reasons, Germany, stand in between the two. All in all, the evidence suggests that the occurrence of natural disasters spurs variations in the allocation of funds worldwide that may not pair, in terms of recipient countries, with those observed during downturns: by inducing climate risk-driven changes in investors' preferences across countries, the wake-up call effect of the disaster on the global climatic threat is what makes the difference.

# 5 Robustness and additional results

We here report additional results based on several variations of the baseline estimates, which experiments different data sources as well as different econometric specification. More detailed material on these exercises is reported in the Appendix B.

**Climate events.** Our baseline analysis employs both climate events and non-climate natural disasters in order to get larger statistical power in the estimation. Although some natural disasters such as earthquakes and volcano eruptions are not directly related to climate change, the same channel at work for climate events is arguably in place for those other type of disasters. As no general consensus exists on what can be labeled as a pure climate event, we consider two possible definitions for our robustness exercise: a broad definition encompassing droughts, extreme temperatures, floods, storms, wildfires and landslides, thus excluding earthquakes and volcanoes eruptions, and a narrow definition that also excludes wildfires and landslides. We repeat our estimates by including the two alternative sets of natural events and obtain very similar, albeit slightly less statistically significant results, see Figure B.1.

**Events severity - death and damages.** We investigate whether investors' response is amplified when a severe disaster occurs by restricting our analysis to events reporting dead people and economic damages. To enhance results comparability, Figure B.2 displays the marginal impact of severe natural disasters with respect to the baseline IRFs for HCR-EMEs reported in the left plot of Figure 4. Both type of events are found to reduce inflows to the affected countries relatively more than the baseline estimate: the additional impact at its peak is around 0.3 p.p. for events with deaths and 0.2 p.p. for those with reported economic losses.

**Breakdowns.** We have repeated the main estimation for HCR-EMEs by breaking-down the equity funds with respect to portfolio management strategy (active vs passive) and investor's category (retail vs institutional). Figure B.3 shows that active funds drive the aggregate response and potentially exacerbate portfolio volatility after the adverse event, plausibly because the managers of these funds can modify the portfolio allocation more easily in the short-run compared to passive funds where benchmark replication constraints limit the capacity of the manager to adjust the relative weight of the country hit by a natural disaster. Figure B.4 in Appendix B displays the IRFs distinguishing across investor's categories: we do not find major differences in terms of magnitude but only with respect to the redemption dynamics, with flows to retail funds less resilient and reverting to zero after the climatic shock.

**Low-frequency datasets.** As it could be argued that the EPFR dataset captures only a fraction of portfolio flows, specifically those channeled through mutual funds, we replicate the analysis by using two lower-frequency yet more comprehensive measures of portfolio flows. Firstly, we employ balance of payments (BoP) quarterly data on portfolio equity flows obtained from the IMF. Secondly, we utilize the monthly proxy of the BoP portfolio flows based on the methodology described in Koepke and Paetzold (2020) and de Crescenzio and Lepers (2021).[19] The natural counterpart to standardize BoP portfolio flows would be the international investment position (IIP); however, due to the number of missing data in the IIP for countries included in our dataset, we employ the trend in local GDP in U.S. dollars to normalize equity portfolio flows as in Broner et al. (2013). Results for the BoP data and for its monthly proxy counterpart are reported in Figure B.5 for the subsample of HCR-EMEs Clearly, given the lower frequency of our data we now consider the response of portfolio flows to the increase in the number of quarterly/monthly events, instead of using a weekly dummy variables. In both cases the response is persistently negative, with a very similar shape in the case of the monthly exercise.[20]

**Control for trade share and fiscal capacity.** The conclusions from our analysis remain unaffected if we include explicit controls for the trade/GDP ratio and the fiscal capacity of the country (debt/GDP). Controlling for trade/GDP may be relevant to capture the economic impact especially for open economies where disasters may affect disproportionately imports/exports compared to domestic consumption. The fiscal capacity may instead influence the response of investors as the local authorities may react more effectively to the disasters if they dispose of a larger fiscal space. Those variables are generally quite persistent and highly collinear with the country fixed effects, albeit in principle time-varying. For this exercise we thus remove the country fixed effects and find qualitatively similar results, see Figure B.6.

**Alternative proxies of climate riskiness and climatic insurance.** The results from our estimations are largely unaffected (see Figure B.8) when we substitute i) the ND-GAIN vulnerability index with the Germanwatch climate risk index to compute the impact of natural disasters on flows to HCR-EMEs; ii) the WB measure of non-life insurance with

[19]The monthly proxy of BoP portfolio flows is available only for a subset of EMEs, namely BRA, CHL, CHN, COL, CZE, IND, MEX, PAK, PHL, POL, ROU, THA, TUR, ZAF.

[20]Results are qualitatively similar if we employ BoP flows in non-standardized U.S. dollars.

OECD data on non-life gross premium to insure against fire and other property damage insurance.[21]

**Employing disaster shock in U.S. dollars.** We repeat our analysis by substituting our disaster shock dummy with the reported U.S. dollars damages (Figure B.9). The main results are similar to the baseline but less statistical significant possibly because of the reduced statistical power due to widespread missing values for this variable.

**Controlling for the lagged realization of disasters.** The response of equity portfolio flows is qualitatively similar to the baseline when we include as additional control variables the lagged number of natural disasters affecting each country (Figure B.10).

**Estimation of spillovers by country-groups.** We split advanced economies, i.e. those countries where investors generally tend to reallocate their funds following a catastrophic event in EMEs, on the basis of their level of non-life insurance premium to GDP: countries with a value larger than the sample median include AUS, AUT, CAN, ESP, FRA, GBR, KOR, USA, whereas a lower level of this indicator is found for BEL, CHE, DEU, GRC, ITA, JPN, NZL, PRT. We then repeat our spillover estimates (see eq. 8) by splitting the sample between AEs with low vs high level of non-life insurance premium. Results are shown in Figure B.11. The left panel shows that countries with high level of non-life insurance premium to GDP catalyze most of the spillover effect. In other words, investors tend to reallocate their funds towards countries that are safer in terms of future climate risks, identified as the most resilient to natural disasters. The right panel reports the average spillover effect towards three commonly known safe havens, namely Japan, Germany, and Switzerland, which are however at higher climate risk relative to other advanced economies. The results show that the effect on net inflows to those countries is

[21] According to the OECD definition, premium in this category should hedge against damages or property due to fires, explosions, storms, natural forces other than storms, nuclear energy incidents, land subsidence. We normalize premium by country GDP.

not significant, confirming that a flight towards *climatic safety* is a distinct phenomenon compared to the standard flight-to-safety episode.

# 6 Conclusions

We uncover a novel and relevant dimension through which climate change affects the global economy that was previously disregarded in the international finance literature. The occurrence of a natural disaster in EMEs generates a significant decrease in net financial inflows in the affected country. This pull factor is at work only for EME countries at high climate risk, suggesting that the occurrence of disasters triggers climate risk awareness. As a mirror image of the domestic portfolio outflows, we find that natural disasters spark international spillovers towards advanced economies characterized by lower climatic riskiness and higher level of non-life insurance, often employed as a proxy of financial resilient against climate risk. Going ahead, these portfolio movements might become more frequent and grow in size, as natural disasters increase in frequency and intensity over time because of climate change, raising uncertainty about financial capital availability at country level. Our findings are relevant for the policy debate on the design of effective mitigation and adaptation policies at regional scale.

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# A Dataset

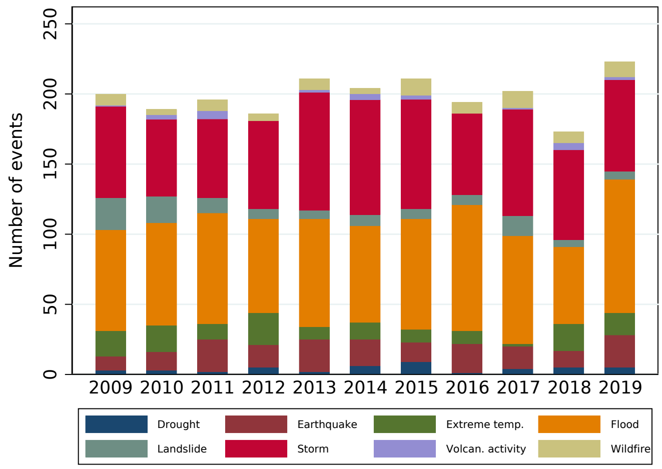


**FIGURE A.1:** *Distribution of disasters classified with respect to event type.*

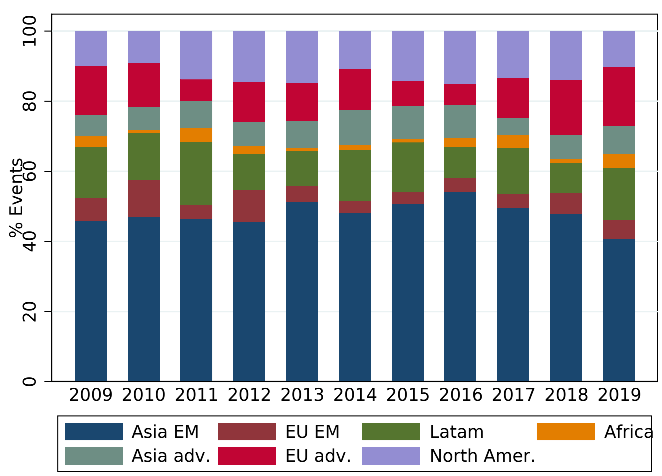


**FIGURE A.2:** *Distribution of disasters classified with respect to geographical regions.Countries in each geographical group are as follows: Asia EME (CHN, IDN, IND, MYS, PAK, PHL, THA, TWN, VNM), Europe EME (CZE, HUN, POL, ROU, RUS, TUR), Latam (ARG, BRA, CHL, COL, MEX, PER), Africa (NGA, ZAF), Asia advanced (AUS, JPN, KOR, NZL), Europe advanced (AUT, BEL, CHE, DEU, ESP, FRA, GBR, GRC, ITA, PRT), North America (CAN, USA).*

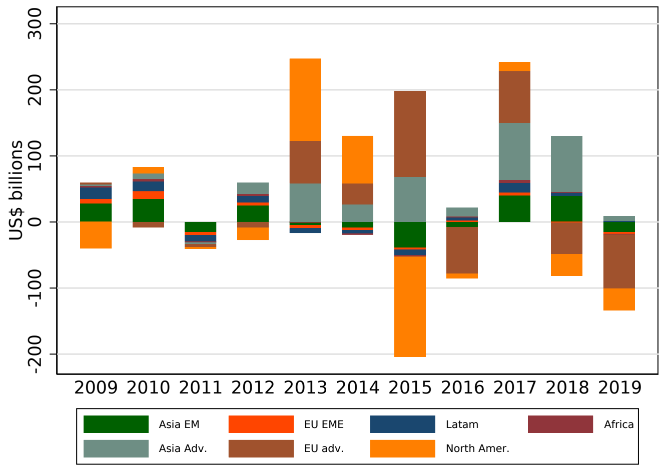


**FIGURE A.3:** *Total yearly amount of net flows across geographical areas. The amount is computed as the simple arithmetic sum of the weekly net flows recorded in all the countries of each geographical area. Countries in each geographical group are as follows: Asia EME (CHN, IDN, IND, MYS, PAK, PHL, THA, TWN, VNM), Europe EME (CZE, HUN, POL, ROU, RUS, TUR), Latam (ARG, BRA, CHL, COL, MEX, PER), Africa (NGA, ZAF), Asia advanced (AUS, JPN, KOR, NZL), Europe advanced (AUT, BEL, CHE, DEU, ESP, FRA, GBR, GRC, ITA, PRT), North America (CAN, USA).*

Table A.1: Descriptive statistics

| | Advanced Economies | | | | |
|---|---|---|---|---|---|
| | Mean | St.Dev. | 25p | 50p | 75p |
| Net flows/Asset allocation (%) | 0.10 | 0.82 | -0.11 | 0.06 | 0.27 |
| Event duration (weeks) | 1.87 | 6.07 | 0.29 | 0.57 | 1.14 |
| Number of dead people | 75.90 | 946.01 | 2.00 | 5.00 | 15.00 |
| Damages (bln US$) | 2.86 | 14.34 | 0.13 | 0.53 | 1.82 |
| ND-GAIN vulnerability | 0.33 | 0.03 | 0.30 | 0.33 | 0.35 |
| | Emerging markets economies | | | | |
| | Mean | St.Dev. | 25p | 50p | 75p |
| Net flows/Asset allocation (%) | 0.16 | 0.93 | -0.14 | 0.10 | 0.40 |
| Event duration (weeks) | 2.52 | 9.18 | 0.14 | 0.57 | 1.29 |
| Number of dead people | 135.68 | 1766.70 | 7.00 | 16.00 | 44.00 |
| Damages (bln US$) | 0.77 | 2.48 | 0.01 | 0.11 | 0.52 |
| ND-GAIN vulnerability | 0.43 | 0.07 | 0.38 | 0.42 | 0.48 |

Descriptive statistics. Net flows/Asset allocation are weekly percentage country flows normalised by country asset allocation, damages are measured in CPI-deflated US$ billions, the ND-GAIN vulnerability values are computed over pre-sample years (1995-2008).

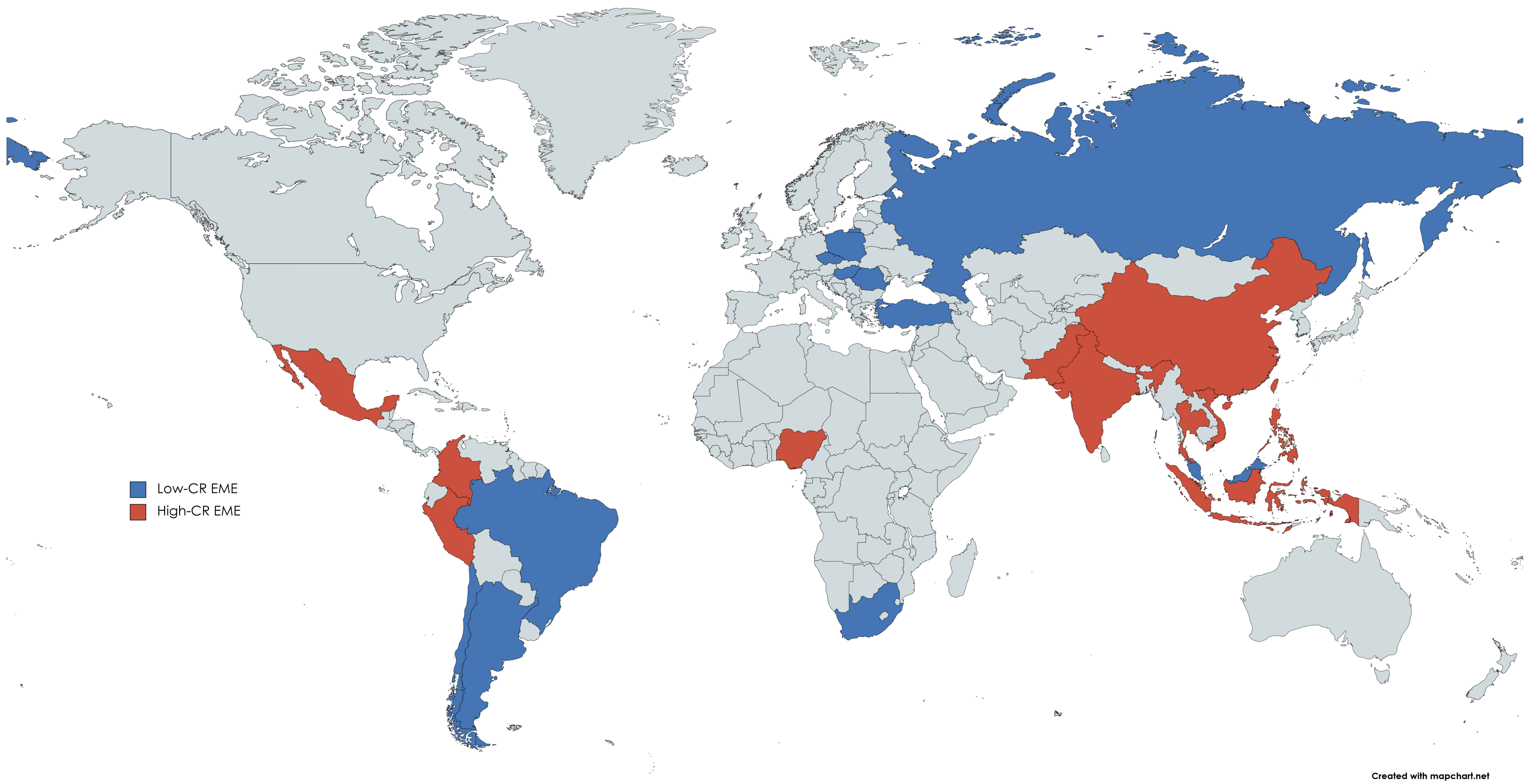


**FIGURE A.4:** *Country classification with respect to climate vulnerability based on the values of the ND-GAIN index over the period 1995-2008.*

| Ranking | Country | Insurance (high to low) | Ranking | Country | climate risk (low to high) |
|---|---|---|---|---|---|
| 1 | United States | 3.362 | 1 | Switzerland | 0.268 |
| 2 | United Kingdom | 2.823 | 2 | Austria | 0.291 |
| 3 | Australia | 2.619 | 3 | United Kingdom | 0.293 |
| 4 | Korea | 2.601 | 4 | Germany | 0.305 |
| 5 | Canada | 2.421 | 5 | Spain | 0.307 |
| 6 | Spain | 2.287 | 6 | Canada | 0.309 |
| 7 | France | 2.269 | 7 | France | 0.317 |
| 8 | Austria | 2.245 | 8 | Australia | 0.329 |
| 9 | Belgium | 2.229 | 9 | Italy | 0.330 |
| 10 | Switzerland | 2.187 | 10 | New Zealand | 0.334 |
| 11 | Portugal | 2.090 | 11 | Greece | 0.336 |
| 12 | Germany | 2.080 | 12 | United States | 0.339 |
| 13 | Italy | 2.023 | 13 | Portugal | 0.353 |
| 14 | New Zealand | 1.649 | 14 | Belgium | 0.353 |
| 15 | Japan | 1.519 | 15 | Japan | 0.379 |
| 16 | Greece | 0.741 | 16 | Korea | 0.399 |

Table A.2: **Rankings of advanced economies (from safer to riskier)**. Ranking of advanced economies with respect to non-life insurance premiums over GDP (World Bank data) and climate risk (ND-GAIN vulnerability); averages are pre-determined to the start of our sample and computed on yearly values before 2009.

# B Robustness exercises

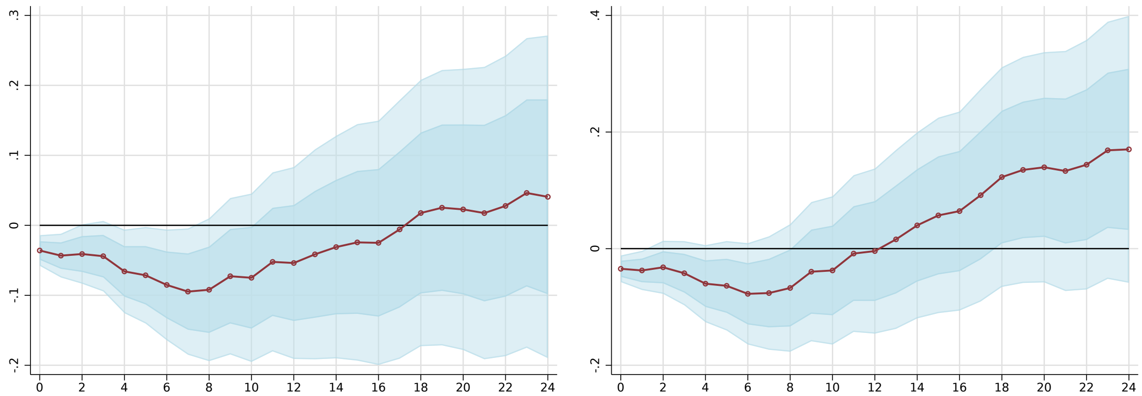


**FIGURE B.1:** *Impact of natural disasters on equity portfolio flows. The left plot is based on the broad definition of climate events (droughts, extreme temperatures, floods, storms, wildfires and landslides), whereas the right plot displays the impact based on a narrow definition of climate events (droughts, extreme temperatures, floods, storms). Estimates are based on the subsample of HCR-EMEs. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

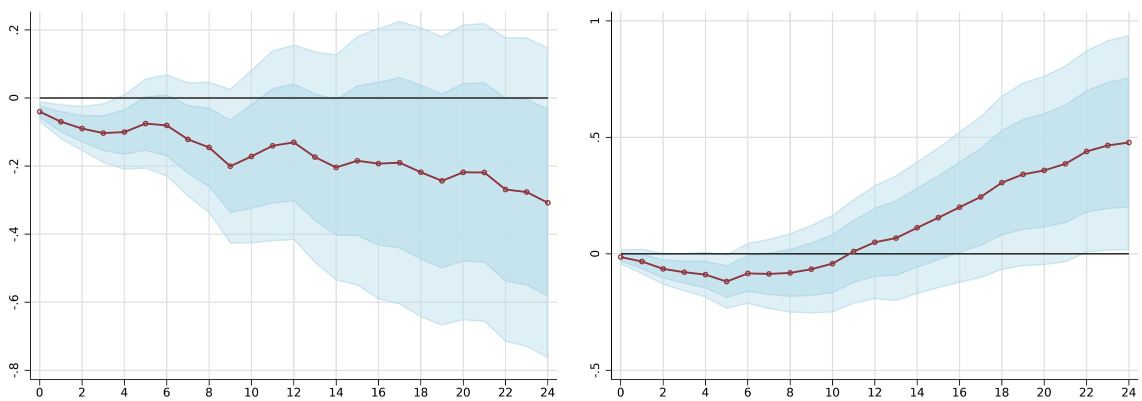


**FIGURE B.2:** *Impact of severe natural disasters on equity portfolio flows, the IRFs display the marginal impact on top of the baseline effect reported in the left plot of Figure 4. The left plot limits the analysis to events with dead people, the right plot to events with reported economic damages. Estimates refer to the subsample of HCR EMEs. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

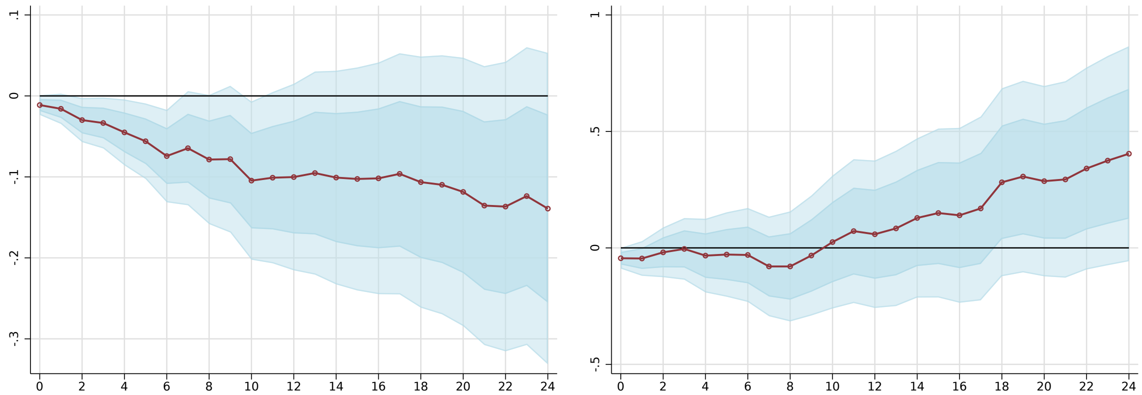


**FIGURE B.3:** *Impact of natural disasters on equity portfolio flows, breakdowns with respect to investment strategies: active funds (left plot) vs passive funds (right plot). The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

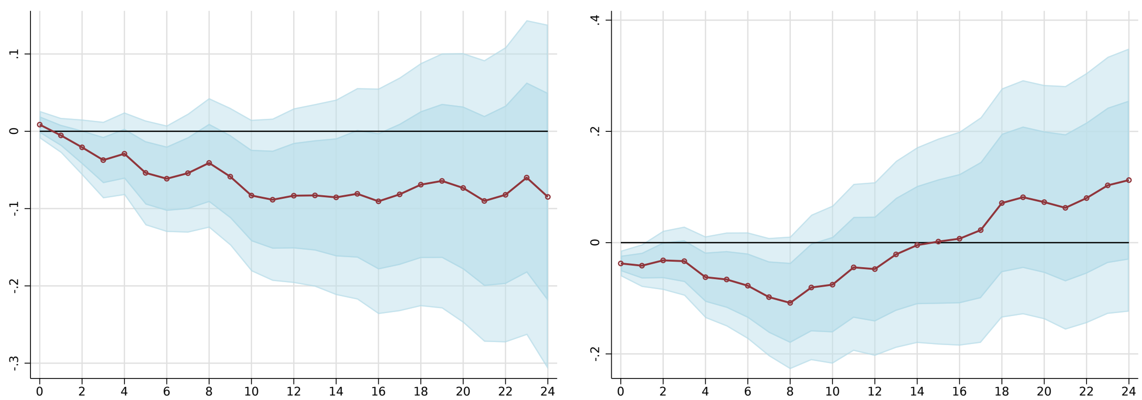


**FIGURE B.4:** *Impact of natural disasters on equity portfolio flows, breakdowns with respect to investors'category: retail funds (left plot) vs institutional funds (right plot). The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

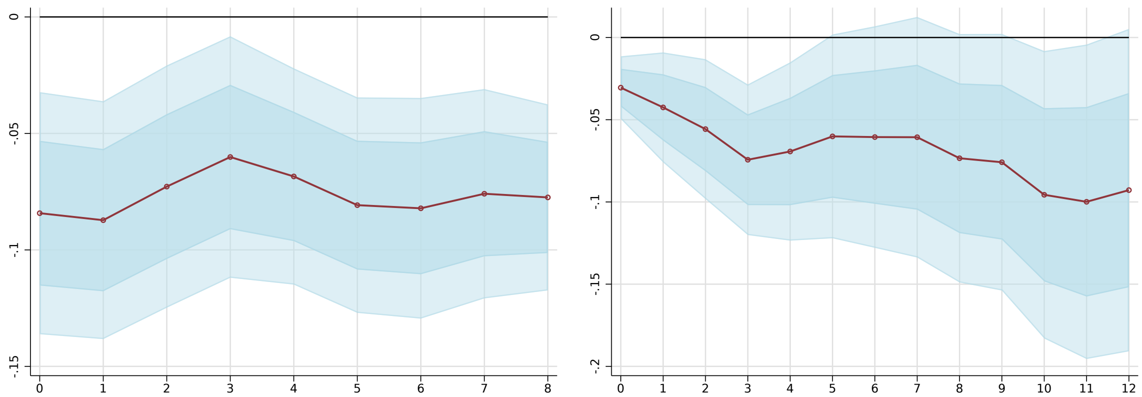


**FIGURE B.5:** *Impact of natural disaster on equity portfolio flows using low-frequency datasets The left plot displays the estimates using quarterly BoP data, the right plot displays the estimates using the monthly proxy for BoP portfolio flows described in Koepke and Paetzold (2020) and de Crescenzio and Lepers (2021). Time is measured in quarters in the left plot and months in the right plot; coefficients represent p.p., with 68% and 90% confidence bands. Flows are normalized by trended GDP. The IRF shows the response to the increase in the number of events (no dummy estimation). Estimates refer to the subsample of HCR EMEs.*

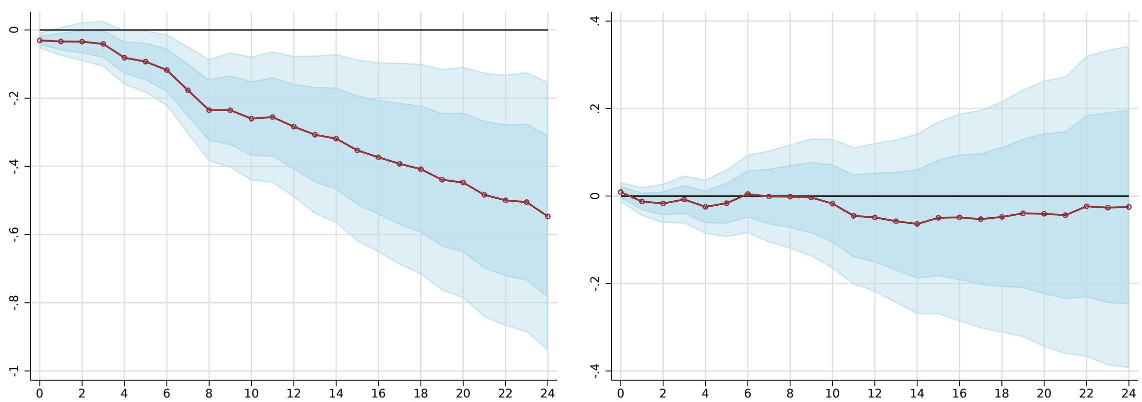


**FIGURE B.6:** *Impact of natural disasters on equity portfolio flows, excluding fixed effects, but including fiscal capacity (debt/GDP) e trade/GDP (economic links with neighbours). High risk EMEs (left plot) vs low risk EMEs (right plot). The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

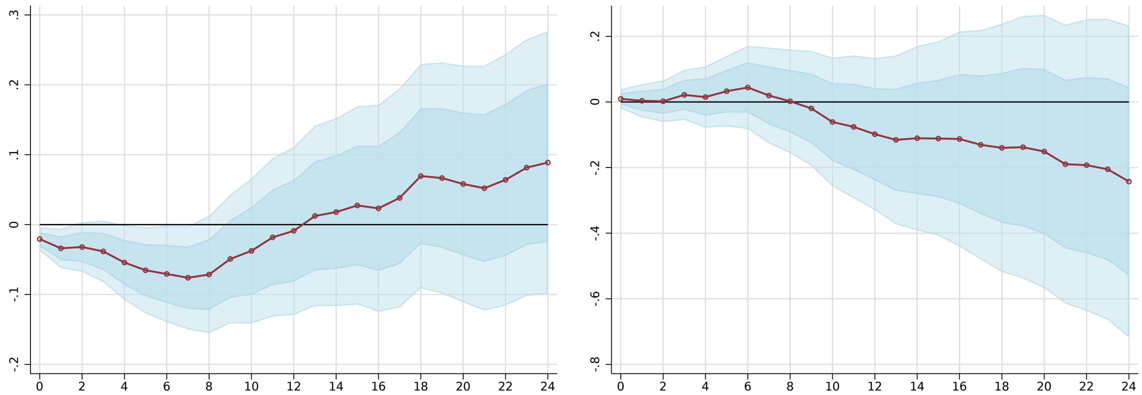


**FIGURE B.7:** *Impact of natural disaster on equity portfolio flows, EME countries with high risk (left plot) EME countries with low risk (right plot). GCRI classification. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

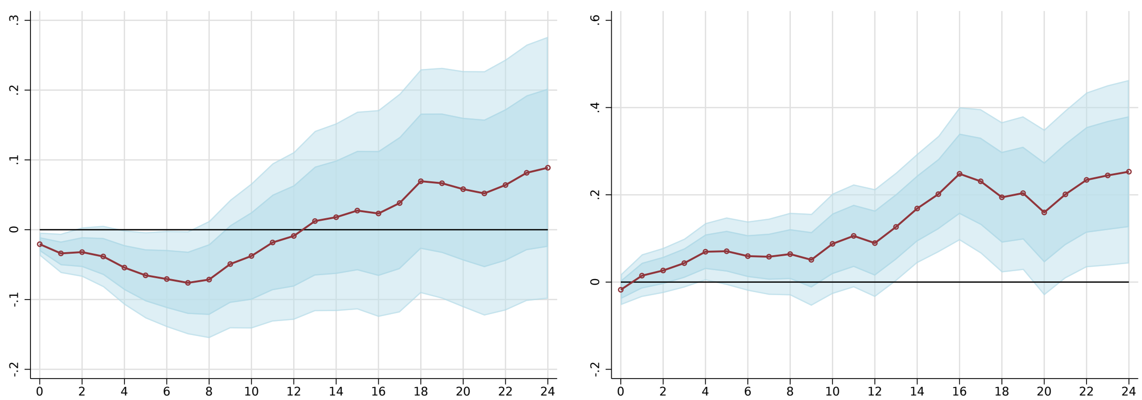


**FIGURE B.8:** *The left plot displays the impact of natural disaster on equity portfolio flows for HCR EME countries classified according to the Germanwatch climate risk index. The right plot shows the spillover to advanced economies with high level of non-life insurance to GDP using OECD data. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

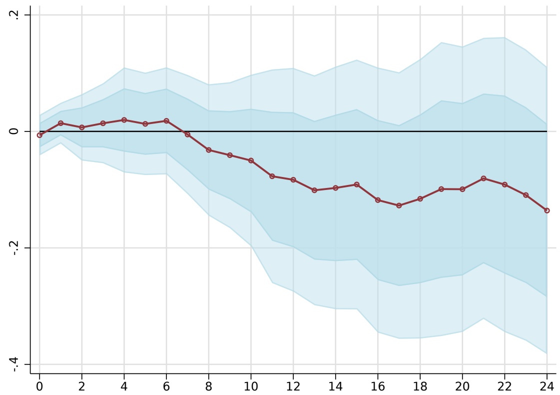


**FIGURE B.9:** *Impact of natural disasters on equity portfolio flows using CPI-deflated US dollars to measure disaster shocks, estimates are based on the HCR-EMEs subsample.The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

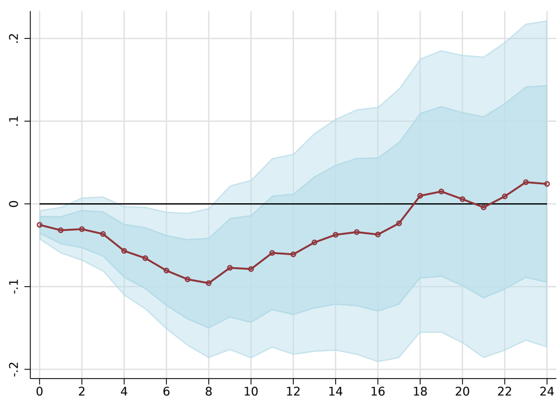


**FIGURE B.10:** *Impact of natural disasters on equity portfolio flows controlling for lagged natural disasters, estimates are based on the HCR-EMEs subsample. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

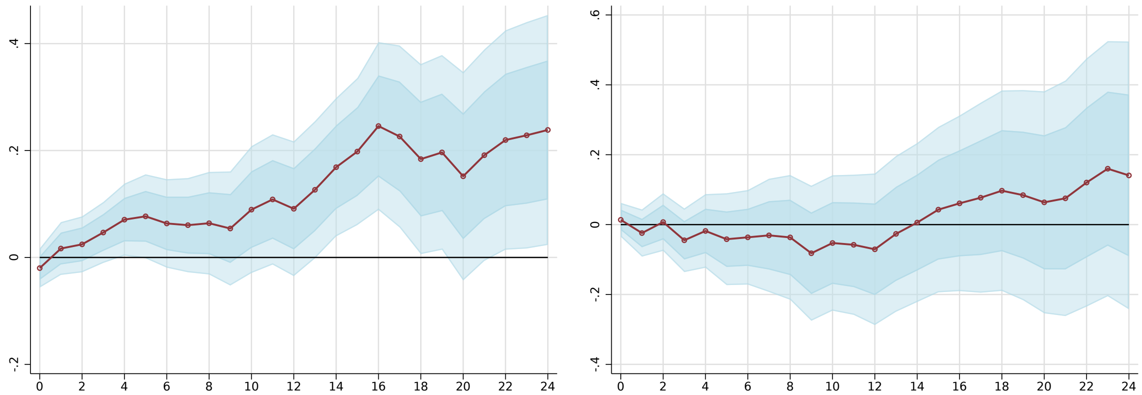


**FIGURE B.11:** *Spillover from high risk-EME to AEs - time series estimation. The left plot displays spillovers from HCR-EMEs to advanced economies with high level of non-life insurance premium to GDP, the right plot reports spillover from HCR-EMEs to JPN, DEU, CHE. The horizon is weekly; coefficients represent p.p., with 68% and 90% confidence bands.*

| VARIABLES | (1)<br>equity flows |
|---|---|
| natural disaster | -31.61* |
| | (17.248) |
| local equity prices | 0.06** |
| | (0.025) |
| exchange rate | -0.26 |
| | (0.237) |
| local equity volatility | 9.56*** |
| | (3.558) |
| IP | -0.07 |
| | (1.768) |
| PMI | -9.24 |
| | (16.984) |
| lagged allocation | 0.00 |
| | (0.003) |
| | |
| Observations | 6,270 |
| Number of groups | 11 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B.1: Regression table. Local projection for h=8

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