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From Brussels to Bangkok: how investment funds transmit financial spillovers

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Abstract

We explore whether investment funds transmit spillovers from local shocks to financial markets in other economies. As a laboratory we consider shocks to financial-market beliefs about the probability of a rare, euro-related disaster and their spillovers to Asian sovereign debt markets. Given their geographic distance from and relatively limited macroeconomic exposure to the euro area, these markets are an ideal testing ground *a priori* stacking the deck against finding evidence for investment funds transmitting spillovers from euro disaster risk shocks. Analyzing proprietary security-level holdings data over the period from 2014 to 2023, we find that investment funds strongly shed Asian sovereign debt in response to euro disaster risk shocks. Markets with greater investment-fund presence exhibit considerably larger price spillovers. The main driver of this sell-off is the need to generate liquidity to meet investor redemption demands rather than portfolio rebalancing. Especially market liquidity determines which sovereign debt investment funds shed. Taken together, our findings suggest that due to a flighty investor base investment funds are powerful transmitters of spillovers from local shocks across global financial markets.

Keywords: Investment funds, spillovers, sovereign debt markets, euro disaster risk shocks.

JEL-Classification: F34, F45, G23.

Non-technical Summary

Investment funds have become important players in global finance, holding significant shares of financial assets worldwide. They typically manage diversified portfolios and tend to follow steady benchmarks over time. This means that when their investors withdraw money, funds often sell off assets broadly across their portfolios, not just those directly affected by the original impulse.

This paper explores whether investment funds thereby contribute to spreading financial shocks from one region in the world to other economies. It explores how spiking concerns about a crisis in the euro area—such as fears about the euro breaking apart—affect the sovereign bond markets in nine East and Southeast Asian economies. These markets are far from Europe and have limited direct economic ties to the euro area, making them an empirically conservative test case to explore if investment funds transmit spillovers from euro area shocks.

Using detailed data on the bonds that investment funds hold from 2014 to 2023, the paper obtains four key results: First, investment funds significantly reduce their holdings of Asian sovereign bonds when the risk of a euro area crisis rises. Second. this reduction is mainly driven by the need to raise cash quickly to meet investors' withdrawal requests, rather than changing the overall investment strategy. Third, funds tend to sell off bonds from larger and hence more liquid markets first. Fourth, Asian bond prices are more sensitive to rising euro crisis risks in markets with greater investment fund participation, which is direct evidence that funds amplify the spillovers from euro area shocks.

These findings highlight the important role of investment funds in linking global financial markets, especially through their response to investor withdrawals during times of stress. Understanding this mechanism is crucial for policymakers aiming to manage and mitigate risks across borders in today's interconnected financial system.

1 Introduction

Two stylized facts raise the question whether investment funds transmit shocks across economies. First, they are important players in global financial markets holding about 15% of world financial sector assets in 2023 (FSB 2024). Second, they typically hold diversified portfolios that follow pre-defined benchmarks with slow-moving weights. This means that when investment funds face outflows, they tend to shed assets across their entire portfolios to satisfy investor redemption demands. Taken together, these two stylized facts imply that investment funds might generate spillovers to economies that are not directly exposed to the shock that causes redemption demands in the first place.

While existing work studies the procyclical behavior of investment funds and how they transmit the global financial cycle to local financing conditions, our understanding of their role for spillovers from local shocks to other regions is limited (e.g., Carney 2019; Eren and Wooldridge 2022). We fill this gap in the literature. As a laboratory we consider the role of investment funds in transmitting spillovers from euro disaster risk shocks to Asian sovereign debt markets. Given their geographic distance from and relatively limited direct macroeconomic exposure to the euro area, these markets are an ideal testing ground *a priori* stacking the deck against finding evidence for investment funds transmitting spillovers from euro disaster risk shocks.

We analyze proprietary security-level investment-fund holdings data for the period from 2014 to 2023 and obtain four key findings. First, investment funds strongly shed Asian sovereign debt in response to euro disaster risk shocks. Second, the main driver of this sell-off is the need to generate liquidity to meet investor redemption demands rather than portfolio rebalancing. Third, Asian sovereign bond prices are considerably more sensitive in markets with greater investment-fund participation. Fourth, investment funds shed Asian sovereign debt particularly on larger and hence more liquid markets. Taken together, our findings suggest that investment funds transmit spillovers to economically distant markets as they generate the liquidity needed to meet redemption demands triggered by local shocks.

In more detail: In the spirit of Barro (2006) and Barro (2009), Wachter (2013), and Barro and Liao (2021), we define a *euro disaster* as (i) a low but unknown probability event that is (ii) related to the institutional integrity of the euro area and that (iii) entails large and long-lasting damage to productivity, output, and consumption (iv) across large parts of the euro area. Just as financial markets in real time, we remain agnostic about the exact scenario such a disaster would entail in terms of euro area dissolution or country exit(s), disorderly debt redenomination and sovereign default. Moreover, we do not constrain the set of exogenous events that trigger a euro disaster; among others, these could include government turnarounds resulting from public backlash due to a loss of political sovereignty associated with euro membership, or non-fundamental, self-fulfilling prophecies about the unsustainability of fiscal debt. Because disasters are rare events by definition, it is challenging to evaluate their probability by frequentist methods. Therefore, potentially updating priors based on historical data, financial markets form beliefs about this *euro disaster risk*. To do so, they exploit signals from a wide range of contexts, in our application especially politics.

Our goal is to estimate the effects of *euro disaster risk shocks*, defined as exogenous innovations to financial-market beliefs about the probability of a euro disaster. As such shocks are not observable to the econometrician, we adopt a proxy-variable approach for identification. Analogous to an instrumental-variable setting, the key assumptions are that (i) the proxy variable moves in response to euro disaster risk shocks (relevance), and (ii) all other empirically relevant macro-financial determinants of the proxy variable are controlled for (exogeneity). We use the change in the spread between the credit default swap (CDS) premia of euro area periphery and core sovereign debt issuers as a proxy variable, while controlling for macro-financial variables in the periphery and the core that may also drive CDS premia.

We provide two pieces of evidence to demonstrate that euro disaster risk rather than other non-controlled macro-financial shocks are the main driver of the change in the periphery-core CDS spread in our sample period—and hence that it is a valid proxy variable for euro disaster risk shocks satisfying the relevance and exogeneity conditions (i) and (ii). First, for the dates with empirically relevant movements in the CDS spread we carry out a narrative analysis of intra-day news reports. The analysis reveals that spikes in the CDS spread coincide with unexpected political events related to elections, resignations, or disagreements between national governments and international institutions—all events that observers at the time deemed would question the integrity of the euro area in its existing form. Second, we show that among existing industry-standard measures of key macro-financial shocks only a broader class of disaster risk but not other shocks, such as monetary policy or geopolitical risk shocks correlate with the change in the CDS spread.

To provide a broader context before focusing on investment-fund responses, we use the periphery-core CDS spread as proxy variable for euro disaster risk shocks in local projections for aggregate macro-financial variables. We find that euro disaster risk shocks tighten especially euro area periphery financial conditions despite no increase in sovereign debt stocks, raise policy uncertainty, induce portfolio debt outflows from the euro area, a loosening in ECB but no change in Federal Reserve monetary policy, and a depreciation of the euro exchange rate.

We then consider the effects on investment-fund holdings of sovereign debt of nine East and Southeast Asian economies, namely China, Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, South Korea, Thailand, and Vietnam. Among many possible choices for spillover recipients we consider this group of economies for three reasons. First, given their geographic distance from and relatively weak macroeconomic exposure to the euro area, we expect small spillovers from euro disaster risk shocks to these economies, *a priori* stacking the deck against finding evidence for a role for investment funds in transmitting spillovers. Second, these sovereign debt markets exhibit rich heterogeneity in terms of size, openness, riskiness, and sophistication, which we can exploit to infer the mechanisms through which investment funds transmit spillovers. Third, due to policies such as the ASEAN+3/Asian Development Bank Asian Bond Markets Initiative, these bond markets are relatively developed compared to those in Latin America, Africa and the Middle East.[1] For brevity, in the following we simply refer to Asian rather than East and Southeast Asian economies.

To estimate the effect of euro disaster risk shocks on investment-fund holdings of Asian sovereign debt we make use of security-level data over the period from 2014 to 2023 obtained from Refinitiv Lipper. We focus on bond and mixed-asset funds, as these account for more than 95% of the sovereign debt holdings in our dataset. The sample consists mostly of mutual funds, but also includes some exchange-traded, insurance and pension funds. The funds we consider are granular investors, in the sense that for a given security they hold very small shares of total debt outstanding. The coverage of our dataset is high, as it accounts for about 50% of the universe of investment-fund holdings of Asian sovereign debt. For example, to estimate the response of fund holdings of Asian sovereign debt we exploit information on about 2,000 funds and about 200,000 observations aggregated to the fund-issuer level.

We first use panel local projections at the fund-issuer level to estimate the effects of euro disaster risk shocks on investment-fund holdings of Asian sovereign debt. We focus on holdings rather than portfolio weights, as our goal is to explore whether funds exert

[1] We do not consider Cambodia, Laos, Myanmar, Brunei, Mongolia or Taiwan, as funds hold virtually no sovereign debt of these economies. We do however consider an extension in which we include holdings of Japanese sovereign debt, which we exclude from our baseline due to its extraordinary role in global sovereign bond markets.

price pressure as they shed assets. In particular, suppose funds shed assets proportionately across their balance sheet. In this case, portfolio weights would be unchanged while at the same time as funds would cause spillovers in terms of downward price pressures. We also estimate more granular specifications at the fund-issuer-currency-maturity level to explore the determinants of heterogeneous fund responses and thereby infer the mechanisms through which they transmit spillovers. Finally, we estimate specifications at the security level to document directly that greater investment-fund presence amplifies spillovers to Asian sovereign debt markets.

Our four key findings are as follows: First, investment funds strongly shed Asian sovereign debt holdings in response to euro disaster risk shocks. The estimated effects appear large as they are of about the same size as the effects on holdings of euro area sovereign debt. Second, funds shed Asian sovereign debt to generate the liquidity needed to meet investor redemption demands rather than to rebalance their portfolios. Third, funds discriminate between Asian sovereign debt both across issuers for given security characteristics and across securities of a given issuer. In particular, funds shed primarily debt in markets that are larger and hence more liquid. This is consistent with evidence in market sell-off episodes, for example in the early stage of the COVID pandemic (Ma et al. 2022; Huang et al. 2025). Moreover, US dollar denominated debt—which accounts only for a relatively small share of outstanding amounts in Asia and in investment-fund holdings—stands out as particularly resilient, even after controlling for observed and unobserved characteristics such as credit risk, residual maturity, and liquidity. Fourth, the effects of euro disaster risk shocks on Asian sovereign bond prices are larger for securities in which funds hold a larger share of outstanding amounts. This finding is robust to controlling for unobserved factors that could induce funds to be more active in markets that exhibit larger spillovers for other reasons.

Overall, our findings are consistent with the mechanism through which investment funds might transmit spillovers across global financial markets we hypothesized above: As funds are reluctant to adjust portfolio weights given their commitment to benchmarks, when investors demand redemptions they shed assets across their entire balance sheet proportionately to portfolio weights regardless of how pervasive the direct effects of the initial shock are. Taken together, our findings suggest that due to a flighty investor base investment funds are powerful transmitters of spillovers from local shocks across global financial markets.

Related literature. We contribute to several strands of the literature. First, our paper is related to work on investment funds in the context of international co-movement and the sensitivity of local markets to global factors. Raddatz and Schmukler (2012) document procyclical investment-fund responses to global and local risk. Chari (2023) and Chari et al. (2022) find that investment funds are particularly sensitive to global risk shocks and thereby accentuate the procyclicality of capital flows especially to emerging market economies (EMEs). Cerutti et al. (2019) show that when EMEs rely more on mutual funds their equity and bond inflows are more sensitive to variation in global push factors. Converse and Mallucci (2023) document that investment funds reduce their holdings of EME issuers when local sovereign default risk rises. Our contribution to this literature is to show that investment funds not only accentuate the transmission of the global financial cycle to local markets, but also the transmission of spillovers from local shocks in one part of the world to financial markets elsewhere. Additionally, our analysis nuances the findings of Elliott et al. (2024) on the role of other non-bank investors in transmitting spillovers, which they find counteract the cross-border effects of US monetary policy tightening through banks.

Second, our paper is related to the literature on the role of inflows and redemptions for investment-fund behavior. Closely related work is Jotikasthira et al. (2012), who show that inflows to funds in developed markets are correlated with changes in their holdings of EME assets and eventually equity prices. Shek et al. (2018) decompose the change in fund holdings into contributions due to investor flows, fund-manager discretionary sales and valuation effects, and show that investor inflows are typically the main driver of changes in fund holdings. Schrimpf et al. (2021) suggest that redemptions are a key factor driving fund sales, while fund liquidity management in terms of cash hoarding conditional on a shock can be important as well. We contribute to this literature by highlighting the key role of investor redemptions and inflows through investment funds in generating spillovers from identified local shocks in one part of the world to financial markets elsewhere.

Third, our paper relates to the literature on the role of bond characteristics for international bond portfolios, as we find that US dollar denominated debt holdings stand out as particularly resilient independently from credit risk, residual maturity, and liquidity. Burger et al. (2018) document a home-currency bias and a special status for US dollar denominated securities in international bond portfolios. Relatedly, Maggiori et al. (2020) document that US dollar bonds are special as they are the only denomination that is not predominantly held by home-currency investors. Bertaut et al. (2023) show that despite the decrease in foreign-currency borrowing, EME vulnerabilities persist due to the duration-risk exposure of foreign investors in local-currency sovereign bond markets. We contribute to this literature by showing that dollar denominated debt shields sovereigns from spillovers from shocks abroad in terms of stabilizing investment-fund responses independently from credit risk, residual maturity, and liquidity. This finding also echoes the literature on the convenience yield of US dollar denominated bonds (Liao 2020; Caramichael et al. 2021).

Finally, our paper is related to the literature on financial-market spillovers from euro crisis shocks. Stracca (2015) studies global financial market effects of the euro debt crisis in 2010-12, while Ioannou et al. (2024) study spillovers from euro area stress shocks on macroeconomic variables in the rest of the world. We expand this strand of the literature showing that spillovers from euro area sovereign bond market stress to the rest of the world is transmitted at least in part through investment funds.

Section 2 presents some stylized facts about Asian sovereign debt markets. In Section 3 we explain how we think of euro disaster risk shocks and how we use a proxy-variable approach for identification. Section 4 introduces the Refinitiv Lipper investment-fund holdings dataset. In Section 5 we estimate the response of investment-fund holdings of Asian sovereign debt to euro disaster risk shocks. Section 6 concludes.

2 Stylized facts

We first provide context by presenting some stylized facts about Asian sovereign debt markets for the economies we study in the rest of the paper. The discussion covers the size of government debt stocks, whether these are held by foreign or domestic investors, the role of local and foreign-currency debt, as well as the relative importance of investment fund and other investor-group holdings. Whenever possible we present central rather than general government debt figures, as this is the focus in our empirical analysis below. In general, general and central government debt figures are similar for the economies we consider.

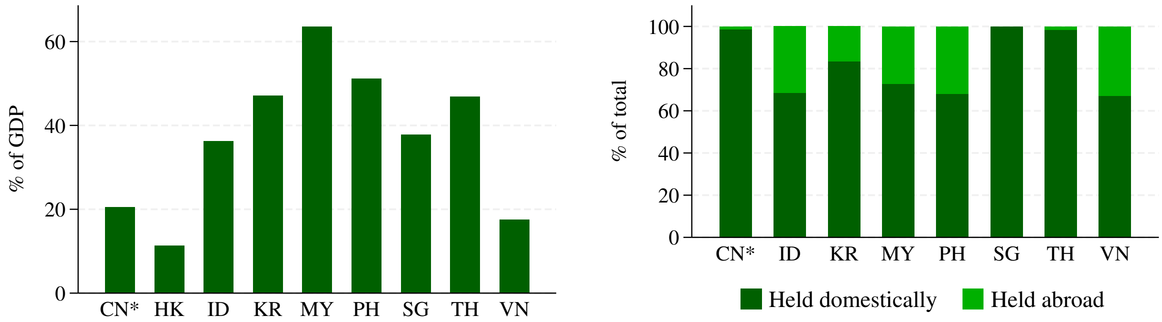
The left-hand side panel in Figure 1 shows that government-debt-to-GDP ratios in 2021 ranged from less than 10% in Hong Kong to almost 60% in Malaysia.[2] Online Appendix Figure B.2 shows that debt stocks have increased continuously since 2014 for almost all economies we study.

The right-hand side panel in Figure 1 shows that government debt is held mainly by domestic investors. In some economies hardly any debt is held by foreign investors, such

[2]The low level of debt in China in Figure 1 might be surprising, but note that Figure 1 shows central government debt. Online Appendix Figure B.1 shows that general government debts stocks are about three times as large.

as in China, Singapore or Thailand. In Indonesia, Malaysia, the Philippines and Vietnam foreign investors hold noticeable shares of outstanding debt, but these are still smaller than the shares held by domestic investors.[3] Online Appendix Figure B.4 shows that government debt held by foreign investors has been falling since 2014, consistent with the goals of local bond market development initiatives.

Figure 1: Government debt stocks and foreign holder share (in 2021)



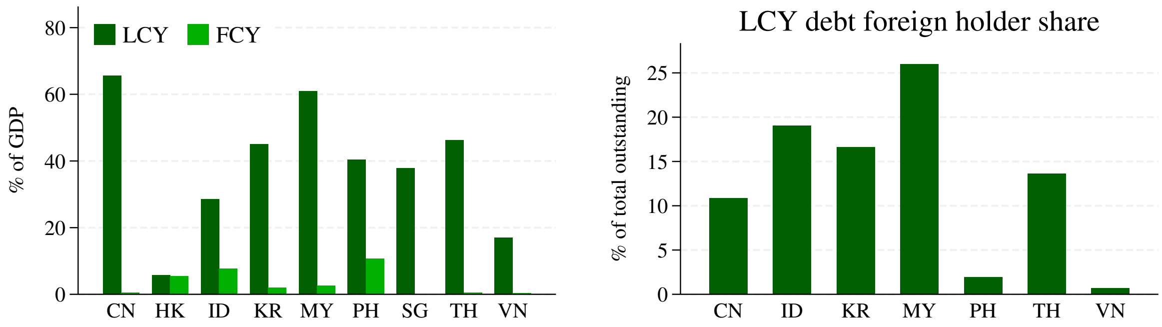
Note: The left-hand side panel shows government debt outstanding as a share of GDP. The data are taken from AsianBondsOnline and represent the sum of local and foreign-currency general government debt. In general, central and general government debt stocks are very similar (see Online Appendix Figure B.1). For China the data represent central government (federal gross) debt taken from China National Bureau of Statistics accessed through Haver, because general government debt from AsianBondsOnline include large debts of local governments (see again Online Appendix Figure B.1). See the note to Online Appendix Figure B.1 for information on central government debt numbers for Singapore. The right-hand side panel shows the holder composition of government debt in terms of domestic and foreign holders. The data on domestic and foreign holdings are taken from national sources accessed through Haver (CN: Ministry of Finance; ID: Bank of Indonesia; MY: Bank Negara Malaysia; PH: Bureau of the Treasury; SG: Monetary Authority of Singapore; TH: Bank of Thailand; VN: Ministry of Finance). For South Korea the data are taken from AsianBondsOnline and represent the domestic/foreign holdings shares of general government debt reported in local currency. See Online Appendix Figure B.3 for a comparison of domestic and foreign debt holdings from AsianBondsOnline and national sources accessed though Haver.

The left-hand side panel in Figure 2 shows that most outstanding debt in 2021 is denominated in local currency (LCY). In fact, several economies have not issued any sovereign debt in foreign currency. Consistent with the right-hand side panel in Figure 1, the right-hand side panel in Figure 2 shows that foreign participation in local-currency sovereign debt markets has been noticeable in several economies, but limited overall. Malaysia and Indonesia stand out with 20-25% of outstanding local-currency sovereign debt held by foreign investors. Online Appendix Figure B.6 shows that local-currency sovereign debt markets have been growing much faster than foreign-currency debt markets since 2014.

The left-hand side panel in Figure 3 shows the evolution of the share of Asian government debt held by euro-area domiciled investment funds over time; we start with

[3]In Thailand and China the foreign holdings share is larger for general than for central government debt (Online Appendix Figure B.3).

Figure 2: Local-currency debt markets (in 2021)



Note: The left-hand side panel shows outstanding amounts of general government debt split by local and foreign-currency denomination. The data are taken from AsianBondsOnline. See Online Appendix Figure B.5 for a comparison to debt stocks from other sources. The right-hand side panel depicts foreign-holder share of LCY general government debt outstanding. The data are taken from AsianBondsOnline.

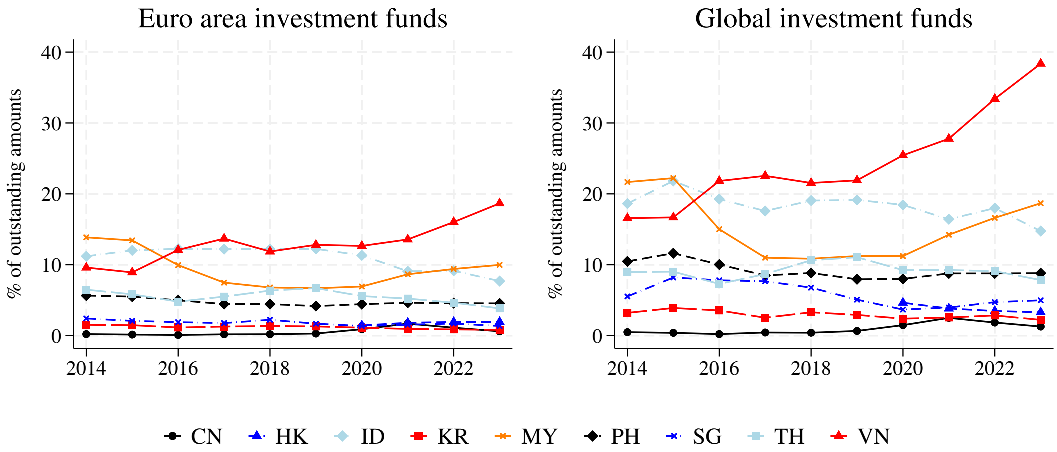
euro-area domiciled investment funds because of better data (see the figure note for details). There is noticeable heterogeneity in investment-fund sector holding shares across Asian sovereign debt. For example, about 10% of Vietnam and Indonesia government debt is held by euro-area domiciled investment funds. In contrast, only less than 5% of South Korea and Hong Kong government debt is held by euro-area domiciled investment funds. Euro-area domiciled investment funds hold noteworthy amounts of China government debt only since 2020.

The right-hand side panel in Figure 3 shows analogous holding shares for investment funds domiciled all over the world. As the industry is concentrated in a few euro area economies, global investment fund holding shares in the right-hand side panel are not much higher than euro-area investment-fund holding shares in the left-hand side panel. Nonetheless, globally, investment funds hold large shares of government debt of several Asian economies, including Vietnam, Indonesia, Malaysia, Thailand and the Philippines (see Eren and Wooldridge 2021, for similar evidence on holding shares).

Finally, Figure 4 shows the shares of foreign holdings of Asian government debt that are accounted for by investment funds. The left-hand side panel shows shares by issuer, and the right-hand side panel shows the average share across issuers and the share in aggregate amounts across issuers, respectively. While there is some heterogeneity across economies, investment funds typically hold more than 50% of total foreign holdings of Asian government debt. In some economies, such as Vietnam, Malaysia and the Philippines, investment funds are by far the largest holder among foreign investors.

To summarize: First, government debt stocks vary across Asian economies, ranging

Figure 3: Investment-fund holdings shares of Asian sovereign debt



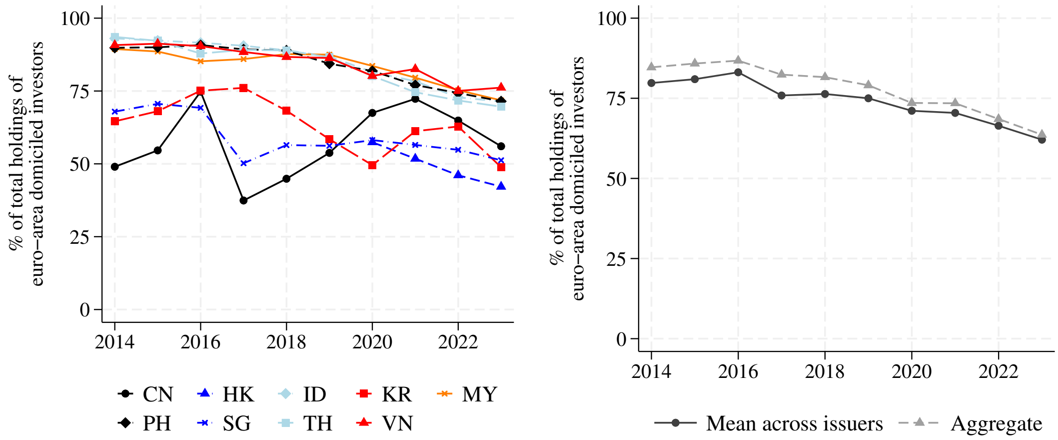
Note: The left-hand side panel shows the evolution of the share of holdings Asian central government debt of euro-area domiciled investment funds in total outstanding amounts. The data are based on information on euro-area domiciled investment-fund holdings from the ECB Securities Holdings Statistics by Sector (SHSS) and the ECB's Centralised Securities Database (CSDB). CSDB provides information on security characteristics such as price, coupon payments, outstanding amounts, or currency for the universe of securities held by some euro-area domiciled investor (investment funds, banks, households, insurance corporations, pension funds, etc). The right-hand side panel shows the analogous statistics for investment funds domiciled all over the world. We obtain this statistic assuming that the share of outstanding amounts of Asian central government debt by non-euro-area domiciled investment funds is the same as that for euro-area domiciled investment funds, that is by scaling up holdings of euro-area domiciled investment funds by the ratio of holdings of euro-area to non-euro area domiciled investment funds in the Refinitiv Lipper sample (see Section 4 for a detailed description). SHSS data for Hong Kong before 2020Q4 and for China between 2016Q2 and 2017Q2 cannot be shown due to confidentiality.

from below 10% to about 60% of GDP, and have been rising over time. Second, the share of government debt held by foreign investors is limited to at most 25%, and it has been falling over time. Third, local-currency denominations account for the bulk of government debt, and some economies even do not issue any foreign-currency debt at all. Local-currency debt markets have been growing over time, while foreign-currency debt markets have stagnated, and foreign participation in local-currency debt markets has been falling, consistent with developments in overall foreign participation. Finally, investment funds hold a non-trivial share of government debt in several Asian economies, and account for the bulk of total foreign holdings.

3 Euro disaster risk shocks

In this section we first explain how we conceive of euro disaster risk shocks and how we identify them with a proxy-variable approach. We present evidence to suggest that our proxy-variable approach successfully identifies euro disaster risk shocks. Finally, we

Figure 4: Euro area investment-fund holdings shares of Asian sovereign debt in total euro area holdings



Note: The left-hand side panel shows holdings of Asian central government debt held by euro-area domiciled investment funds relative to total euro-area domiciled investor holdings of Asian central government debt by issuer. The statistic is calculated using data from ECB Securities Holdings Statistics by Sector (SHSS). Data for Hong Kong before 2020Q4 and for China between 2016Q2 and 2017Q2 cannot be shown due to confidentiality. The right-hand side panel shows the mean of this holder share across issuers (black diamond line) and the holder share calculated based on holdings summed over issuers (gray triangle line).

present estimates for the effects of euro disaster risk shocks on aggregate macro-financial variables to provide context before we zoom in on the effects on investment-fund holdings.

3.1 Euro disaster risk shocks

In the spirit of Barro (2006) and Barro (2009), Wachter (2013), and Barro and Liao (2021), we define a *euro disaster* as (i) a low but unknown probability event that is (ii) related to the institutional integrity of the euro area and that (iii) entails large and long-lasting damage to productivity, output, and consumption (iv) across large parts of the euro area.[4] Just as financial markets in real time, we remain agnostic about the exact scenario such a disaster would entail in terms of euro area dissolution or country exit(s), disorderly debt redenomination and sovereign default. Moreover, we do not constrain the set of exogenous triggers of a euro disaster; among others, these could include government turnarounds resulting from public backlash due a loss of political sovereignty associated with euro membership, or non-fundamental, self-fulfilling prophecies about the unsustainability of

[4]Formally, suppose, say, output evolves according to $y_t = y_{t-1} + g + u_t + \nu_t$, where g is a deterministic growth rate, u_t an *iid* normally distributed shock, and ν_t a disaster that occurs randomly. If a disaster occurs, then $\nu_t = -by_{t-1}$, $0 < b < 1$, and otherwise $\nu_t = 0$.

fiscal debt.

Whether a disaster occurs can be thought of as being governed by a probabilistic process that describes the likelihood for the number of discrete outcomes that materialize in a given interval of time. Because disasters are rare events by definition, it is challenging to estimate the parameters of this process by frequentist methods. Therefore, potentially updating priors based on historical data, financial markets form beliefs about this *euro disaster risk*. To do so, they exploit signals from a wide range of contexts, in our application especially politics. Our goal is to estimate the effects of exogenous innovations to financial-market beliefs about the probability of a euro disaster, i.e. the effects of *euro disaster risk shocks*.

Two points deserve special emphasis. First, it is important to distinguish between a euro disaster, euro disaster risk (the probability of a euro disaster), and a euro disaster risk shock (an exogenous innovation to the beliefs about euro disaster risk). Our focus in this paper is on the latter: *euro disaster risk shocks*. Second, some events that trigger a euro disaster risk shock may be related to fiscal policy. What distinguishes euro disaster risk shocks associated with such events from conventional fiscal policy shocks is that the latter have a much more contained effect on financial-market beliefs about the probability of a euro disaster.[5]

3.2 Identification by proxy-variable approach

Shocks to financial-market beliefs about euro disaster risk are not directly observable to an econometrician. Therefore, we adopt a proxy-variable approach for identification. In particular, we assume that in reduced form euro disaster risk shocks ϕ_t affect some observable variable π_t according to

$$\pi_t = \boldsymbol{\varpi} \boldsymbol{d}_{t-1} + \alpha \phi_t + \boldsymbol{\vartheta} \boldsymbol{\zeta}_t, \tag{1}$$

where $\boldsymbol{d}_{t-1}$ includes the lag of the proxy variable as well as other (lagged) endogenous variables of the economy, and $\boldsymbol{\zeta}_t$ are all other structural shocks in the economy. Equation (1) is a reduced form as the coefficients, e.g. $\boldsymbol{\varpi}$, do not have a structural interpretation, e.g. as price elasticities.

The proxy variable is said to be valid when it allows the econometrician to estimate

[5] Of course, eventually the labeling of the shock is just a more or less instrumentally useful conceptual choice. In that sense, one may view particularly large fiscal policy shocks and fiscal policy shocks with non-linear effects as a subset of euro disaster risk shocks.

consistently the causal effect of a euro disaster risk shock on other variables of interest. To be a valid proxy variable, π_t must satisfy the standard instrumental variable (IV) (i) relevance condition that it is correlated with the euro disaster risk shock ($\alpha \neq 0$) and (ii) exogeneity condition that it is uncorrelated with all other structural shocks in the economy ($\boldsymbol{\vartheta} = 0$).[6] Intuitively, if the relevance ($\alpha \neq 0$) and exogeneity ($\boldsymbol{\vartheta} = 0$) conditions hold, the proxy variable is simply a re-scaled, observed measure of the unobserved euro disaster risk shock. The proxy-variable approach is operationalized by using Equation (1) to substitute out the unobserved euro disaster risk shock ϕ_t in the equation from which impulse responses are estimated, e.g. a local projection (see below).[7]

3.3 CDS spreads as proxy variable

Given the IV relevance condition $\alpha \neq 0$, for a candidate proxy variable we should have good reasons to believe that it is strongly affected by euro disaster risk shocks. A natural candidate thus is a variable that prices outcomes in states of the world in which a euro disaster materializes, such as sovereign default and debt redenomination. Additionally, data for that candidate proxy variable should be readily available over a long sample period and at reasonably high frequency. These requirements point to CDS premia. In particular, we use the monthly change in the spread between the average sovereign CDS premium across euro area periphery and core economies, respectively. For brevity, in the following we refer to this as the 'change in the CDS spread' and denote it by $\Delta(\overline{cds}_t^p - \overline{cds}_t^c)$.

We use data for Italy and Spain (Austria, Germany, France, Netherlands, Belgium, Finland) to calculate the average periphery (core) sovereign CDS premium. We use only Italy and Spain for the periphery as a baseline because most other economies (Greece, Ireland, Portugal, Cyprus) went through a "Troika" program so that their CDS premia might be weak proxy variables due to large measurement error for a significant part of our sample period. The CDS contracts are denominated in US dollar, have a maturity of five years, and pertain to senior debt. We obtain the periphery-core CDS spread as the difference between the (unweighted) averages of euro area periphery and core sovereign

[6]In general, the proxy variable π_t in Equation (1) may also be driven by measurement error. If the share in the variation of π_t due to measurement error is large, it remains a valid but becomes weak proxy variable.

[7]The proxy-variable approach is closely related to the internal IV approach in structural vector-autoregressive (VAR) models. In particular, Plagborg-Møller and Wolf (2021) show that structural impulse responses can be estimated consistently by ordering an IV first in a recursive VAR model. Intuitively, because of the recursive structure, the internal IV approach also involves substituting out the structural shock of interest by the IV in the equations of all other endogenous variables in the VAR model.

CDS premia. The left-hand side panel in Figure 5 shows the evolution of the level of the periphery-core CDS spread, and the right-hand side panel the associated monthly changes; this is our proxy variable for euro disaster risk shocks.

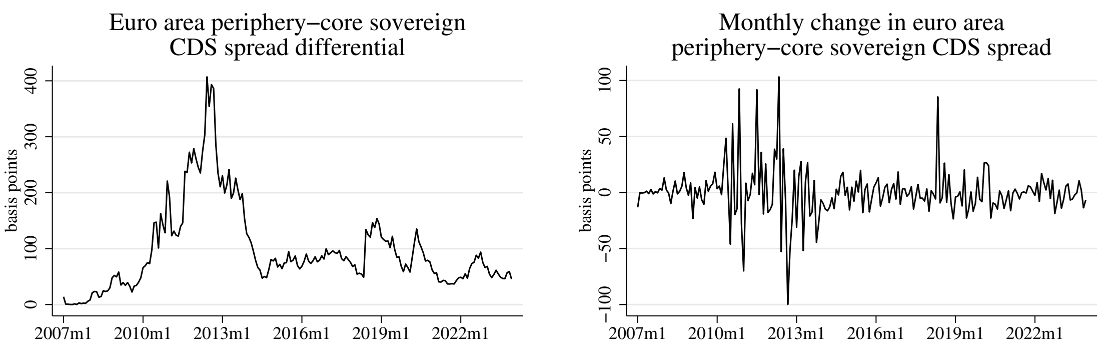
In Online Appendix C.1 we show that under relatively weak assumptions, for the CDS spread as proxy variable the general formulation in Equation (1) boils down to

$$\Delta(\overline{cds}_t^p - \overline{cds}_t^c) = \boldsymbol{\varpi}^\eta \boldsymbol{\eta}_{t-1} + \boldsymbol{\varpi}^w \left(\overline{\boldsymbol{w}}_{t-1}^p - \overline{\boldsymbol{w}}_{t-1}^c\right) + \alpha\phi_t + \boldsymbol{\vartheta}^\eta \tilde{\boldsymbol{u}}_t^\eta + \boldsymbol{\vartheta}^{\boldsymbol{w}} \left(\overline{\boldsymbol{u}}_t^{w,p} - \overline{\boldsymbol{u}}_t^{w,c}\right), \quad (2)$$

where $\overline{\boldsymbol{w}}_{t-1}^p$ and $\overline{\boldsymbol{w}}_{t-1}^c$ are cross-country averages of euro area periphery and core country-specific variables (including the lagged level of the CDS spread), $\boldsymbol{\eta}_{t-1}$ are common (regional or global) variables, $\tilde{\boldsymbol{u}}_t^\eta$ are common macro-financial shocks, and $\overline{\boldsymbol{u}}_t^{w,p}$ and $\overline{\boldsymbol{u}}_t^{w,c}$ are cross-country averages of periphery and core country-specific macro-financial shocks, respectively. This means that compared to the general formulation of the proxy-variable Equation (1), the other (lagged) endogenous variables in the economy that drive the CDS spread are $\boldsymbol{d}_{t-1} \equiv (\boldsymbol{\eta}_{t-1}', \overline{\boldsymbol{w}}_{t-1}^{p\prime} - \overline{\boldsymbol{w}}_{t-1}^{c\prime})'$, and the other structural shocks that drive the CDS spread are $\boldsymbol{\zeta}_t \equiv (\tilde{\boldsymbol{u}}_t^{\eta\prime}, \overline{\boldsymbol{u}}_t^{w,p\prime} - \overline{\boldsymbol{u}}_t^{w,c\prime})'$.

The common macro-financial shocks $\tilde{\boldsymbol{u}}_t^\eta$ may for example include euro area monetary policy shocks or global risk shocks. The cross-country averages of periphery and core country-specific macro-financial shocks $\overline{\boldsymbol{u}}_t^{w,j}$, $j \in \{p, c\}$ may for example include averages of country-specific sovereign CDS market liquidity shocks or country-level aggregate demand and sovereign debt supply shocks. Note that $\overline{\boldsymbol{u}}_t^{w,j}$, $j \in \{p, c\}$ pertains to cross-country *averages* of country-specific shocks, which vanish by definition as the number of euro area economies N_i grows.

Figure 5: Euro area periphery-core sovereign CDS spread dynamics



Note: The left-hand side panel shows the evolution of the periphery-core sovereign CDS spread and the right-hand side panel the corresponding first difference over time.

Three points on proxy-variable choice in general and the CDS spread specifically deserve special emphasis. First, the periphery-core CDS spread is not the only plausible proxy-variable choice. Equation (1) makes clear that any variable for which the relevance condition $\alpha \neq 0$ and the exogeneity condition $\boldsymbol{\vartheta} = \mathbf{0}$ hold qualifies as a proxy variable. In our empirical analysis below we explore several alternatives, including the average CDS premium across both core and periphery economies, only across periphery economies instead of the periphery-core spread, using different economies to calculate the spread, using only (dummies for) the dates with the largest spikes of the CDS spread, and the change in the periphery-core sovereign bond yield spread.

Second, Equation (2) shows that for proxy validity it is not required that the CDS spread is unconditionally driven only by euro disaster risk shocks. In particular, the exogeneity condition is required to hold only conditional on $\overline{\boldsymbol{w}}^{p}_{t-1} - \overline{\boldsymbol{w}}^{c}_{t-1}$ and $\boldsymbol{\eta}_{t-1}$. These variables may account especially for more slow-moving determinants of CDS premia, such as variation in fiscal debt at the business-cycle frequency.

Third, Equation (2) is silent about the mechanism through which euro disaster risk shocks affect the CDS spread. Specifically, the validity of the CDS spread as proxy variable in terms of satisfying the (i) relevance and (ii) exogeneity conditions in Equation (2) is not compromised if euro disaster risk shocks work through reducing sovereign bond demand, thereby raising yields and hence—mechanically—CDS premia. Relatedly, it is not a problem that below we regress quantities (investment-fund sovereign debt holdings) on prices (the CDS spread) as long as the exogeneity condition (ii) in Equation (2) holds and thereby rules out that structural shocks other than euro disaster risk shocks drive the CDS spread. In particular, while it may be that investment-fund trading in response to euro disaster risk shocks contributes to the change in the CDS spread, even then the initial exogenous impulse for the change in the CDS spread is the euro disaster risk shock. This is what matters for identification of the causal effects of euro disaster risk shock through the proxy-variable approach.

We provide some evidence next to demonstrate that the CDS spread is a valid proxy variable for euro disaster risks shocks as it satisfies the relevance condition $\alpha \neq 0$ and the exogeneity condition $\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$ and $\boldsymbol{\vartheta}^{w} = \mathbf{0}$ in Equation (2).

3.4 Is the change in the CDS spread a valid proxy variable?

As we do not observe the euro disaster risk shocks ϕ_t and the common and cross-country averages of country-specific macro-financial shocks $\widetilde{\boldsymbol{u}}^{\eta}_{t}$ and $\overline{\boldsymbol{u}}^{w,j}_{t}$, $j \in \{p, c\}$, we cannot directly test if our proxy variable satisfies the relevance condition $\alpha \neq 0$ and the exogeneity condition $\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$ and $\boldsymbol{\vartheta}^{w} = \mathbf{0}$ in Equation (2). Instead, we present two pieces of evidence to suggest that the change in the CDS spread in our sample period satisfies the relevance and exogeneity conditions. We provide the main threads here and relegate details to Online Appendix C.2.

First, in Online Appendix C.2.1 we show that for the few empirically relevant CDS spread changes the drivers are clearly related to euro disaster risk ($\alpha \neq 0$) but not to other common macro-financial shocks ($\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$) or averages of country-specific shocks $\overline{\boldsymbol{u}}_t^{w,j}$, $j \in \{p, c\}$ ($\boldsymbol{\vartheta}^{w} = \mathbf{0}$). Specifically, Figure 6 provides the most frequent terms mentioned in intra-daily real-time news on the days with the ten largest spikes in the CDS spread. The distribution of the most frequent terms suggests that the main theme on these days was euro disaster risk ($\alpha \neq 0$). Also a more detailed narrative analysis of these intra-daily real-time news confirms that the spikes in the CDS spread are all related to unexpected and exogenous political events such as election outcomes, leader resignations, disagreements between national governments and international institutions, and the design of new regulatory/supervisory bodies and practices (see Online Appendix Tables C.1 and C.2).[8] Notably, none of these events is related to country-specific sovereign debt supply or common macro-financial shocks other than euro disaster risk shocks ($\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$ and $\boldsymbol{\vartheta}^{w} = \mathbf{0}$).

Second, in Online Appendix C.2.2 we show that when evaluated over the full sample period beyond the few large spikes, the change in the CDS spread is correlated with industry-standard measures of disaster risk shocks ($\alpha \neq 0$) that are broader in nature, more sophisticated in their construction, but available only for shorter sample periods. For example, Corradin and Schwaab (2023) estimate an unobserved components model to decompose euro area sovereign bond yields into (i) expected future short-term risk-free rates and a term premium, (ii) a default risk premium, (iii) a redenomination risk premium, (iv) a liquidity risk premium, and (v) a segmentation (convenience) premium. The bottom panel in Online Appendix Figure C.3 shows that when we take the sum of default and redenomination risk premia and then the difference between their averages across Italy and Spain as well as across Germany and France, respectively, this correlates

[8]The events listed in Online Appendix Tables C.1 and C.2 usually have a country-specific origin. which again raises the fundamental question what delineates a country-specific from a common—e.g. euro disaster risk—shock. As mentioned before, in our empirical framework at the monthly frequency we take any shock that has a geographic origin in a specific economy but that has systemic effects across euro area financial markets within the same month as a common shock. Online Appendix Figure C.2 suggests that the euro disaster risk shock events—including those listed in Online Appendix Tables C.1 and C.2—do have such systemic and immediate effects across periphery financial markets even if they have a geographic origin in a specific economy.

Figure 6: Most frequent words in intra-daily real-time news reports on the days with the largest spikes in the CDS spread

Note: The figure shows the 150 most frequent terms in real-time news on the days with the largest changes in the CDS spread discussed in Table C.1. The frequency of words is calculated using the Term-Document Matrix (TDM). TDM rows represent terms (words) and columns documents. The frequency of each word is calculated by summing the values in each row. The words are selected and plotted in different sizes based on their frequency. Words are excluded based on a list of common stopwords and additional specified terms, such as articles, conjunctions, prepositions, and other unimportant words like "and," "the," "or," month and day names, common verbs and words repeated in the Real-time News disclaimers.

strongly with the periphery-core CDS spread, especially at the largest spikes. This suggests that the empirically relevant changes in the periphery-core CDS spread primarily reflect changes in redenomination and default risk. At the same time, in Online Appendix C.2 we show that the change in the CDS spread is not correlated with industry-standard measures of other common macro-financial shocks, such as US and euro area monetary policy shocks, geopolitical risk shocks or oil supply shocks ($\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$).

3.5 Aggregate macro-financial effects

We next present estimates of the effects of euro disaster risk shocks on aggregate macro-financial variables. We do so to provide a broader context for our analysis of investment funds below. We explore aggregate macro-financial effects on the euro area, global financial markets, and Asian economies.

We start with the effects on euro area economies, for which we distinguish between the core and the periphery. Following Jorda (2005), we estimate panel local projections

$$y_{i,t+\ell} = \gamma_i^{(\ell)} + \boldsymbol{\rho}^{(\ell)}\boldsymbol{x}_{i,t-1} + \boldsymbol{\beta}^{(\ell)}\boldsymbol{\eta}_{t-1} + \left[\lambda_0^{(\ell)} + \lambda_1^{(\ell)}\mathbb{1}(i \in \mathcal{C})\right]\phi_t + q_{it}^{(\ell)}, \tag{3}$$

where $y_{i,t+\ell}$ is an outcome variable of interest for economy i at horizon ℓ, $\boldsymbol{x}_{i,t-1}$ are economy-specific variables including $y_{i,t-1}$, $\mathbb{1}(i \in \mathcal{C})$ is an indicator variable that returns unity if economy i is a euro area core economy, and $q_{it}^{(\ell)}$ is a residual that includes all other period-t and future structural shocks up to horizon ℓ. Using Equation (2) to substitute the unobserved euro disaster risk shock in Equation (3) under the proxy-variable approach we get

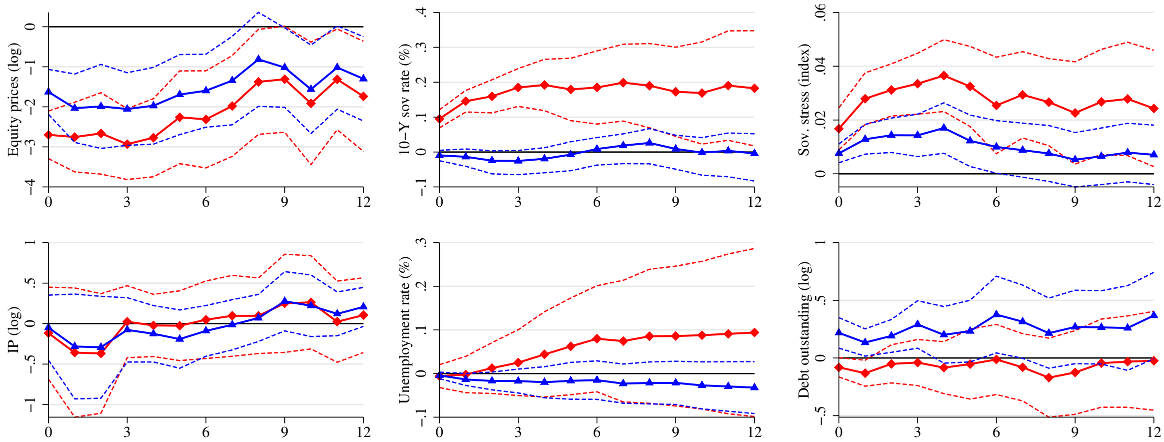
$$y_{i,t+\ell} = \gamma_i^{(\ell)} + \boldsymbol{x}_{i,t-1}\boldsymbol{\beta}^{(\ell)} + \boldsymbol{d}_{t-1}\boldsymbol{\mu}^{(\ell)} + \left[\widetilde{\lambda}_0^{(\ell)} + \widetilde{\lambda}_1^{(\ell)}\mathbb{1}(i \in \mathcal{C})\right]\Delta(\overline{cds}_t^p - \overline{cds}_t^c) + \nu_{it}^{(\ell)}, \tag{4}$$

where $\boldsymbol{d}_{t-1} \equiv (\boldsymbol{\eta}'_{t-1}, \overline{\boldsymbol{w}}_{t-1}^{p\prime} - \overline{\boldsymbol{w}}_{t-1}^{c\prime})'$, $\widetilde{\lambda}_0^{(\ell)} \equiv \lambda_0^{(\ell)}/\alpha$, $\widetilde{\lambda}_1^{(\ell)} \equiv \lambda_1^{(\ell)}/\alpha$, and the residual $\nu_{it}^{(\ell)}$ is a function of all other structural shocks including $\boldsymbol{\vartheta}^{\eta}\widetilde{\boldsymbol{u}}_t^{\eta}$ and $\boldsymbol{\vartheta}^{w}(\overline{\boldsymbol{u}}_t^{w,p} - \overline{\boldsymbol{u}}_t^{w,c})$ from the proxy-variable Equation (2); however, recall that we argue that the exogeneity condition (ii) holds so that $\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$ and $\boldsymbol{\vartheta}^{w} = \mathbf{0}$.

For the estimation of Equation (4) we include in $\boldsymbol{x}_{i,t-1}$ the lagged dependent variable $y_{i,t-1}$ as well as lags of the logarithms of economy i industrial production and the one-year German Bund rate. The purpose of these controls is to improve fit and hence the precision of the estimates of $\widetilde{\lambda}_j^{(\ell)}$, $j = 0, 1$, not to ensure consistent estimation. In $\boldsymbol{d}_{t-1}$ we include the lagged level of the CDS spread as well as lags of the periphery-core spreads between year-on-year industrial production growth rates and the logarithms of the stocks of central government debt outstanding. To maximize the number of observations and the precision of the estimates, given that this is aggregate economy-level data only we consider a long sample period from 2007m1 to 2024m6.

Figure 7 presents the results for macro-financial variables of core (blue) and periphery (red) economies. Equity prices drop in core and even more so in periphery economies. Sovereign bond yields rise for periphery but fall somewhat for core economies. Volatility in sovereign bond markets as measured by the sovereign Composite Index of Systemic Stress (CISS; Garcia-de-Andoain and Kremer 2017) rises in core and even more in periphery economies. Real activity and unemployment contract somewhat in periphery economies, but the estimates are not statistically significant; recall that we estimate the effects of euro disaster risk shocks and not of an actual euro disaster. The stock of outstanding sovereign debt in periphery economies does not increase.

Figure 7: Effects of euro disaster risk shocks on macro-financial variables in euro area core (blue triangle) and periphery (red diamond) economies



Note: The figure shows the effects of a euro disaster risk shock at the monthly frequency. The effects are estimated from the economy-level panel local projections in Equation (4). The impulse responses should be interpreted relative to that of some reference variable (Plagborg-Møller and Wolf 2021). For example, the impulse responses show the effect of a euro disaster risk shock that raises the periphery-core sovereign bond yield spread by 10 basis points on impact, which happens to be about one standard deviation of this variable in the data. Solid blue lines with triangles depict the point estimate of the effects on core economies, while solid red lines with diamonds the point estimate of the effects on periphery economies. Core economies include Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, and the Netherlands, and periphery economies include Cyprus, Greece, Ireland, Italy, Latvia, Lithuania, Malta, Portugal, Slovenia, Slovakia, Spain. We weight observations by a economy's average nominal GDP over the sample period. The dashed lines represent 90% confidence bands based on Driscoll-Kraay standard errors robust to heteroskedasticity, autocorrelation and cross-sectional dependence.

Next we explore macro-financial effects on regional and global variables. Figure 8 presents results for impulse responses estimated from time-series local projections

$$y_{t+\ell} = \gamma^{(\ell))} + \boldsymbol{x}_{t-1}\boldsymbol{\beta}^{(\ell)} + \boldsymbol{d}_{t-1}\boldsymbol{\mu}^{(\ell))} + \widetilde{\lambda}^{(\ell)}\Delta(\overline{cds}_t^p - \overline{cds}_t^c) + \nu_t^{(\ell)}, \tag{5}$$

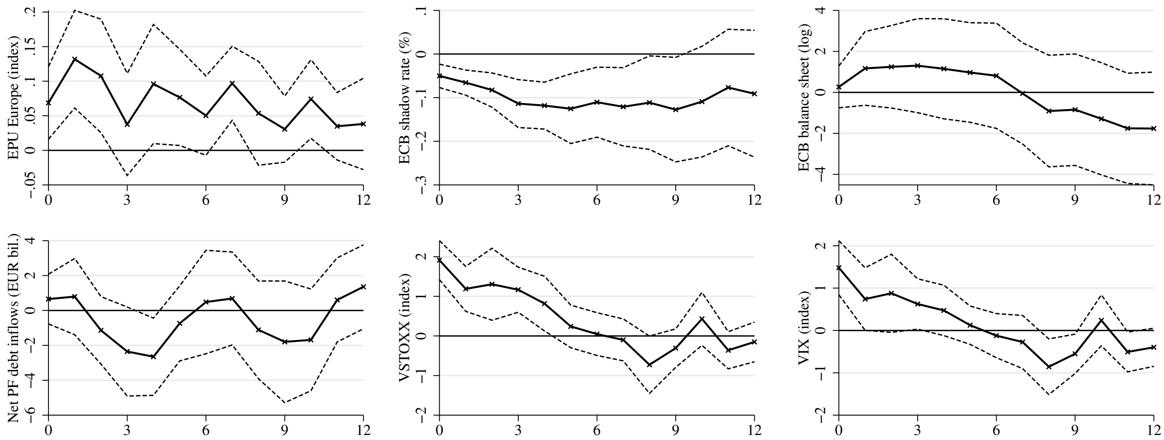
with controls analogous to those in Equation (4). ECB monetary policy eases as measured by the shadow rate of Wu and Xia (2016) and the size of the ECB balance sheet (measured by covered bonds and debt securities held for monetary policy purposes) rises.[9] Economic Policy Uncertainty (EPU) and financial-market volatility (VSTOXX/VIX) increase more strongly and persistently in the euro area than in the US. Online Appendix Figure B.7 shows further that the euro depreciates against the dollar and that there is no systematic change in US monetary policy.

Finally, we explore macro-financial effects on Asia and Hong Kong specifically based on

$$y_{i,t+\ell} = \gamma_i^{(\ell)} + \boldsymbol{x}_{i,t-1}\boldsymbol{\beta}^{(\ell)} + \boldsymbol{d}_{t-1}\boldsymbol{\mu}^{(\ell)} + \widetilde{\lambda}^{(\ell)}\Delta(\overline{cds}_t^p - \overline{cds}_t^c) + \nu_{it}^{(\ell)}, \tag{6}$$

[9]ECB core and periphery sovereign bond holdings are not available separately due to confidentiality.

Figure 8: Effects of euro disaster risk shocks on regional and global macro-financial variables



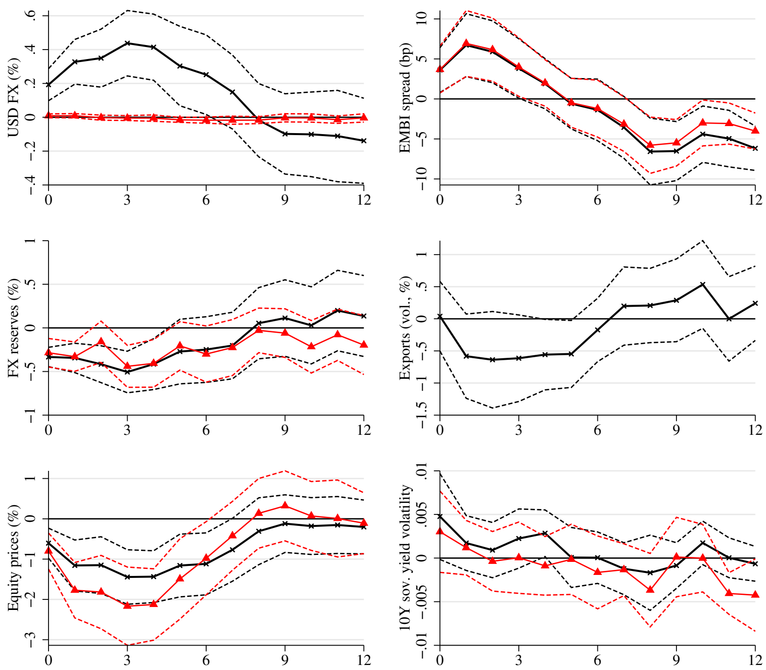
Note: The black dashed lines represent 90% confidence bands based on Newey-West standard errors robust to serial correlation. See also the note to Figure 7.

where in $\boldsymbol{x}_{i,t-1}$ we include the lagged dependent variable $y_{i,t-1}$ as well as lags of the US excess bond premium of Favara et al. (2016), the one-year US Treasury rate, and the logarithms of economy i industrial production and the bilateral nominal exchange rate against the US dollar.

We find that euro disaster risk shocks spill over to Asian financial markets and even the real economy. In particular, Figure 9 presents the impulse responses for macro-financial variables of Asian economies (black crossed lines) from panel local projections in Equation (6) and of Hong Kong (red triangle lines) from time-series local projections analogous to Equation (5). We estimate that euro disaster risk shocks generally depreciate Asian currencies against the US dollar and deplete foreign exchange reserves. Being pegged to the US dollar, the Hong Kong dollar exchange rate does not move. Equity prices drop, sovereign bond spreads over US Treasury yields rise (EMBI), sovereign bond market volatility rises, and portfolio debt inflows drop. Exports and industrial production generally fall, although not in Hong Kong. Monetary policy loosens somewhat, but this is imprecisely estimated.

We next describe the data that we use to estimate the response of investment-fund holdings of Asian sovereign debt to euro disaster risk shocks.

Figure 9: Effects of euro disaster risk shocks on macro-financial variables in Asian economies (black crossed) and Hong Kong (red diamond)



Note: The figure shows the estimated effects of a euro disaster risk shock on macroeconomic and financial variables at the monthly frequency. The effects are estimated from the economy-level panel local projections in Equation (4). The impulse responses have to be interpreted relative to that of some reference variable (Plagborg-Møller and Wolf 2021). For example, the impulse responses show the effect of a euro disaster risk shock that raises the periphery-core sovereign bond yield spread by 10 basis points on impact, which happens to be about one standard deviation of this variable in the data. The corresponding dashed lines represent 90% confidence bands based on Driscoll-Kraay standard errors robust to heteroskedasticity, autocorrelation and cross-sectional dependence.

4 Asian sovereign bond holdings data

4.1 Data sources

We exploit a security-level dataset on investment-fund holdings of Asian sovereign debt from Refinitiv Lipper (RL). RL provides information on holdings at the investment fund $\times$ security $\times$ time level. This sample covers funds domiciled all over the world and is available to us at the monthly frequency. RL is a proprietary dataset compiled based on information collected from fund-management companies, regulators, and third-party sources. In addition to holdings, RL also provides information on time-varying fund variables—such as net flows (inflows less outflows) and assets under management—as well as on time-invariant fund characteristics—such as the asset universe (mutual fund, exchange-traded fund, pension fund, or hedge fund), domicile, investment asset class (e.g. bonds, equity, or mixed assets), and geographical focus (e.g. Global, Asia, individual economies).[10] RL is rather comprehensive in terms of the coverage of investment-fund holdings, at least towards the end of our sample period. For example, for euro-area domiciled investment funds for which we can calculate RL coverage using the ECB Securities Holdings Statistics by Sector (SHSS), Figure 10 shows that RL covers on average more than 50% of the universe of investment-fund holdings.[11]

We work with securities at the International Securities Identification Number (ISIN) level. We focus on holdings in terms of nominal (face) values to account for mechanical valuation effects due to price and exchange-rate changes. We obtain nominal values by dividing market values by the corresponding prices. We take prices from the ECB's Centralised Securities Database (CSDB), Eikon and Bloomberg, in this order of availability.

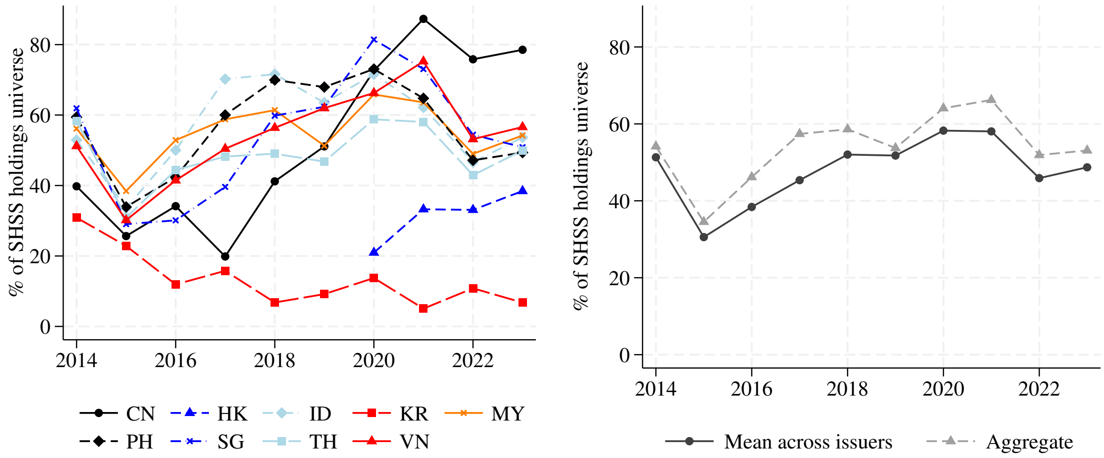
Note that RL only provides information on *direct* holdings of Asian government debt. For example, RL does not provide information on the investor universe of the shares in the funds in the sample, including fund-of-fund holdings.[12]

[10] For more information on RL see `https://www.lseg.com/en/data-analytics/financial-data/fund-data/lipper-fund-data`.

[11] EPFR Global and Morningstar also provide fund-level information with similar granularity as RL. While Morningstar and RL are broadly similar, an advantage of RL relative to EPFR Global is greater fund coverage.

[12] For an analysis that 'looks through' such indirect holdings to determine ultimate ownership, see Beck et al. (2024). For an analysis of the role of within-fund-sector interconnectedness through fund-of-fund shares, see Allaire et al. (2023).

Figure 10: Coverage of RL fund holdings of Asian government debt



Note: The figure shows the coverage of fund holdings of Asian sovereign debt in the RL sample by issuer (left-hand side) and based on aggregated holdings (right-hand side). We calculate the coverage summing Asian sovereign debt holdings across all euro-area domiciled investment funds in RL and then divide by the sum of all euro-area investment fund holdings of Asian sovereign debt in the ECB SHSS. Data for Hong Kong before 2020Q4 and for China between 2016Q2 and 2017Q2 cannot be shown due to confidentiality.

4.2 Sample definitions and stylized facts

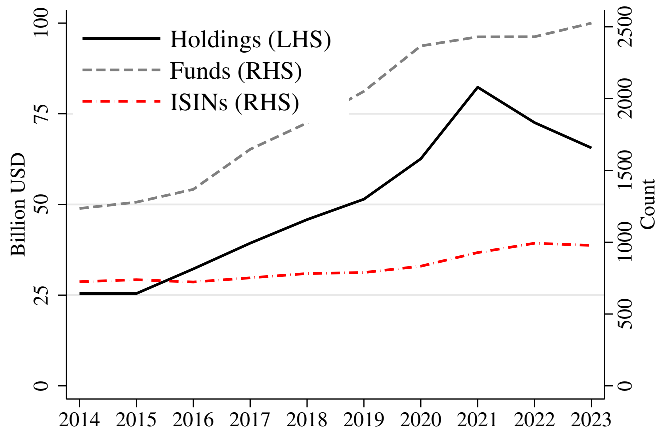
We start with about 750mn investment fund × security × time observations in the RL dataset available to us. We then keep only (i) central government debt[13] held by (ii) mutual, exchange-traded, pension and insurance funds, (iii) labeled as bond or mixed-asset funds with (iv) a geographic focus on individual Asian economies, Asia, or the world, and (v) for which domicile does not coincide with geographical focus. The rationale for this selection is that we want to study actively managed and investable funds with an international investor base for which holdings of Asian sovereign bonds are not trivial by design. Imposing these selection criteria and focusing on the nine Asian economies for the time period from 2014 onward narrows down the RL sample to around 2.6 million observations at the fund × security × time level. Aggregating holdings over ISINs for a given issuer yields a regression sample of about 0.2 million observations at the fund × issuer × time level for about 2,000 funds.

Figure 11 presents the coverage in terms of aggregated investment-fund holdings of Asian sovereign debt together with corresponding ISIN and fund counts. Two observations stand out. Nominal holdings, fund and ISIN counts increase over time. This is

[13]We classify central government debt holdings based on the RL holding type, country codes in ISINs and name searches. We cross-check our classification based on ISIN and issuer information in RL with the corresponding information from CSDB.

because of a survivorship bias. In particular, in the RL subscription available to us, a dataset retrieved in period t does not include funds that were liquidated or merged more than 40 days before period t. Such a survivorship bias is common in many widely-used micro-level datasets, such as the Orbis or Amadeus datasets on cross-economy firm-level records (Kalemli-Ozcan et al. 2015).

Figure 11: RL funds, number of ISINs and holdings



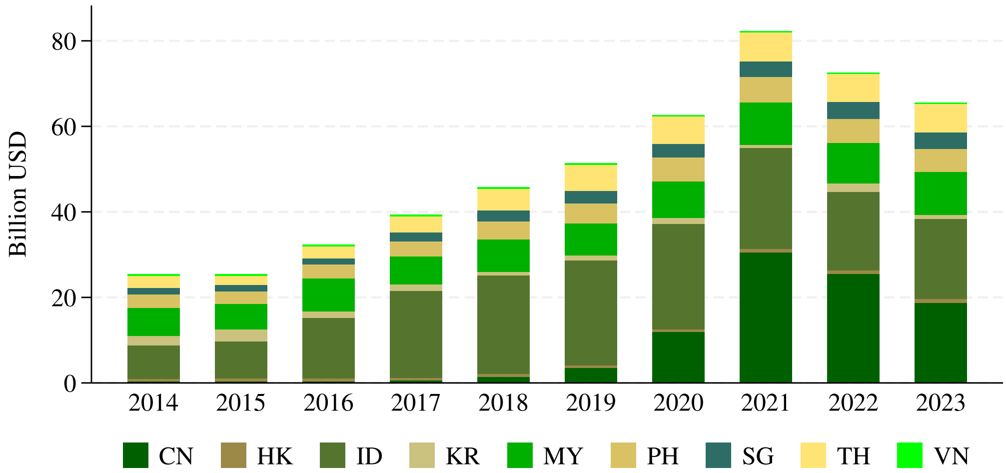
Note: The figure shows the evolution of the number of unique funds, unique ISINs and total holdings across funds, ISINs and issuers in the RL dataset over time. We consider only (i) holdings of Asian central government debt by (ii) mutual funds (iii) labeled as bond or mixed-asset funds with (iv) geographical focus Global or Asia.

Figure 12 presents total fund holdings by issuer in the RL dataset. Consistent with the relative economic size of the issuers we consider, most fund holdings are accounted for by sovereign debt of China, Indonesia, Malaysia, the Philippines and Thailand. Online Appendix Figure B.8 shows that fund holdings of Japan sovereign debt are about as large as holdings of all other Asian economies in our sample. Given this extraordinary role of Japanese sovereign debt, we do not consider it in our baseline; however, below we report results from a robustness check in which we include fund holdings of Japan sovereign debt.

The left-hand side panel in Figure 13 shows that the median portfolio weight of Asian sovereign debt across issuers and funds is around 1%. The right-hand side panel in Figure 13 shows that the majority of the funds hold Asian central government debt of more than one issuer.

Figure 14 shows the breakdown of fund holdings and fund counts for fund domicile, geographic focus, asset type, and asset universe in 2021. The first column shows that around two thirds of the Asian sovereign debt is held by funds domiciled in the EU and

Figure 12: RL fund holdings of Asian government debt



Note: The figure shows the evolution of Asian central government debt holdings by investment funds in the our sample over time and by issuer. From the RL dataset, we focus on mutual funds that are labeled as bond or mixed-asset funds and have as geographical focus Global or Asia.

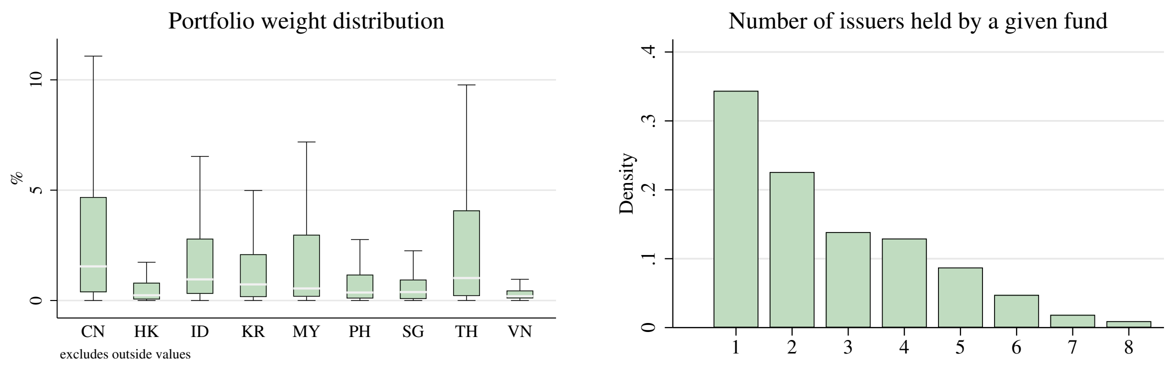
neighboring financial centers, consistent with the industry's concentration in Europe. About one third is held by funds domiciled in the US and, to a much lesser extent, in Singapore and Hong Kong. The number of funds domiciled in other jurisdictions as well as their amounts held are small. It should be emphasized that the fact that most funds are domiciled in Europe does not artifactually inflate estimates of spillovers from euro area shocks to Asia for two reasons. First, while the global investment-fund industry is concentrated in Europe, the underlying investor base is not (Beck et al. 2024). Second, we document below that fund responses to euro disaster risk shocks do not differ meaningfully across fund domiciles.

The second column shows that most Asian sovereign debt holdings are with funds with a global focus. The remaining amounts are mostly held by funds with a focus on Asia or China. In terms of fund counts, an even greater share of the sample is accounted for by funds with a global focus.

The third column shows that almost all Asian sovereign debt holdings are with bond funds, while very little is with mixed-asset funds. In terms of fund counts, holdings are mostly with bond rather than mixed-asset funds, although the difference is less pronounced.

Finally, the last column shows that our sample mostly consists of mutual funds, contains a noteworthy share of exchange-traded funds (ETFs), and only very few insurance and pension funds.

Figure 13: RL fund holdings characteristics in 2021



Note: The left-hand side panel depicts box plots of funds' Asian central government debt portfolio weight distribution in 2021 by issuer. The upper and lower ends of the dark boxes represent the 25% and 75% percentiles, and whiskers the adjacent values (i.e. the upper whisker includes all data points within 1.5 times the inter-quartile range of the upper quartile and stops at the largest such value); outside values above and below the adjacent values are not plotted. The right-hand side panel shows a histogram for the number of Asian sovereign issuers of which funds hold debt in 2021.

Online Appendix Figure B.9 presents the distribution of individual funds' holding shares for a given issuer's outstanding debt. Generally, the holdings of the funds in our sample are very granular compared to outstanding amounts.

Overall, our sample includes funds with relatively broad mandates, such as global bonds and equities as well as specialized funds focusing on specific segments of Asian sovereign bond markets. We next turn to the effects of euro disaster risk shocks on investment-fund holdings of Asian sovereign debt.

5 Spillovers through investment funds

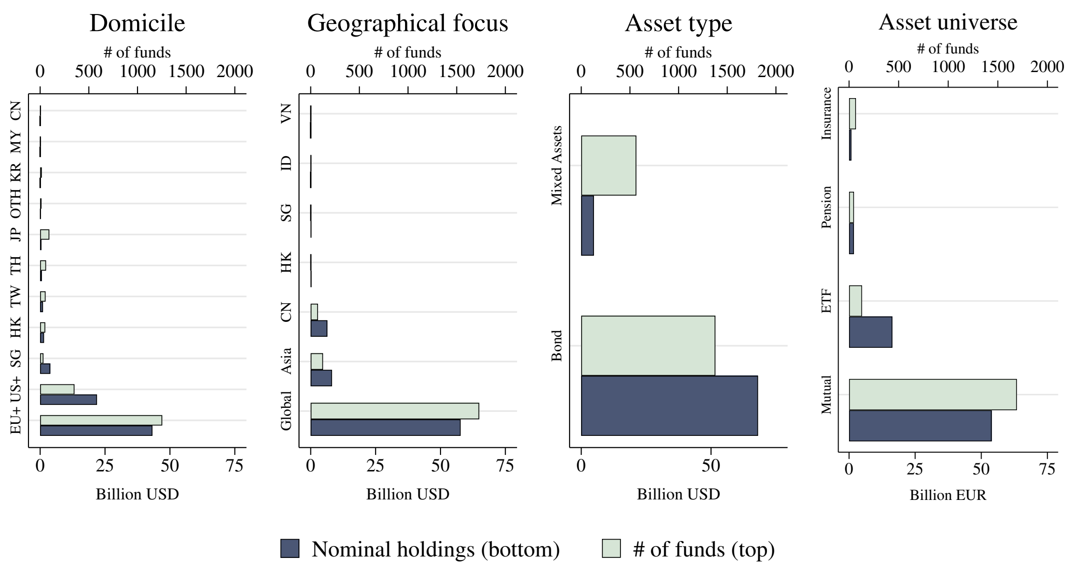
5.1 Estimation strategy

We again use the proxy-variable Equation (2) to substitute out the unobserved euro disaster risk shock by the periphery-core CDS spread and consider as starting point

$$h_{fit} = \gamma_{fi} + \rho_h h_{fi,t-1} + \boldsymbol{\beta x}_{f,t-1} + \boldsymbol{\delta w}_{i,t-1} + \boldsymbol{\kappa \eta}_{t-1} + \boldsymbol{\mu d}_{t-1} + \psi \Delta(\overline{cds}_t^p - \overline{cds}_t^c) + \nu_{fit}. \tag{7}$$

Notice two observations. First, using a proxy-variable approach means that we have to interpret the estimated effect on a variable of interest relative to that on some reference variable (Plagborg-Møller and Wolf 2021). For example, recall that we estimate that a euro disaster risk shock raises the periphery-core sovereign bond yield spread by 10 basis

Figure 14: Distribution across fund characteristics in the RL sample in 2021



Note: The panels show the distribution of total nominal holdings and the number of funds in the RL sample across different fund characteristics. The first panel shows the distribution across fund domicile, the second panel across fund geographical focus, the third panel across fund asset type, and the fourth across asset universes. EU+ includes EU economies and Norway, the UK, and Switzerland, and US+ stands for the US and Canada. The bottom horizontal axis depicts the magnitude of total nominal holdings in USD billion, and the top horizontal axis the number of funds.

points on impact, which happens to be about one standard deviation of this variable in the data (Figure 7). Therefore, we could say that 'a euro disaster risk shock that increases the sovereign bond yield spread by about one standard deviation impacts variable of interest X by x'.

Second, if the exogeneity condition $\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$ and $\boldsymbol{\vartheta}^{w} = \mathbf{0}$ holds as we argue in Section 3, the proxy-variable Equation (2) simplifies to

$$\Delta(\overline{cds}_t^p - \overline{cds}_t^c) = \boldsymbol{\varpi}^w \left(\overline{\boldsymbol{w}}_{t-1}^p - \overline{\boldsymbol{w}}_{t-1}^c\right) + \boldsymbol{\varpi}^\eta \boldsymbol{\eta}_{t-1} + \alpha\phi_t, \tag{8}$$

which implies the change in the CDS spread is uncorrelated with any common, issuer or fund-specific components in the error term ν_{fit}, including fund and fund-issuer specific shocks.

5.2 Local-projection specification

Against the background of Equation (7) we estimate fund × issuer panel local projections

$$h_{fi,t+\ell} - h_{fi,t-1} = \gamma_{fi}^{(\ell)} + \rho^{(\ell)} h_{fi,t-1} + \boldsymbol{\beta}^{(\ell)} \boldsymbol{x}_{f,t-1} + \boldsymbol{\delta}^{(\ell)} \boldsymbol{w}_{i,t-1} + \boldsymbol{\kappa}^{(\ell)} \boldsymbol{\eta}_{t-1} + \boldsymbol{\mu}^{(\ell)} \boldsymbol{d}_{t-1} + \psi^{(\ell)} \Delta(cds_t^p - cds_t^c) + u_{fit}^{(\ell)}, \tag{9}$$

for horizons of $\ell = 0, 1, \ldots, 12$ months. To robustify against extreme values for negative changes in holdings, instead of the log-difference $h_{fi,t+\ell} - h_{fi,t-1}$ as the dependent variable we use the exact percent growth rate in fund f's nominal holdings of issuer i sovereign debt between period $t+\ell$ and $t-1$ denoted by $g^h_{fi,t+\ell}$; results hardly change though when we use log differences.[14] While holdings are persistent, funds adjust them frequently even over one month (left-hand side panel in Online Appendix Figure B.10).

In the fund-level controls $\boldsymbol{x}_{f,t-1}$, we include fund inflows scaled by lagged assets under management. In the issuer-level controls $\boldsymbol{w}_{i,t-1}$, we include the EMBI spread as well as logarithms of issuer i's average bond price, industrial production, and equity prices; government debt stocks could be controlled for as well, but are not available at the monthly frequency for most of the economies we consider. In the common controls $\boldsymbol{\eta}_{t-1}$ we include the euro area and US one-year sovereign-bond yield as well as the US excess bond premium. And in $\boldsymbol{d}_{t-1}$ we again include the lagged level of the periphery-core CDS spread as well as year-on-year industrial production growth rates and the logarithms of the stocks of central government debt outstanding.

It should be emphasized that except for $\boldsymbol{d}_{t-1}$ the rationale for the choice of the variables in $\boldsymbol{x}_{f,t-1}$, $\boldsymbol{w}_{i,t-1}$ and $\boldsymbol{\eta}_{t-1}$ is to reduce the variance of the error term $u^{(\ell)}_{fit}$ in Equation (9) rather than to ensure identification of euro disaster risk shocks. In fact, after reporting some first results with controls $\boldsymbol{x}_{f,t-1}$, $\boldsymbol{w}_{i,t-1}$ and $\boldsymbol{\eta}_{t-1}$ below, we run most of our regressions controlling only for $\boldsymbol{d}_{t-1}$. Economizing on controls $\boldsymbol{x}_{f,t-1}$, $\boldsymbol{w}_{i,t-1}$ and $\boldsymbol{\eta}_{t-1}$ allows us to maximize the sample as we are then not dependent on data availability for these variables.

Table 1 presents summary statistics of the dependent and explanatory variables. To carry out the estimations, we use `reghdfe` in Stata (Correia 2014). We cluster standard

[14]Moreover, we: (i) focus on non-negative holdings $h_{fit} > 0$; (ii) set all observations $0 < h_{fit} <$ 10,000USD to missing, as we assume these are mis-reported by a factor of 10^x; (iii) trim the percent changes $g^h_{fi,t+\ell}$ at the 99% percentile. We focus on non-negative holdings and thereby intensive-margin adjustments in the baseline because RL does not report zero holdings. We discuss below estimations that also explore extensive-margin adjustments based on some weak assumptions about observations with zero holdings.

errors at the fund and issuer-economy × time level, but we report results for alternative clusterings below. The sample period is 2014m1 to 2023m12.

Table 1: Summary statistics

	mean	min	p5	p50	p95	max	sd	count
Change in fund holdings of issuer i between t and $t-1$	0.31	-100.0	-24.1	0.0	25.9	120.8	18.76	180,303
Change in fund holdings between $t+3$ and $t-1$	3.41	-100.0	-51.4	0.0	69.8	203.7	36.26	181,617
Lagged fund holdings of issuer i (log)	1478.34	-144.4	1068.4	1492.2	1837.3	2257.6	237.75	181,617
Change in periphery-core sovereign CDS spread	-0.03	-1.2	-0.9	-0.1	1.2	4.2	0.65	181,617
Lagged industrial production (log)	501.02	303.0	455.0	488.5	618.5	696.5	58.10	181,617
Lagged equity prices (log)	822.64	627.5	721.8	847.4	895.9	1036.8	69.07	181,617
Lagged EMBI spread	168.71	121.6	125.1	156.5	235.2	272.4	37.58	181,617
Lagged issuer i average bond price (log)	464.55	436.5	451.7	463.6	480.4	494.1	8.30	177,870
lagged fund inflows rel. to lagged AuM	0.15	-12.9	-3.1	-0.0	4.3	18.9	2.71	147,318
Lagged euro area 1-year bond yield	1.11	-0.2	-0.2	0.9	3.1	3.2	1.09	181,617
Lagged US 1-year bond yield	1.47	0.0	0.0	1.0	5.2	5.5	1.67	181,617
Lagged US excess bond premium	-0.15	-1.0	-0.7	-0.2	0.4	1.2	0.34	181,617
Lagged periphery-core sovereign CDS spresd (level)	73.85	36.9	37.4	68.7	134.2	153.8	27.55	181,617
dlip$_{y}oy_{l}1_{c}p$	-0.86	-26.8	-5.5	-0.8	3.3	24.4	5.34	181,617
lamountoutst$_{l}1_{c}p$	114.62	107.7	109.9	114.8	120.1	120.4	3.03	181,617

Note: The table reports summary statistics of the dependent and explanatory variables in the fund-level regressions using RL data.

5.3 Results

Table 2 reports results for the effect of a euro disaster risk shock on the average fund's Asian sovereign debt holdings on impact and after three months. Comparing Columns (1) and (2) as well as Columns (3) and (4) indicates that results hardly change when we include controls $\boldsymbol{x}_{f,t-1}$, $\boldsymbol{w}_{i,t-1}$, and $\boldsymbol{\eta}_{t-1}$. As without these controls the sample size increases by about 30%, in the following we do not include them anymore. Online Appendix Figure B.11 documents how many observations enter the regression sample by issuer, year, and impulse response horizon.

The black circled line in the left-hand side panel in Figure 15 presents the full profile of the impulse response of the average fund's Asian sovereign debt holdings to a euro disaster risk shock over a six-month horizon. We find that the average fund sheds Asian sovereign debt for up to five months. The right-hand side panel presents results for the corresponding portfolio weights, which fall somewhat but not statistically significantly. We return to portfolio weights below in the context of the drivers of fund responses.

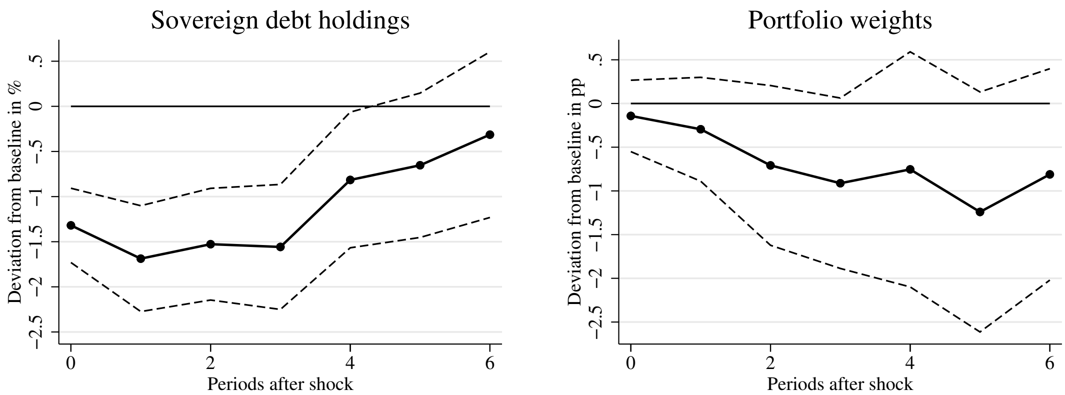
Online Appendix D presents results for adjustments at the extensive and intensive margins in response to euro disaster risk shocks. The results suggest that changes in fund holdings of Asian sovereign debt occur predominantly at the intensive margin; in other words, hardly no fund sheds all of its sovereign debt holdings of specific Asian economies following a euro disaster risk shock.

Table 2: Baseline regression results for effects of euro disaster risk shocks on fund holdings of Asian sovereign debt

	On impact		After 3 periods	
	(1)	(2)	(3)	(4)
Euro disaster risk shock	-1.276***	-1.319***	-1.218***	-1.558***
	(0.00)	(0.00)	(0.00)	(0.00)
Lagged holdings $h_{fi,t-1}$	✓	✓	✓	✓
Proxy controls $\boldsymbol{d}_{t-1}$	✓	✓	✓	✓
Common controls $\boldsymbol{\eta}_{t-1}$	✓	-	✓	-
Issuer controls $\boldsymbol{w}_{i,t-1}$	✓	-	✓	-
Fund controls $\boldsymbol{x}_{f,t-1}$	✓	-	✓	-
Fund-issuer FEs	✓	✓	✓	✓
Total observations	171,072	218,136	143,854	181,617
Number of funds	2,009	2,243	1,848	2,059
Within R-squared	0.10	0.09	0.22	0.21

Note: The table reports results from the regression of Equation (9) for $\ell = 0$ in Columns (1) and (2) and $\ell = 3$ in Columns (3) and (4). In the fund-level controls $\boldsymbol{x}_{f,t-1}$ we include the lag of fund inflows scaled by lagged assets under management. In the issuer-level controls $\boldsymbol{w}_{i,t-1}$ we include lags of the EMBI spread as well as logarithms of issuer i's average bond price, industrial production, equity prices. In the common controls $\boldsymbol{\eta}_{t-1}$ we include lags of the euro area and US one-year sovereign-bond yield as well as the US excess bond premium. In $\boldsymbol{d}_{t-1}$ we include the lagged level of the periphery-core CDS spread. Standard errors are clustered at the fund level and issuer × time level. p-values are provided in parentheses below the point estimates. Asterisks indicate significance at 10%(*), 5%(**), and 1%(***).

Figure 15: Effects of euro disaster risk shocks on Asian sovereign debt holdings



Note: The left-hand side panel shows impulse response of fund-level holdings of Asian sovereign debt to a euro disaster risk shock that raises the periphery-core 10-year sovereign bond yield spread by one standard deviation. Impulse responses are obtained from regressions of Equation (9). The right-hand side shows the effect of euro disaster risk shocks on Asian sovereign debt portfolio weight estimated using panel local projections at the investment-fund level analogous to Equation (9). Dashed lines indicate 90% confidence bands. Standard errors are clustered at the fund and issuer × time level. Periods refer to months.

Because a proxy-variable approach only identifies relative effects (Plagborg-Møller and Wolf 2021), we have to interpret the magnitude of the impulse response in Figure 15 relative to that of some benchmark variable; in Figure 7 we see that the euro disaster risk shock raises the periphery-core 10-year sovereign bond yield spread by about 10 basis points on impact. This corresponds to about one standard deviation of the latter's monthly change over the full sample period. The results in Figure 15 and Table 2 therefore imply that a euro disaster risk shock that raises the periphery-core 10-year sovereign bond yield spread by about one standard deviation induces the average fund to shed approximately 1.4% of its Asian sovereign debt holdings in the impact month and up to approximately 1.6% at the trough one month later. In the following, we refer to a 'one-standard-deviation' euro disaster risk shock in this sense.

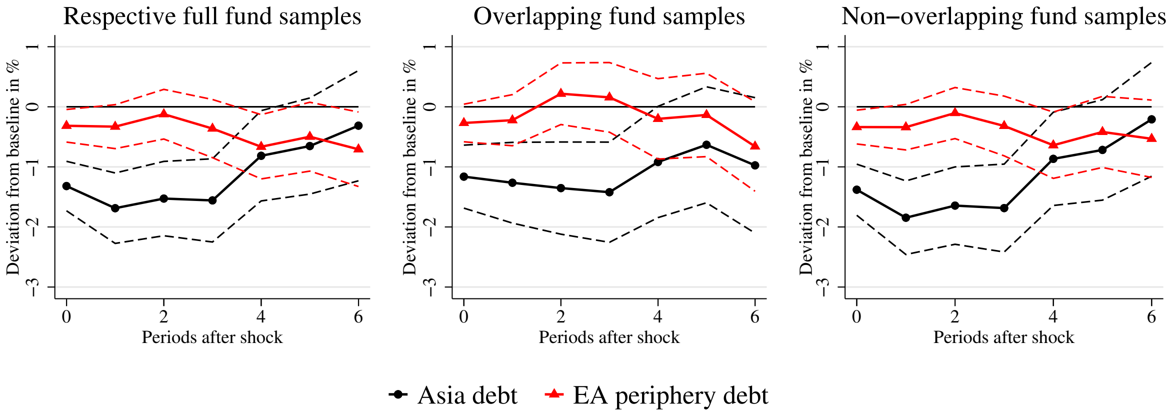
Another way to gauge the magnitude of the effect is to compare it to that on investment-fund holdings of euro area periphery sovereign debt shown in Figure 16 (Table 3 reports the underlying regression results for the effects after three months with additional information, including the number of observations). The left-hand side panel compares this effect for generally different fund samples, namely for funds that hold euro area periphery (Anaya Longaric et al. 2025) but not necessarily at the same time also Asian sovereign debt as in our baseline.[15] The middle panel shows results for an overlapping sample of funds that hold both euro area periphery and Asian sovereign debt, and the right-hand side panel for funds that hold either Asian or euro area periphery sovereign debt. Remarkably, we estimate that at least in the short term the average fund sheds Asian sovereign debt more strongly than euro area periphery sovereign debt in response to a euro disaster risk shock.

Figure 17 presents the effect of euro disaster risk shocks on investment-fund holdings of Asian sovereign debt over time. We obtain these estimates from three-year rolling-window regressions of Equation (9). The results suggest that the shedding of Asian sovereign debt in response to a euro disaster risk shock has been a feature of the data throughout most of our sample period from 2014 to 2023. In fact, the effect has been largest in more recent sub-samples.

Our main results in Figure 15 and Table 2 are robust to several relevant specification changes. First, our results are robust to using alternative choices and definitions for the proxy variable for euro disaster risk shocks. Online Appendix Table A.1 documents that

[15] The results are slightly different from those in Anaya Longaric et al. (2025) as there we consider the period from 2007m1 to 2023m12, while here we consider the period from 2014m1 to 2023m12. Online Appendix Figure B.12 presents the average portfolio shares of Asian and euro area periphery sovereign debt across the funds in the sample.

Figure 16: Effects of euro disaster risk shocks on investment-fund holdings of Asian sovereign debt for different subsets of funds



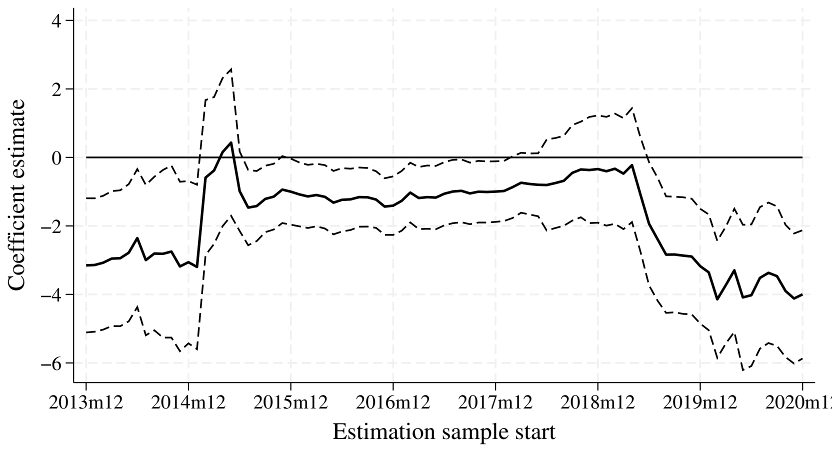
Note: The figure shows the effect of euro disaster risk shocks on fund holdings of Asian (black circled lines) and euro area periphery (red triangle lines) sovereign debt. The left-hand side panel compares this effect for generally different fund samples, namely for all funds that hold euro area periphery (Anaya Longaric et al. 2025) but not necessarily at the same time also Asian sovereign debt (this paper), the middle panel for an overlapping sample of funds that hold both euro area periphery and Asian sovereign debt, and the right-hand side panel for samples of funds that hold either euro area periphery or Asian sovereign debt.

Table 3: Effects of euro disaster risk shocks of Asian and euro area periphery sovereign debt holdings

	(1) Baseline	(2) Overlapping funds	(3) Only Asian debt holders
Euro disaster risk shock	-1.558***	-1.422***	-1.686***
	(0.00)	(0.01)	(0.00)
Lagged holdings $h_{fi,t-1}$	✓	✓	✓
Proxy controls $\boldsymbol{d}_{t-1}$	✓	✓	✓
Fund-issuer FEs	✓	✓	✓
Total observations	181,617	48,578	132,502
Number of funds	2,059	830	1,846
Within R-squared	0.21	0.25	0.22

Note: The table presents the regression results underlying the impulse responses of investment-fund holdings of Asian sovereign debt shown in Figure 16 (black circled lines) at horizon $\ell = 3$. Column (2) reports refers to the for the right-hand side panel in Figure 16, and Column (3) to a sample restrcited to funds that hold only Asian sovereign debt.

Figure 17: Time variation in the effects of euro disaster risk shocks on investment-fund holdings of Asian sovereign debt



Note: The figure presents the evolution of the effect of euro disaster risk shocks on fund holdings of Asian sovereign debt over time estimated using three-year rolling-window regressions of Equation (9). The solid line depicts the point estimate and the dashed lines 90% confidence bands. See also the note to Figure 15.

our results hardly change when we cleanse the country-specific, daily CDS premia from Bloomberg macro surprises before we temporally aggregate and calculate the periphery-core spread (Column (2)), when we calculate the periphery CDS premium using data for Portugal and Ireland in addition to Italy and Spain (Column (3)), when we use the average CDS premium across periphery economies rather than the periphery-core CDS spread (Column (4)), and when we use the periphery-core 10-year sovereign bond yield spread instead (Column (5)).

Second, Online Appendix Table A.2 documents that our results are also robust to alternative specifications of the proxy variable for euro disaster risk shocks based on the periphery-core CDS spread, namely when we use only the five or ten largest positive spikes (Columns (2) and (3)), when we use dummy variables at these spikes (Columns (4) and (5)), and when we use the ten largest positive and negative spikes as well as positive and negative dummy variables for these (Columns (6) and (7)). Recall that the largest spikes in the CDS spread can be attributed straightforwardly to euro disaster risk events (Online Appendix Tables C.1 and C.2 as well as Online Appendix Figure C.1), and should therefore even more convincingly satisfy the relevance and exogeneity conditions in Equation (2) than the raw CDS spread change. In particular, given our narrative analysis of intra-daily real time news we are especially confident that the variation in the CDS spread on these dates is due to euro disaster risk shocks and not other country-specific or common macro-financial shocks.

Third, the right-hand side panel in Online Appendix Figure B.13 shows that our findings do not change if we run weighted regressions, using either holdings of Asian sovereign debt by issuer at the fund level or total outstanding amounts at the issuer level as weights.

Fourth, Online Appendix Figure B.14 shows that the results in Figure 15 hardly change for different issuer economy samples.

Fifth, Columns (2) and (3) in Online Appendix Table A.3 document that our results do not change if we use only fund-issuer pairs with a large number of time-series observations to minimize the Nickell-bias in dynamic panel regressions such as our local projection in Equation (9) (Herbst and Johannsen 2024).

Sixth, Columns (4) and (5) in Online Appendix Table A.3 document that our inference is unchanged if we cluster standard errors at the fund, issuer and time level or at the fund×time and issuer level rather than the fund and issuer×time level.

Seventh, Online Appendix Table A.4 documents that our results do not change if we estimate the panel local projections at the more granular fund × issuer × currency × residual maturity level rather than at the fund × issuer level.

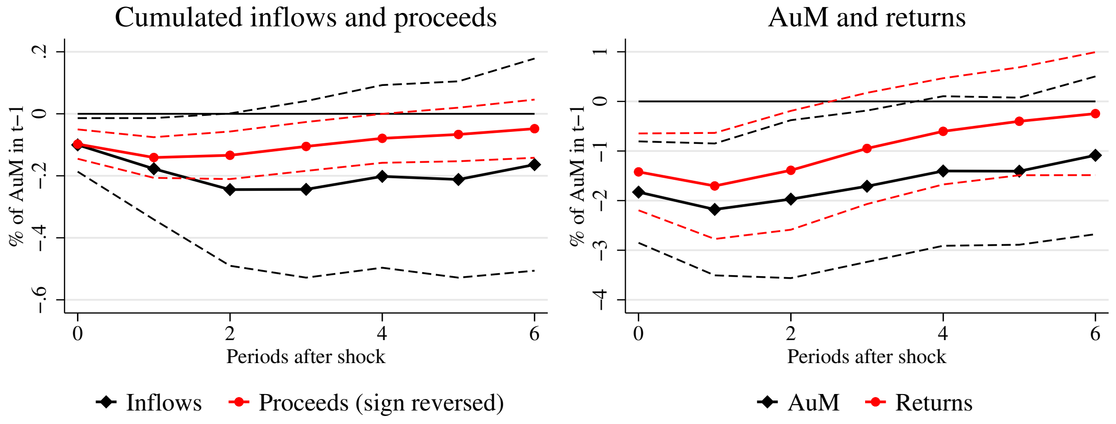
Finally, Online Appendix Figure B.15 documents that our findings do not change much if we additionally consider investment-fund holdings of Japan sovereign debt. The left-hand side panel shows that our results do not change much if we expand the sample of fund holdings to include Japan sovereign debt. The right-hand side panel shows that the average fund also sheds Japan sovereign debt, even if this is estimated to be somewhat less pronounced.

We next explore whether investment-fund responses are driven by fund-manager or fund-investor decisions and which funds are more sensitive.

5.4 Who is driving the responses: fund-managers or investors?

Investment-fund responses to euro disaster risk shocks may be driven by both fund-manager and/or fund-investor decisions. For example, fund-investors may decide to liquidate their fund shares and demand redemptions, which requires the fund to generate liquidity by shedding some of its assets. Given such outflows, the fund-manager may shed assets proportionately to initial portfolio weights or rebalance the portfolio. In the former case fund responses can be ascribed to fund-investor decisions, while in the latter case to fund-manager decisions.

Figure 18: Effects of euro disaster risk shocks on inflows from fund-investors, proceeds from shedding periphery debt, and portfolio weights of euro area sovereign debt



Note: The figure shows the impulse response of inflows from fund-investors and the proceeds from shedding Asian sovereign debt (left-hand side panel) as well as assets under management and returns (right-hand side panel) to a one-standard-deviation euro disaster risk shock. See also the note to Figure 15.

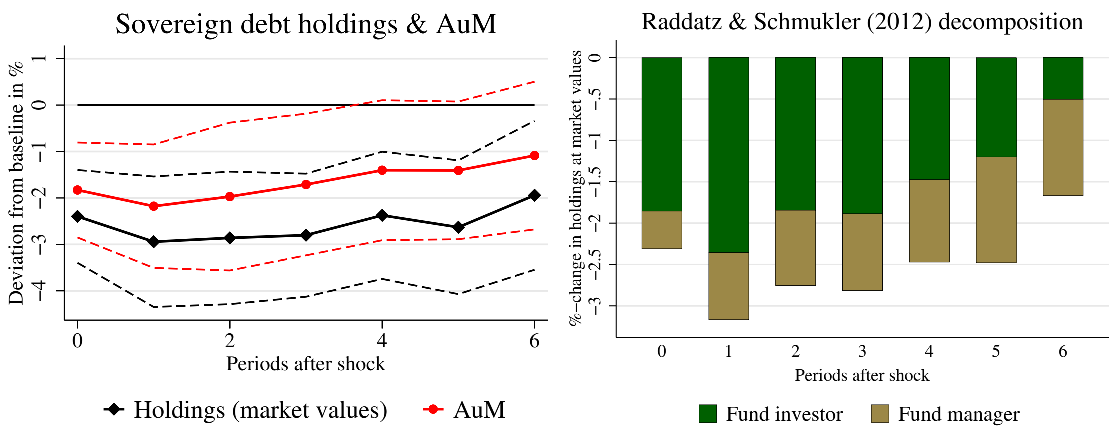
The left-hand side panel in Figure 18 shows that the average fund indeed faces sizable and persistent outflows from investors (black diamond line). Therefore, the fund must be shedding its Asian sovereign debt at least in part in order to accommodate fund-investor redemptions. However, taking into account price developments shows that the proceeds from shedding Asian sovereign debt are not enough to meet fund-investor redemption demands, at least after the impact period (red circle line, sign reversed for easier comparability). This means the fund must also be shedding assets other than Asian sovereign debt. This is consistent with our findings in Anaya Longaric et al. (2025), where we document that funds also shed euro area periphery sovereign debt in response to euro disaster risk shocks, but that this is not enough to satisfy redemption demands. Recall also that the right-hand side panel in Figure 15 suggests that funds do not systematically adjust their portfolio weight of Asian sovereign debt in response to a euro disaster risk shock. Taken together, this suggests funds shed Asian sovereign debt to generate the liquidity needed to satisfy investor redemptions—together with other assets, such as euro area periphery sovereign debt—rather than to rebalance the portfolio.

To show this more formally, we carry out a decomposition of fund responses into contributions that reflect fund-investor and fund-manager decisions following Raddatz and Schmukler (2012). Intuitively the decomposition works as follows. The fund's response is ascribed to fully reflect fund-investor decisions if holdings of Asian sovereign debt fall in proportion with total assets under management; in this case, the portfolio weight of

Asian sovereign debt does not change. By contrast, if holdings of Asian debt fall by more than total assets under management, the response at least in part reflects fund-manager decisions.

The left-hand side panel in Figure 19 presents the results for the components of this decomposition. The average fund's assets under management (at market values) drop by up to about 1.5% (red solid line with circle markers). Intuitively, if we observed a drop in fund holdings of Asian sovereign debt (at market prices) of the same size, this would suggest that fund responses entirely reflect fund-investor decisions. In fact, fund holdings of Asian sovereign debt (at market prices) drop by about the same magnitude (black solid line with diamond markers); according to the point estimates the drop is somewhat larger by up to about 0.7 percentage points than for assets under management, but this difference is small compared to the estimation uncertainty; of course, this is just a restatement of the result that the portfolio weight does not change systematically (right-hand side panel in Figure 15). This result again suggests that funds shed Asian sovereign debt to satisfy investor redemption demands rather than to rebalance the portfolio away from Asian debt.

Figure 19: Decomposition of changes in gross holdings of periphery debt due to fund-manager and fund-investor decisions



Note: The left-hand side panel shows the dynamic responses of fund holdings of Asian sovereign debt in market values (solid red circle line) and total assets under management (solid black diamond line) obtained from fund-level local projection regressions based on Equation (9). Dashed lines indicate 90% confidence bands. Standard errors are clustered at the fund and time level. See also the note to Figure 15. The right-hand side panel shows the decomposition of changes in holdings in market values into those driven by fund-manager and fund-investor decisions, respectively, proposed by Raddatz and Schmukler (2012).

The right-hand side panel in Figure 19 presents the results of the decomposition (Equation (7) in Raddatz and Schmukler 2012). On impact the decomposition ascribes almost all of the response of fund holdings of Asian debt to fund-investor decisions, and very little to fund-manager decisions. The relative importance of fund-investor decisions remains dominant over response horizons.[16]

5.5 Do investment funds amplify spillovers?

So far our results suggest that euro disaster risk shocks induce investment funds to shed holdings of Asian sovereign debt (Figure 15). This is consistent with investment funds contributing to spillovers from euro disaster risk shocks to *prices* in Asian sovereign debt markets. However, this is also consistent with investment funds simply mirroring the behavior of other investors, and that prices may fall just as much whether or not investment funds shed their holdings. We next distinguish between these two possibilities by testing whether price effects are larger for securities for which investment funds hold a greater share of total outstanding amounts.

We estimate security-level panel local projections

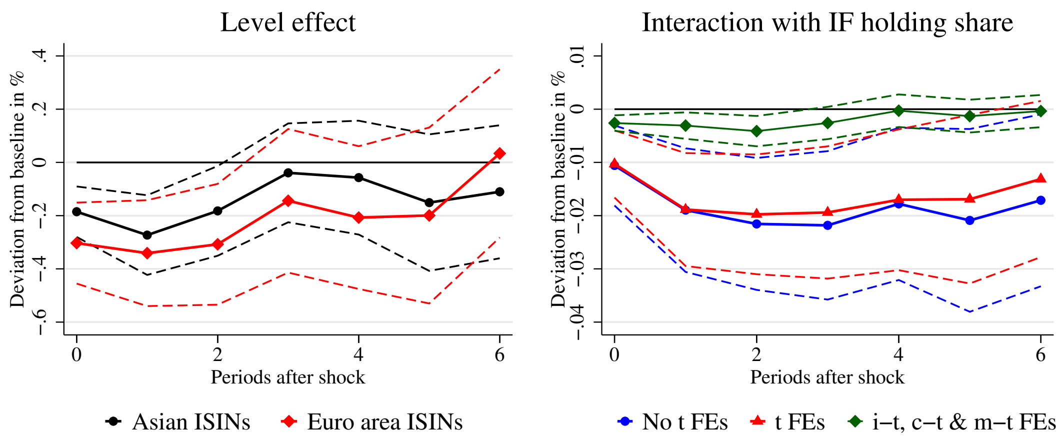
$$\begin{aligned} lp_{s,t+\ell} - lp_{s,t-1} = \gamma_s^{(\ell)} + \varrho^{(\ell)} lp_{s,t-1} + \boldsymbol{d}_{t-1}\boldsymbol{\mu}^{(\ell)} \\ + \psi^{(\ell)}\Delta(\overline{cds}_t^p - \overline{cds}_t^c) + u_{st}^{(\ell)}, \end{aligned} \tag{10}$$

where s indexes a security and $lp_{s,t}$ the logarithm of its price multiplied by 100. $\gamma_s^{(\ell)}$ is a security FE, which absorbs time-invariant security and issuer-specific characteristics.

The left-hand side panel in Figure 20 depicts the results for the price response of the average security. The black solid line with circle markers depicts results for Asian sovereign debt, and the red solid line with diamond markers for euro area sovereign debt. The results indicate that prices of Asian sovereign bonds fall temporarily for up to two months following a euro disaster risk shock. In response to a one-standard deviation euro disaster risk shock the average Asian sovereign bond price falls by up to about 0.3%. These spillovers are large, as they are almost as large as the domestic effect on euro area sovereign debt prices. Online Appendix Figure B.16 compares spillovers separately to the effects on euro area periphery and core sovereign debt prices.

[16]The contribution of fund-manager decisions could be further decomposed into changes in the Asian debt portfolio weight of the fund's benchmark and deviations from this changing benchmark portfolio weight.

Figure 20: Effects of euro disaster risk shocks of Asian sovereign debt holdings for different investment-fund ISIN holding shares



Note: The left-hand side panel shows the effect of euro disaster risk shocks on the bond price of the average Asian sovereign bond estimated from Equation (10). The black solid line with circle markers depicts results for Asian sovereign debt, and the red solid line with diamond markers for euro area sovereign debt. The right-hand side panel shows the estimate of the interaction $\phi^{(\ell)}$ in Equations (11) and (12).

Next we estimate

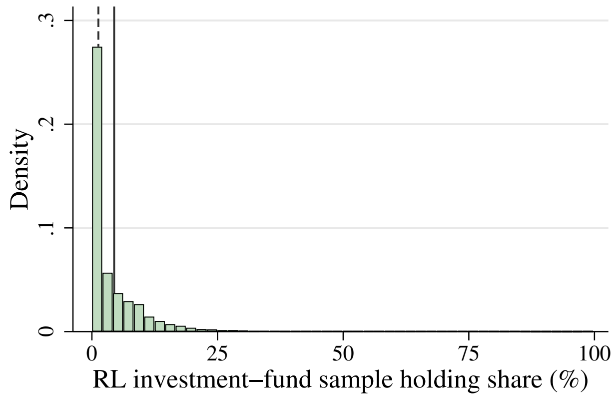
$$lp_{s,t+\ell} - lp_{s,t-1} = \gamma_s^{(\ell)} + \varrho^{(\ell)} lp_{s,t-1} + \boldsymbol{d}_{t-1}\boldsymbol{\mu}^{(\ell)} + \psi^{(\ell)}\Delta(\overline{cds}_t^p - \overline{cds}_t^c) + \phi^{(\ell)}\Delta(\overline{cds}_t^p - \overline{cds}_t^c) \times \sigma_s + u_{st}^{(\ell)}, \qquad (11)$$

where σ_s denotes the average share of the outstanding amount of security s held by the investment funds in the RL sample over the sample period.

Figure 21 presents the distribution of σ_s in our sample. The median investment-fund holding share across all securities in our sample is close to zero (vertical dashed line), and the mean holding share is about 3.5% (solid vertical line). Importantly, Figure 21 shows that there is noticeable variation in the investment-fund holding share across securities.

Column (2) in Table 4 reports the results from the estimation of the local projection for bond prices in Equation (11) with the interaction between the euro disaster risk shock and the investment-fund holding share σ_s after three months; the right-hand side panel in Figure 20 presents the full profile of the impulse response of this interaction term (blue circle line). The coefficient estimate on the interaction term is negative and statistically significantly different from zero. This means that we find that greater investment-fund presence in Asian sovereign debt markets at the security level is associated with a larger

Figure 21: Distribution of investment-fund holding share by ISIN



Note: The figure plots the distribution of the investment-fund holding share s_{st} across securities in the regression sample. The solid (dashed) vertical line indicates the median (mean) holding share.

price effect of euro disaster risk shocks. In other words, investment funds amplify the price spillovers from euro disaster risk shocks to Asian sovereign debt markets.

Quantitatively, based on Column (2) in Table 4, our findings imply that without investment-fund presence a one-standard-deviation euro disaster risk shock that raises euro area periphery yields on impact by 0.1pp (Figure 7) lowers Asian sovereign debt prices by about 0.14%. For a security for which investment funds hold the mean holding share, the price spillover is 0.04% larger (3.5×0.011). This corresponds to an increase in price spillovers of about 30% compared to the case without investment-fund presence. For a security for which investment funds hold 10% of the outstanding amount—which applies to about 10% of securities—the price spillover is almost doubled to 0.25% compared to the case with no investment-fund presence. Recall that Figure 3 shows that investment funds hold such shares of total outstanding sovereign debt for several Asian economies.

Next we refine this finding by accounting for possible confounders. Specifically, it could be that investment funds tend to hold securities that exhibit larger price effects from euro disaster risk shocks in the first place. For example, it could be that investment funds tend to hold securities denominated in local currency and that these are shed first by other investors in case of stress. To account for such confounders, we estimate

$$\begin{aligned} lp_{s,t+\ell} - lp_{s,t-1} = \gamma_s^{(\ell)} + \varrho^{(\ell)} lp_{s,t-1} + \boldsymbol{d}_{t-1}\boldsymbol{\mu}^{(\ell)} \\ + \phi^{(\ell)} \Delta(\overline{cds}_t^p - \overline{cds}_t^c) \times s_{st} + \alpha_{it}^{(\ell)} + \alpha_{ct}^{(\ell)} + \alpha_{mt}^{(\ell)} + u_{st}^{(\ell)}. \end{aligned} \quad (12)$$

where $\alpha_{it}^{(\ell)}$, $\alpha_{ct}^{(\ell)}$ and $\alpha_{mt}^{(\ell)}$ are issuer, currency and residual-maturity time fixed effects (FEs),

Table 4: Effects of euro disaster risk shocks of Asian sovereign debt holdings for different ISIN holding shares

	(1)	(2)	(3)	(4)
Euro disaster risk shock	-0.185***	-0.140**		
	(0.00)	(0.01)		
× investment fund holding share		-0.011**	-0.010***	-0.003***
		(0.02)	(0.01)	(0.00)
Lagged price $h_{fi,t-1}$	✓	✓	✓	✓
Proxy controls $\boldsymbol{d}_{t-1}$	✓	✓	-	-
ISIN FEs	✓	✓	✓	✓
Time FEs	-	-	✓	-
Issuer-time FEs	-	-	-	✓
Currency-time FEs	-	-	-	✓
Maturity-time FEs	-	-	-	✓
Total observations	65,317	63,278	63,278	63,182
Number of ISINs	1,688	1,636	1,636	1,634
Within R-squared	0.04	0.05	0.27	0.61

Note: The table reports regression results for Equation (10) in Column (1), for Equation (11) in Column (2) and for the specification with time FEs in Equation (12) in Columns (3) to (5). The results in Columns (1) underlies the impulse response in the left-hand side panel in Figure 20, and the results in Columns (2), (3) and (4) the impulse responses in the right-hand side panel.

respectively.

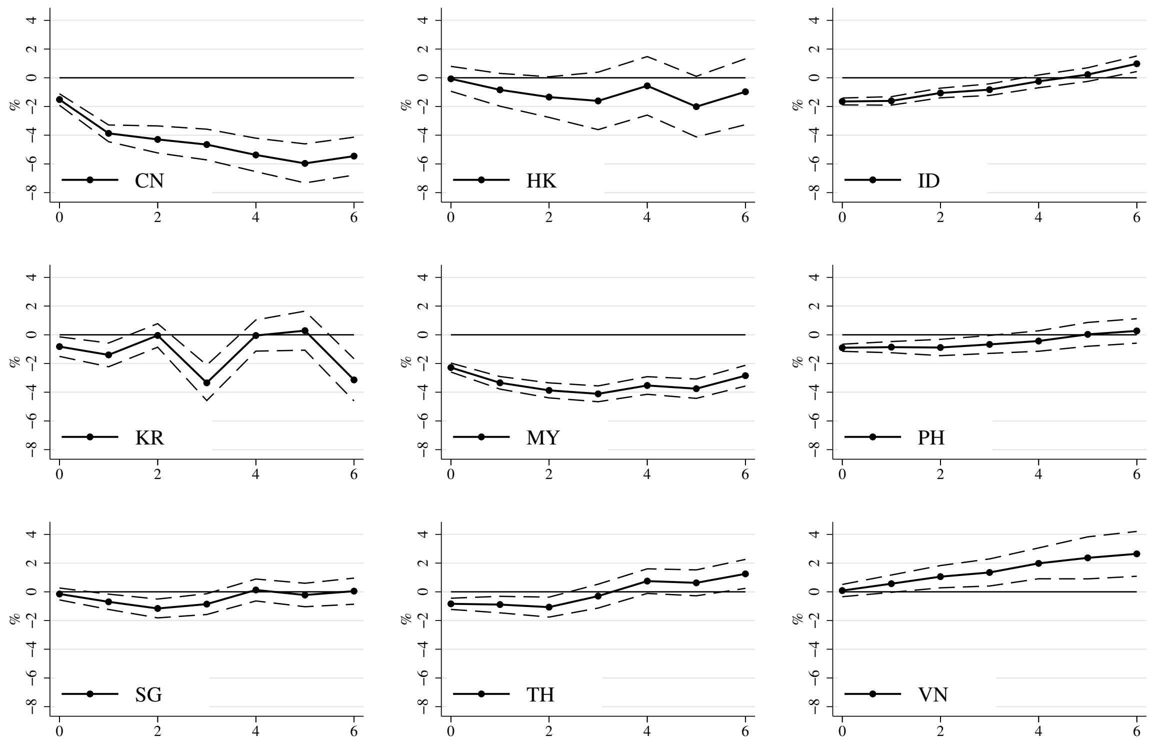
The right-hand side panel in Figure 4 and Columns (3) and (4) in Table 4 present the results. The baseline results (blue circle line) do not change when we include time FEs (red triangle line). When we include issuer × currency × maturity × time FEs (green diamond line), the coefficient estimates are noticeably smaller in absolute terms, but remain statistically significantly different from zero on impact and the first three months after the euro disaster risk shock has hit.

5.6 Spillover heterogeneity

We next analyze heterogeneity in investment-fund responses to euro disaster risk shocks. In particular, we explore whether heterogeneities are due to differences in issuer characteristics, fund characteristics, or security characteristics. The analysis sheds light on which issuers and bonds are particularly affected by euro disaster risk shocks through the shedding of assets by investment funds and why.

To illustrate the existence of spillover heterogeneity, Figure 22 shows that investment-fund responses to euro disaster risk shocks differ across issuers. For example, while investment funds clearly shed holdings of sovereign debt issued by China, Indonesia, South Korea and Malaysia, they adjust their holdings of sovereign debt issued by the Philippines, Singapore and Thailand by much less, and even gradually build up holdings of sovereign debt issued by Vietnam. Online Appendix Figures B.17 to B.19 documents that responses to euro disaster risk shocks also differ noticeably across issuer, security and fund characteristics.

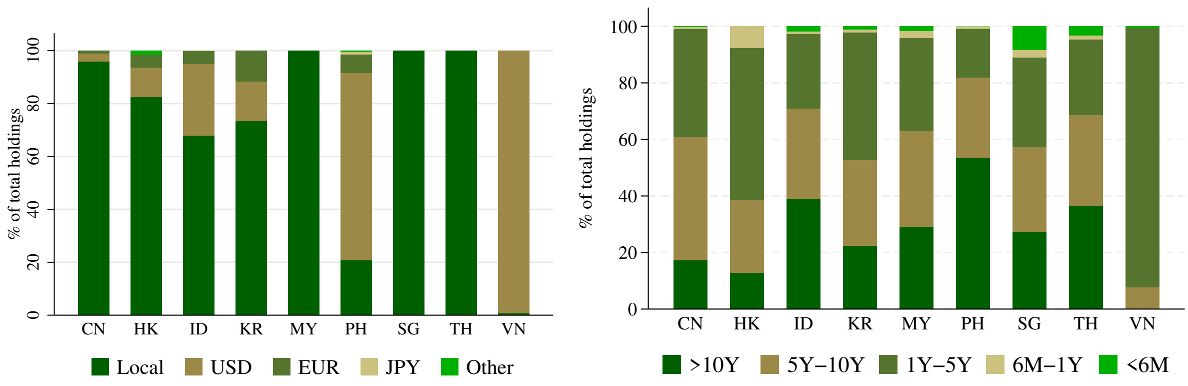
Figure 22: Investment fund responses to euro disaster risk shocks across issuers



Note: The figure presents the effect of euro disaster risk shocks on investment-fund holdings of Asian sovereign debt for each individual issuer. See also the note to Figure 15.

At the same time as there is spillover heterogeneity in responses of holdings to euro disaster risk shocks, there is also substantial heterogeneity in the characteristics of holdings of Asian sovereign debt across issuers, bonds and funds. In particular, the left-hand side panel in Figure 23 indicates that the currency composition of investment-fund holdings of Asian sovereign debt differs noticeably across issuers. For example, while sovereign debt held by investment funds in the sample issued by Malaysia, Singapore and Thailand is denominated exclusively in local currency, debt issued by Vietnam is denominated exclusively in US dollars. Similarly, the right-hand side panel in Figure 23 indicates that residual maturities differ systematically across issuers. Moreover, Figure 24 indicates that issuers differ noticeably across the extent of sovereign debt market liquidity in terms of outstanding amounts, but also capital account openness, their riskiness in terms of credit ratings, and their macro-financial exposure to the euro area.[17] And Figure 25 suggests that the funds holding debt of different issuers also differ systematically in terms of geographical focus, domicile, fund currency, asset universe, and—although less—asset type.

Figure 23: Currency and residual maturity composition of fund holdings



Note: The figure presents the currency (left-hand side) and residual maturity composition (right-hand side) of investment-fund holdings of Asian sovereign debt in 2021 by issuer.

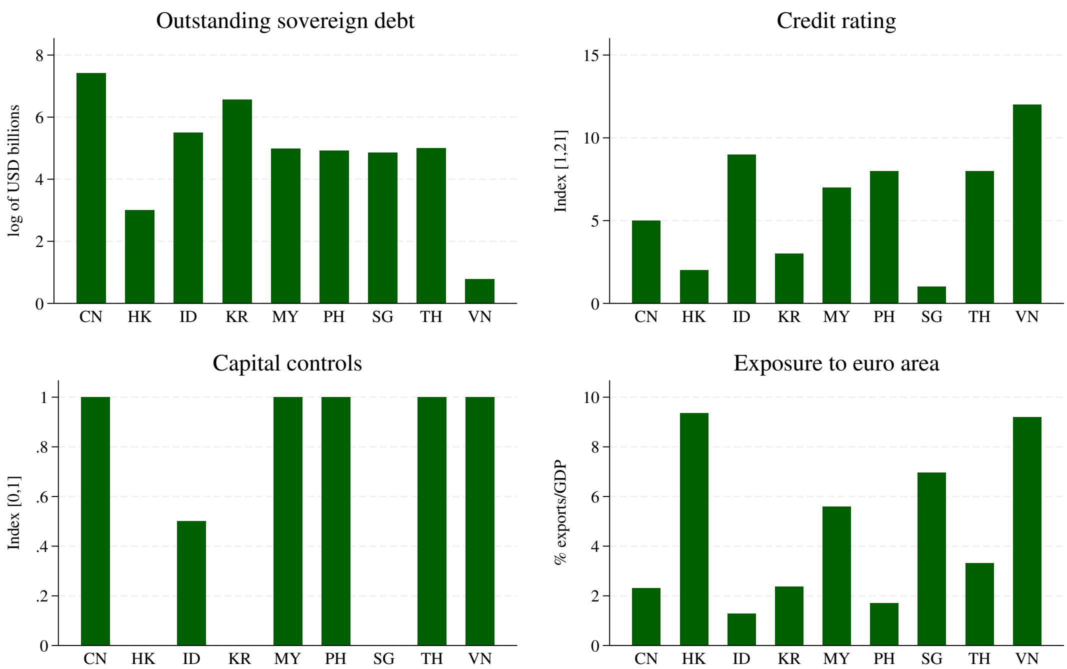
Because these issuer, bond and fund characteristics may correlate, it is difficult to pin down which of them is the ultimate driver of heterogeneity in the effects of euro disaster risk shocks on investment-fund holdings of Asian sovereign debt holdings. However, the granularity of the RL dataset allows us to narrow down the sources of spillover heterogeneity. In particular, using adequate time FEs allows us to perfectly control for spillover heterogeneity due to, say, issuer, currency and residual maturity characteristics and explore whether spillover heterogeneity remains across different fund characteristics. This is what we do next.

We first determine which among fund, issuer, currency and residual maturity entails independent spillover heterogeneity. For example, we estimate fund f $\times$ issuer i $\times$ currency c $\times$ maturity m panel local projections and include appropriate time FEs to *perfectly* control for heterogeneity due to issuer, currency and residual maturity m, and see whether we still find spillover heterogeneity across fund characteristics $\boldsymbol{z}_f$:

$$h_{ficm,t+\ell} - h_{fi,t-1} = \gamma^{(\ell)}_{ficm} + \varrho^{(\ell)} h_{ficm,t-1} + \boldsymbol{x}_{f,t-1}\boldsymbol{\beta}^{(\ell)} + \boldsymbol{w}_{i,t-1}\boldsymbol{\delta}^{(\ell)} + \boldsymbol{\eta}_{t-1}\boldsymbol{\lambda}^{(\ell)} + \boldsymbol{d}_{t-1}\boldsymbol{\mu}^{(\ell)} + \alpha^{(\ell)}_{icmt} + \phi^{(\ell)}\left[\Delta(\overline{cds}^{p}_{t} - \overline{cds}^{c}_{t}) \times \boldsymbol{z}_f\right] + u^{(\ell)}_{ficmt} \tag{13}$$

[17] On average across Asian economies the share of exports accounted for by the euro area is about 8%, which is low relative to other non-euro area economies at 20%.

Figure 24: Issuer heterogeneity

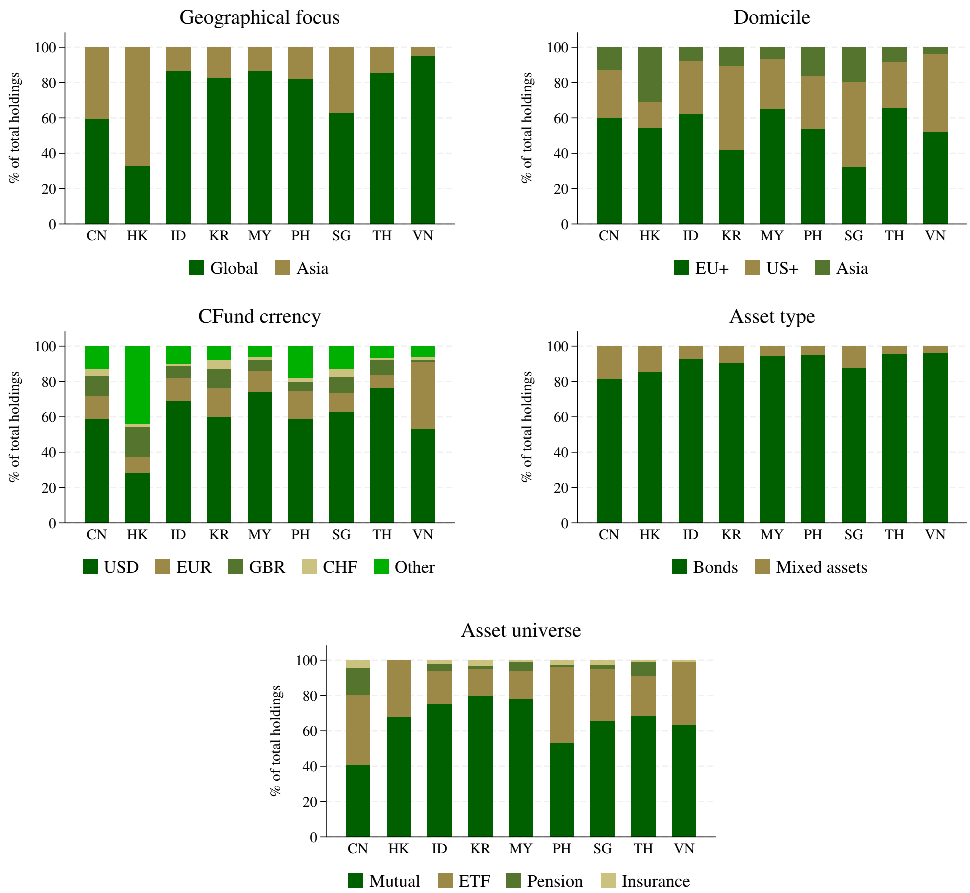


Note: The figure presents information on the outstanding amount of sovereign debt (top left-hand side), the S&P credit risk rating (top right-hand side), capital controls in terms of the measure of Fernández et al. (2016, bottom left-hand side), and export exposure to the euro area in terms of exports scaled by GDP (bottom right-hand side) by issuer. We convert the S&P credit risk rating ranging from AAA (most credit worthy) to SD/D (selective default/default) into a numeric, equidistant scale from 1 to 21. The capital control measure of Fernández et al. (2016) is an index that ranges from 0 (no controls) to 1 (closed).

Due to the inclusion of the time FEs α_{icmt} in Equation (13), heterogeneity in the effect of euro disaster risk shocks $\phi^{(\ell)}$ across fund characteristics $\boldsymbol{z}_f$ is identified by variation across funds with different characteristics for a given issuer-currency-maturity triplet. In other words, $\phi^{(\ell)}$ is identified by comparing the effect of a euro disaster risk shock on holdings of Asian sovereign debt for the same issuer, the same currency and the same residual maturity across funds with different characteristics (Khwaja and Mian 2008).

Table 5 reports the results of the estimation of Equation (13) with different time FEs. Column (1) reports the baseline results without any time FEs. Column (2) reports results from a regression of Equation (13) in which we include fund × issuer × residual maturity time FEs. The results suggest that even when we perfectly control for spillover heterogeneity due to differences across fund, issuers, and residual maturities, we still estimate systematic differences in investment-fund holding responses to euro disaster risk shocks across currencies: Holdings of US dollar denominated debt are statistically significantly more stable than the reference category of local-currency denominated debt. The remain-

Figure 25: Fund heterogeneity



Note: The figure presents information on investment fund geographical focus (top left-hand side), fund domicile (top right-hand side), fund currency (middle left-hand side), fund asset type (middle right-hand side), and asset universe (bottom) by issuer.

Table 5: Heterogeneity in investment-fund responses to euro disaster risk shocks

	(1)	(2)	(3)	(4)	(5)
Euro disaster risk shock	-1.672***				
	(0.00)				
$\times\mathcal{I}(c = \text{USD})$		2.980***			
		(0.01)			
$\times\mathcal{I}(c \notin \{\text{USD, LCY}\})$		1.538			
		(0.18)			
$\times\mathcal{I}(5Y > m > 1Y)$			-2.327*		
			(0.07)		
$\times\mathcal{I}(m > 5Y)$			-2.791**		
			(0.02)		
Lagged holdings	✓	✓	✓	✓	✓
Proxy controls	✓	-	-	-	-
Issuer dummy interactions with disaster risk shock	-	-	-	✓	-
Fund-issuer-currency-maturity FEs	✓	✓	✓	✓	✓
Fund-issuer-maturity-time FEs	-	✓	-	-	-
Fund-issuer-currency-time FEs	-	-	✓	-	-
Fund-currency-maturity-time FEs	-	-	-	✓	-
Issuer-currency-maturity-time FEs	-	-	-	-	✓
Total observations	289,536	42,045	168,582	213,232	289,274
Number of funds	2,044	579	1,213	1,227	2,044
Within R-squared	0.23	0.66	0.67	0.60	0.31
Number of stat. sign. issuer dummy interactions				2	
Number of stat. sign. fund characteristics interactions					0

Note: The table reports results for the estimation of Equation (13) with different combinations of time FEs and interactions between the euro disaster risk shock and currency, residual maturity, issuer, and fund indicator variables. Column (1) reports the baseline results without time FEs and interaction terms. Column (2) reports results from a regression that includes fund × issuer × residual maturity time FEs and interaction terms between the euro disaster risk shock and indicator variables for US dollar and other foreign-currency denomination of investment-fund sovereign debt holdings. Column (3) reports results from a regression that includes fund × issuer × currency time FEs and interaction terms between the euro disaster risk shock and dummy variables for different residual maturity buckets of investment-fund sovereign debt holdings. Column (4) reports results from a regression that includes fund × currency × residual maturity time FEs and interaction terms between the euro disaster risk shock and dummy variables for each issuer. Column (5) reports results from a regression that includes issuer × currency × residual maturity time FEs and interaction terms between the euro disaster risk shock and dummy variables for each fund characteristics, namely geographical focus (Global), domicile (EU and Europe, US and Canada), fund currency (US dollar, euro, other foreign-currency), and fund asset type (bond fund); the reference category is thus a mixed-asset fund domiciled in Asia with a focus on Asia and local currency as fund currency. The last two lines report the number of statistically significant interaction terms between the euro disaster risk shock and issuer/fund characteristics dummy variables. Standard errors are clustered at the fund and issuer × time level.

ing columns proceed analogously and indicate that independent spillover heterogeneity emerges from differences in residual maturity (Column (3)) and from differences in issuer characteristics (Column (4), see the penultimate line reporting the number of statistically significant issuer-dummy interactions with the euro disaster risk shock), but not from differences in fund characteristics (Column (5), see the last line). We next explore the factors that differ across issuer, currency and residual maturity that may account for independent spillover heterogeneity across these dimensions.

Table 6 reports the results from estimating Equation (13) in which we always include fund × currency × residual maturity time FEs, perfectly controlling for spillover heterogeneity due to differences across these dimensions. Column (2) replicates the results from Column (4) in Table 5. Column (3) indicates that the evidence for spillover heterogeneity across different issuers vanishes when we control for differences in liquidity in terms of

Table 6: Determinants of heterogeneity in fund responses to euro disaster risk shocks in issuer dimension

	(1)	(2)	(3)	(4)
Euro disaster risk shock	-1.672***			
	(0.00)			
× Capital controls			-14.268	-0.292
			(0.25)	(0.77)
× (Exports to EA)/GDP			0.484	-0.433**
			(0.78)	(0.04)
× S&P country rating			0.433	-0.307*
			(0.62)	(0.08)
× Outstanding amounts (log)			-0.024	-0.015***
			(0.21)	(0.00)
Lagged holdings	✓	✓	✓	✓
Proxy controls	✓	-	-	-
Country dummy interactions with disaster risk shock	-	✓	✓	-
Fund-issuer-currency-maturity FEs	✓	✓	✓	✓
Fund-currency-maturity-time FEs	-	✓	✓	✓
Total observations	289,536	213,232	206,762	206,762
Number of funds	2,044	1,227	1,216	1,216
Within R-squared	0.23	0.60	0.61	0.61
Number of stat. sign. country dummy interactions		2	0	

Note: The table reports results for the estimation of Equation (13) with fund × issuer × residual maturity time FEs as well as interaction terms between issuer dummy variables (Columns (2) and (3)) and/or issuer characteristics (Columns (3) and (4)) and the euro disaster risk shock. The last line reports the number of statistically significant interaction terms between the euro disaster risk shock and issuer dummy variables. See also the note to Table 5.

outstanding amounts, capital account openness, the macro-financial exposure to the euro area, and economy-level credit risk. Column (4) removes the interaction between the disaster risk shock and the country dummies and shows that spillover heterogeneity is systematically related to all these issuer characteristics except for capital account openness. Specifically, holdings of issuers more exposed to the euro area as an export market, which feature a lower economy-level credit rating and whose sovereign debt markets are less liquid in terms of size are shed more strongly by investment funds in response to euro disaster risk shocks.

Table 7 reports analogous results focusing on the role of spillover heterogeneity due to differences in residual maturity. The table reports the results from estimating Equation (13), in which we include fund × issuer × currency time FEs, perfectly controlling for spillover heterogeneity due to differences across these dimensions. Column (2) replicates the results from Column (3) in Table 5. Column (3) shows that the evidence of spillover heterogeneity across different residual maturities vanishes when we control for differences in liquidity in terms of outstanding amounts. Indeed, Column (4) documents that spillover heterogeneity is systematically related to differences in liquidity across residual maturities.

Table 7: Determinants of heterogeneity in fund responses to euro disaster risk shocks in maturity dimension

	(1)	(2)	(3)	(4)
Euro disaster risk shock	-1.672***			
	(0.00)			
$\times \mathcal{I}(5Y > m > 1Y)$		-2.327*	-0.674	
		(0.07)	(0.80)	
$\times \mathcal{I}(m > 5Y)$		-2.791**	-0.453	
		(0.02)	(0.89)	
× Outstanding amounts (by maturity)			-0.012	-0.012**
			(0.43)	(0.04)
Lagged holdings $h_{fi,t-1}$	✓	✓	✓	✓
Proxy controls $\boldsymbol{d}_{t-1}$	✓	-	-	-
Fund-issuer-currency-maturity FEs	✓	✓	✓	✓
Fund-issuer-currency-time FEs	-	✓	✓	✓
Total observations	289,536	168,582	168,582	168,582
Number of funds	2,044	1,213	1,213	1,213
Within R-squared	0.23	0.67	0.67	0.67

Note: The table reports results for the estimation of Equation (13) with fund × issuer × currency time FEs as well as interaction terms between dummy variables for different residual maturity buckets (Columns (2) and (3)) and/or residual-maturity-bucket characteristics (Columns (3) and (4)) and the euro disaster risk shock. See also the note to Table 5.

Finally, Table 8 reports analogous results focusing on the role of spillover heterogeneity due to differences in currency denomination. Column (2) replicates the results from Column (2) in Table 5. Column (3) indicates that US dollar denominated Asian sovereign debt is more resilient than local and other foreign-currency sovereign debt even beyond differences in liquidity in terms of outstanding amounts. In fact, Column (3) indicates that across different currency denominations, we do not estimate that differences in liquidity matter for spillover heterogeneity, in contrast to differences in liquidity across issuers (Table 6) and residual maturities (Table 7). This may be because there is much stronger concentration in the currency denomination of fund holdings than in residual maturity (Online Appendix Figure B.20). Indeed, recall from the discussion in Section 2 that in the Asian economies we consider foreign-currency sovereign debt markets are relatively small.

6 Conclusion

We explore whether and how investment funds transmit spillovers from local shocks to financial markets in other parts of the world. As a laboratory we consider shocks to financial-market beliefs about the probability of a rare, euro-related disaster and their spillovers to Asian sovereign debt markets. Given their geographical distance from and relatively limited macroeconomic exposure to the euro area, Asian sovereign debt markets

Table 8: Determinants of heterogeneity in fund responses to euro disaster risk shocks in currency dimension

	(1)	(2)	(3)	(4)
Euro disaster risk shock	-1.672***			
	(0.00)			
$\times\mathcal{I}(c = \text{USD})$		2.980***	3.756***	2.313***
		(0.01)	(0.01)	(0.01)
$\times\mathcal{I}(c \notin \{\text{USD, LCY}\})$		1.538	3.353	
		(0.18)	(0.18)	
× Outstanding amounts (by currency)			0.006	-0.002
			(0.50)	(0.64)
Lagged holdings $h_{fi,t-1}$	✓	✓	✓	✓
Proxy controls $\boldsymbol{d}_{t-1}$	✓	-	-	-
Fund-issuer-currency-maturity FEs	✓	✓	✓	✓
Fund-issuer-maturity-time FEs	-	✓	✓	✓
Total observations	289,536	42,045	42,045	42,045
Number of funds	2,044	579	579	579
Within R-squared	0.23	0.66	0.66	0.66

Note: The table reports results for the estimation of Equation (13) with fund × issuer × residual maturity time FEs as well as interaction terms between dummy variables for different currency buckets (Columns (2) and (3)) and/or currency-bucket characteristics (Columns (3) and (4)) and the euro disaster risk shock. See also the note to Table 5.

are an ideal testing ground *a priori* stacking the deck against finding evidence that investment funds transmit spillovers from euro disaster risk shocks.

We analyze holdings data at the security level over the period from 2014 to 2023 and find that in response to euro disaster risk shocks investment funds strongly shed Asian sovereign debt, primarily in order to meet fund-investor redemption demands. Price effects are larger for securities for which investment funds hold larger shares of outstanding amounts. Exploiting the heterogeneity in responses across funds, issuers, debt currency denominations and residual maturities, we find that market liquidity across issuers and maturities predict which sovereign debt holdings investment funds shed. Dollar-denominated holdings are resilient, independently of liquidity, credit and duration risk, and exchange-rate valuation effects.

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Online Appendix

A Tables

Table A.1: Robustness to alternative choices of the proxy variable for euro disaster risk shocks

	(1) Baseline	(2) Cleansed from macro surprises	(3) More EA countries	(4) Only periphery CDS	(5) Bond yield differential
Euro disaster risk shock proxy variable	-1.558***	-1.600***	-2.682***	-0.074***	-2.239***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Lagged holdings $h_{fi,t-1}$	Yes	Yes	Yes	Yes	Yes
Proxy controls $\boldsymbol{d}_{t-1}$	Yes	Yes	Yes	Yes	Yes
Fund-issuer FEs	Yes	Yes	Yes	Yes	Yes
Total observations	181,617	181,617	181,617	181,617	181,617
Number of funds	2,059	2,059	2,059	2,059	2,059
Within R-squared	0.21	0.21	0.21	0.21	0.21

Note: The table presents the regression results for robustness checks regarding the choice of the proxy variable for euro disaster risk shocks. Column (1) presents the baseline results from Table 2 when we use the change in the spread between euro area periphery (Italy and Spain) and core (Germany, Austria, Finland, France, Belgium, Netherlands) sovereign CDS premia, temporally aggregated from daily to monthly frequency. In column (2) we regress the daily CDS spread on Bloomberg macro surprises before temporally aggregating to monthly frequency. In column (3) we use CDS premia for additional periphery economies (Ireland and Portugal). In column (4) we use the average CDS premium across periphery economies. In column (5) we use the 10-year sovereign bond yield spread (Italy, Portugal, Spain, Ireland vs. Germany, Austria, Finland, France) as a proxy variable.

Table A.2: Robustness to alternative specifications of the euro area periphery-core CDS spread as proxy variable for euro disaster risk shocks

	(1) Baseline	(2) 10 largest > 0 spikes	(3) 5 largest > 0 spikes	(4) 10 dummies	(5) 5 dummies	(6) 10 + 10 spikes	(7) 10 + 10 dummies
Euro disaster risk shock proxy variable	-1.558***	-0.083***	-0.079***	-3.298***	-4.390***	-0.071***	-2.073***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Lagged holdings $h_{fi,t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Proxy controls $\boldsymbol{d}_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund-issuer FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total observations	181,617	181,617	181,617	181,617	181,617	181,617	181,617
Number of funds	2,059	2,059	2,059	2,059	2,059	2,059	2,059
Within R-squared	0.21	0.21	0.21	0.21	0.21	0.21	0.21

Note: The table presents the regression results for robustness checks regarding the choice of the proxy variable for euro disaster risk shocks. Column (1) presents the baseline results from Table 2 when we use the change in the spread between euro area periphery (Italy and Spain) and core (Germany, Austria, Finland, France, Belgium, Netherlands) sovereign CDS premia, temporally aggregated from daily to monthly frequency. In column (2) ((3)) we only use the ten (5) largest positive spikes in the euro area periphery-core sovereign CDS spread as proxy variable and set it it to zero in all other period. In Column (4) and (5) we do not use the CDS spread at all but only dummy variables that equal unity in the months with the largest positive spikes. In Columns (6) and (7) we repeat the exercise with spikes and dummies but for the periods with the ten largest positive and the 10 largest negative spikes.

Table A.3: Alternative specifications for effects of euro disaster risk shocks on fund holdings of Asian sovereign debt

	(1) Baseline	(2) $T_{fi} > 25$	(3) $T_{fi} > 50$	(4) Cluster at fund, time, & issuer	(5) Cluster at fund × time, & issuer
Euro disaster risk shock	-1.558***	-1.581***	-1.475***	-1.558*	-1.558***
	(0.00)	(0.00)	(0.00)	(0.05)	(0.00)
Lagged holdings $h_{fi,t-1}$	✓	✓	✓	✓	✓
Proxy controls $\boldsymbol{d}_{t-1}$	✓	✓	✓	✓	✓
Fund-issuer FEs	✓	✓	✓	✓	✓
Total observations	181,617	143,256	90,172	181,617	181,617
Number of funds	2,059	1,037	525	2,059	2,059
Within R-squared	0.21	0.17	0.14	0.21	0.21

Note: The table reports results from alternative specifications of the regression of the panel local projection in Equation (9). Columns (2) and (3)report results from regressions in which we use only fund-issuer pairs with at least 25 and 50 time-series observations, respectively. Columns (4) and (5) report results from regressions in which we cluster standard errors at the fund, issuer and time level as well as at the fund and issuer-time level, respectively.

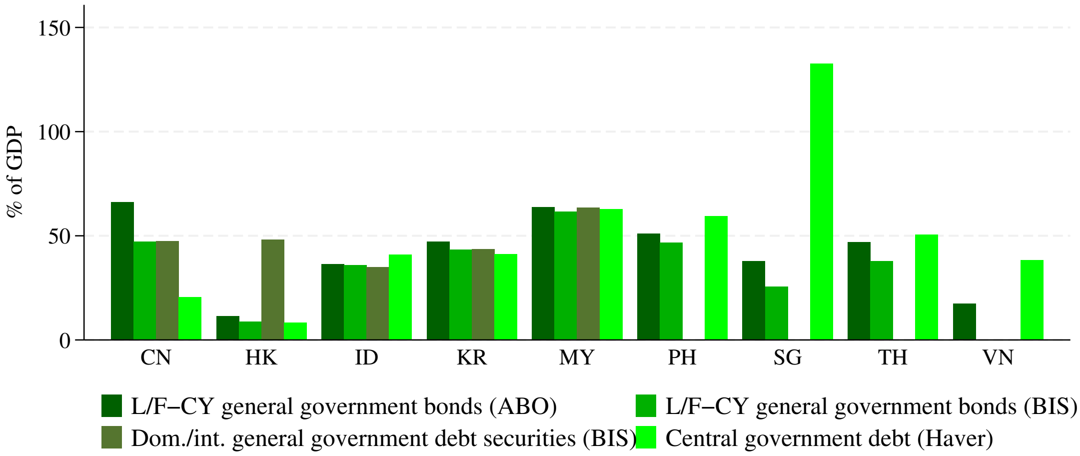
Table A.4: More granular specifications for effects of euro disaster risk shocks on fund holdings of Asian sovereign debt

	On impact		After 3 periods	
	(1)	(2)	(3)	(4)
Euro disaster risk shock	-1.202***	-1.235***	-1.269***	-1.672***
	(0.00)	(0.00)	(0.00)	(0.00)
Lagged holdings $h_{fi,t-1}$	✓	✓	✓	✓
Proxy controls $\boldsymbol{d}_{t-1}$	✓	✓	✓	✓
Common controls $\boldsymbol{\eta}_{t-1}$	✓	-	✓	-
Issuer controls $\boldsymbol{w}_{i,t-1}$	✓	-	✓	-
Fund controls $\boldsymbol{x}_{f,t-1}$	✓	-	✓	-
Fund-issuer-currency-maturity FEs	✓	✓	✓	✓
Total observations	279,835	362,005	226,455	289,536
Number of funds	2,003	2,238	1,836	2,044
Within R-squared	0.11	0.10	0.23	0.23

Note: The table reports results analogous to those in Table 2 but for panel local projections estimated at the more granular fund × issuer × currency × residual maturity level than the fund × issuer level.

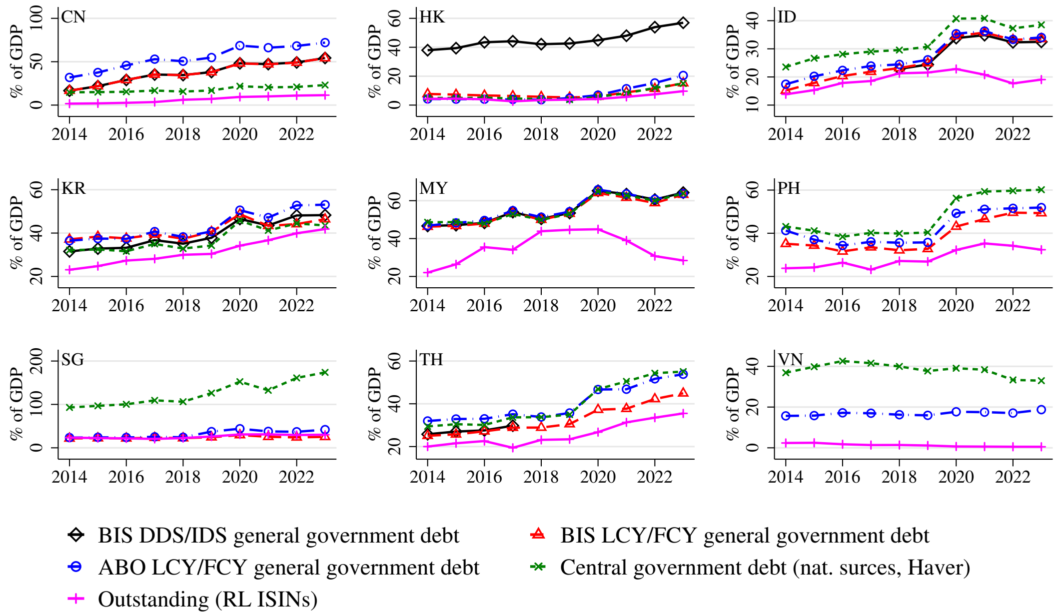
B Figures

Figure B.1: Government debt stocks across sources (in 2021)



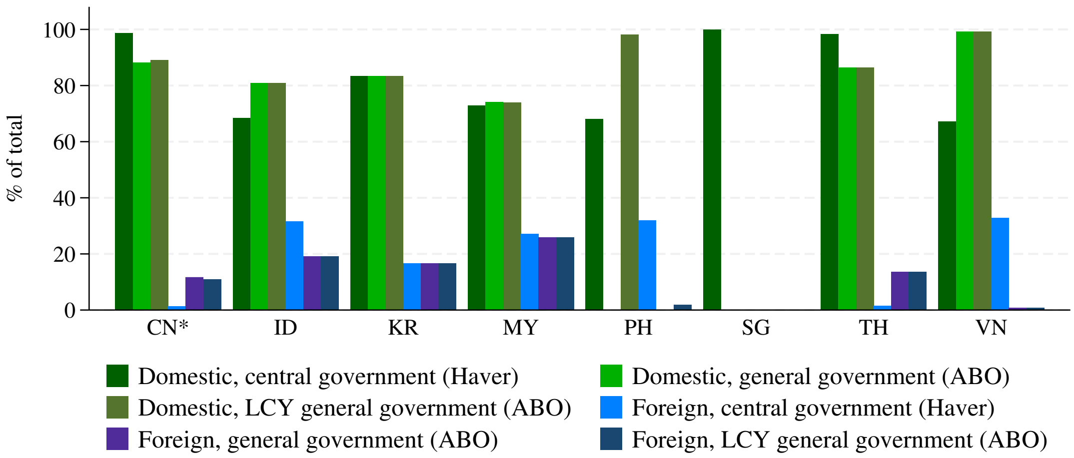
Note: The figure shows government debt outstanding as a share of GDP from different data sources and definitions. The data are taken from AsianBondsOnline (ABO) and represent the sum of local and foreign-currency general government debt, from the BIS Debt Securities Statistics database and represent the sum of local and foreign-currency general government debt (Table C4), from the BIS International Debt Securities database and represent the sum of general government international and domestic debt securities (Table C1), and from national sources accessed through Haver (CN: Ministry of Finance; HK: Treasury; ID: Bank of Indonesia; KR: Ministry of Finance; MY: Bank Negara Malaysia; PH: Bureau of the Treasury; SG: Monetary Authority of Singapore; TH: Bank of Thailand; VN: Ministry of Finance). For Singapore the central government debt stocks from national sources accessed through Haver include large debts from instruments that are unrelated to fiscal needs and issued for non-spending purposes, such as Singapore Government Securities (issued to develop the domestic debt market), Singapore Savings Bonds (provided to individual investors with a long-term saving option with safe returns), Special Singapore Government Securities (non-tradable bonds issued to meet investment needs of Singapore's national pension fund), and Reserves Management Government Securities (non-marketable security issued by the government to the Monetary Authority of Singapore to facilitate transfer of excess official foreign reserves to the government for longer-term management); see here and here for details.

Figure B.2: Government debt stocks over time



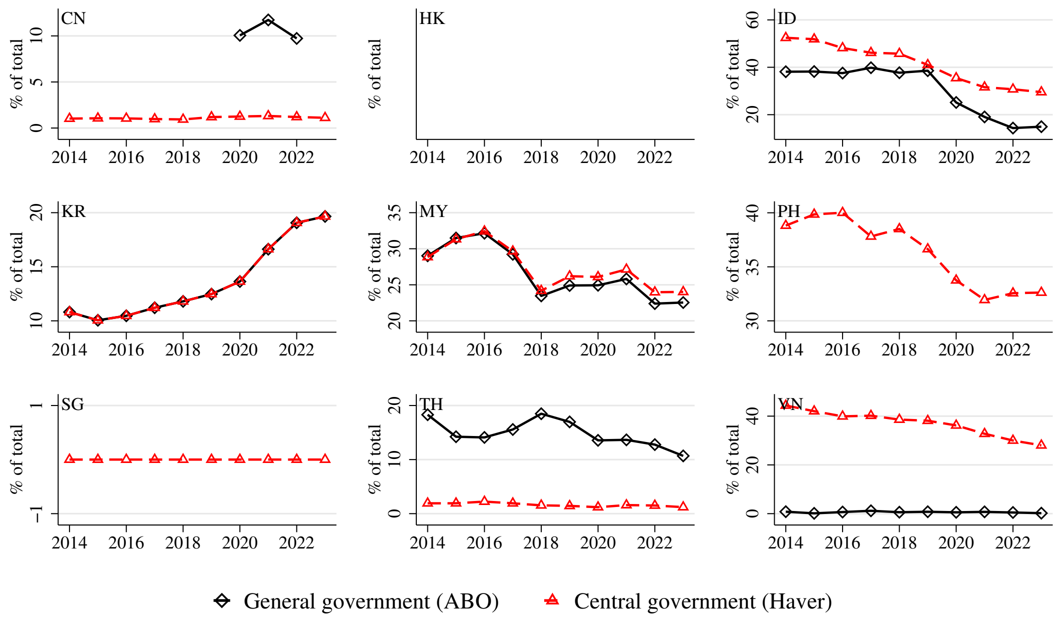
Note: The figure shows the evolution of government debt outstanding as a share of GDP from different data sources and definitions. See the note to Figure B.1 for the sources. The figure additionally shows the sum of outstanding amounts across all ISINs held by RL funds.

Figure B.3: Government debt foreign holder share across sources (in 2021)



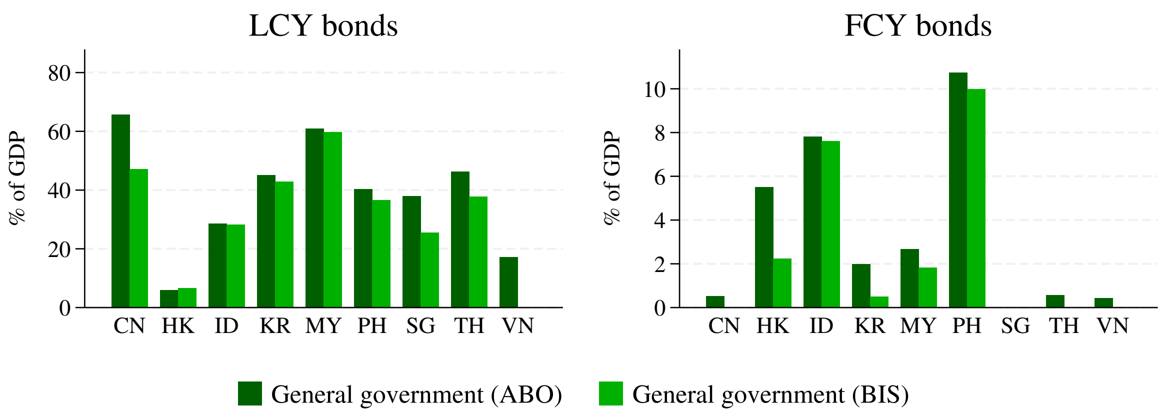
Note: The figure shows domestic and foreign-held government debt outstanding from different data sources and definitions. The are taken from AsianBondsOnline (ABO) and represent the domestic/foreign holdings shares of general government debt reported in local currency as well as the foreign holdings share of local-currency general government debt, and from national sources accessed through Haver (CN: Ministry of Finance; HK: Treasury; ID: Bank of Indonesia; KR: Ministry of Finance; MY: Bank Negara Malaysia; PH: Bureau of the Treasury; SG: Monetary Authority of Singapore; TH: Bank of Thailand; VN: Ministry of Finance).

Figure B.4: Government debt foreign holder share over time



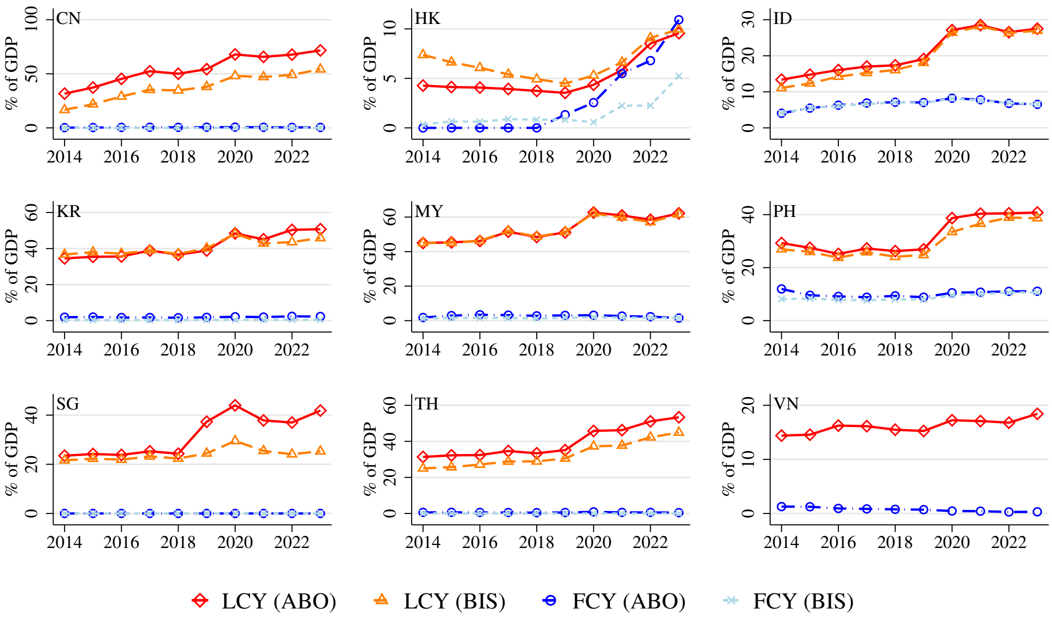
Note: The figure shows foreign-held government debt outstanding from different data sources and definitions. See the note to Figure B.3 for the sources.

Figure B.5: LCY vs. FCY sovereign debt markets across sources (in 2021)



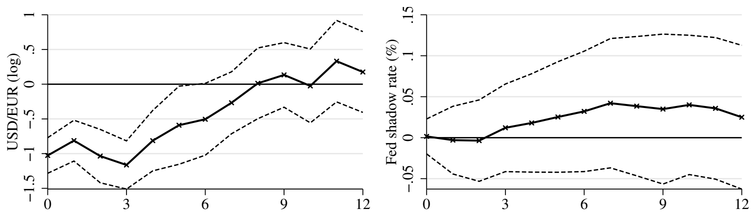
Note: The figure shows the size of local and foreign-currency general government debt markets from different sources, namely local and foreign-currency general government debt from AsianBondsOnline (ABO), and from the BIS Debt Securities Statistics database for local and foreign-currency general government debt (Table C4).

Figure B.6: LCY vs. FCY sovereign debt markets over time



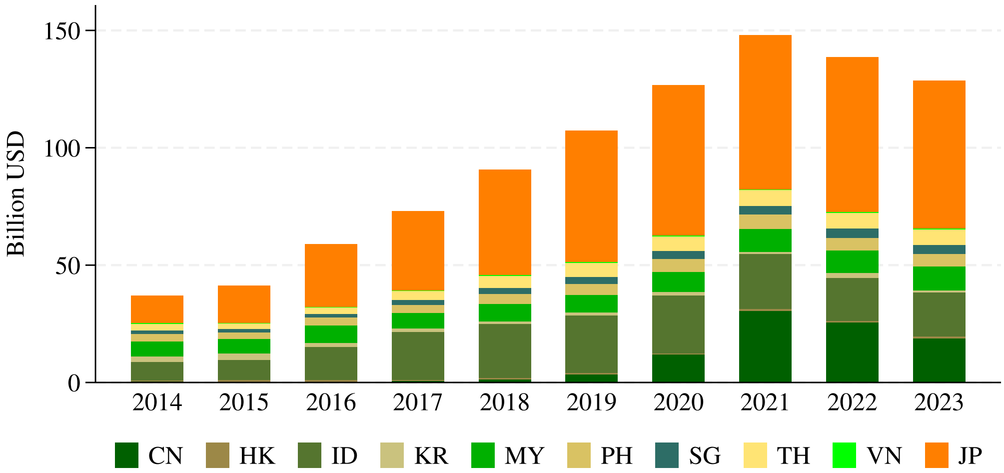
Note: The figure shows the evolution of the size of local and foreign-currency general government debt markets from different sources (see the note to Figure B.5).

Figure B.7: Effects on further regional and global macro-financial variables



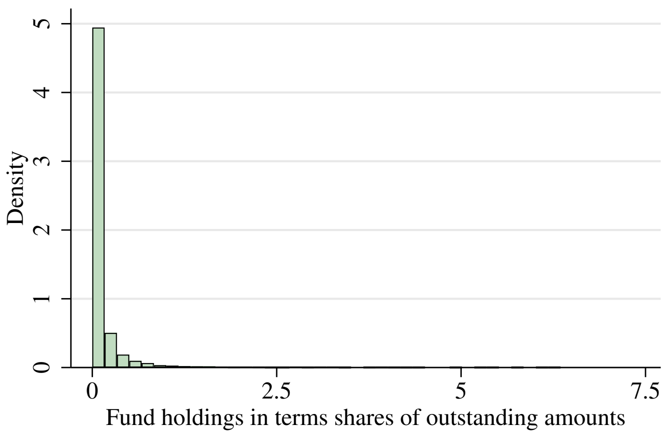
Note: See the note to Figure ??.

Figure B.8: RL fund holdings of Asian government debt with Japan



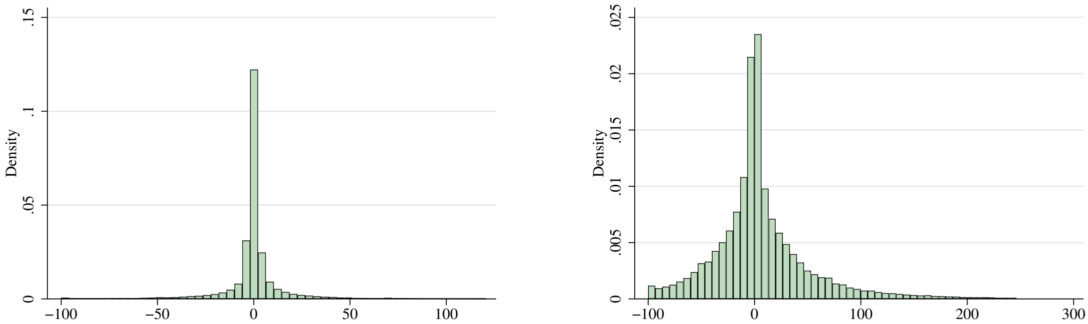
Note: See the note to Figure 12.

Figure B.9: RL fund holding shares for given issuer's outstanding debt



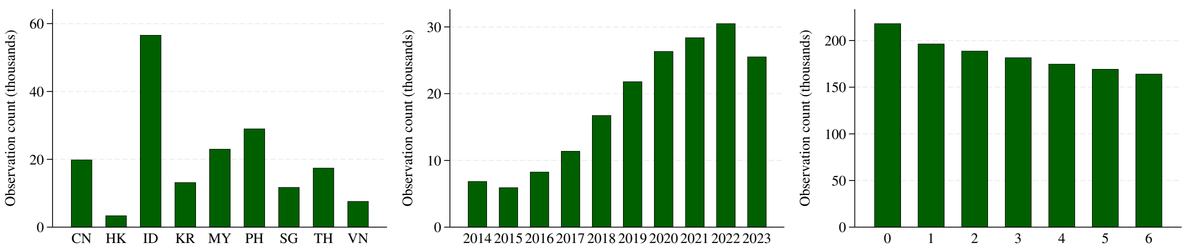
Note: The figure shows the distribution of the share of outstanding amounts held by a given fund at the security level across all RL funds.

Figure B.10: Distribution of changes in holdings



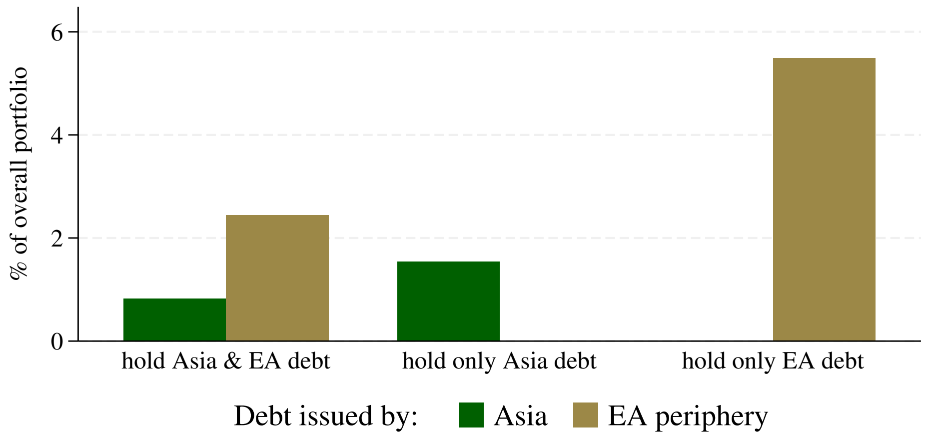
Note: The figure depicts the distribution of the dependent variable $g^{h}_{fi,t+\ell} \equiv 100 \times (h_{fi,t+\ell} - h_{fi,t-1})/h_{fi,t-1}$ *in our regressions, that is the growth rate in fund holdings of Asian issuers' sovereign debt. The left-hand side panel depicts the distribution for* $\ell = 0$*, and the right-hand side for* $\ell = 6$.

Figure B.11: Observations in the regression sample



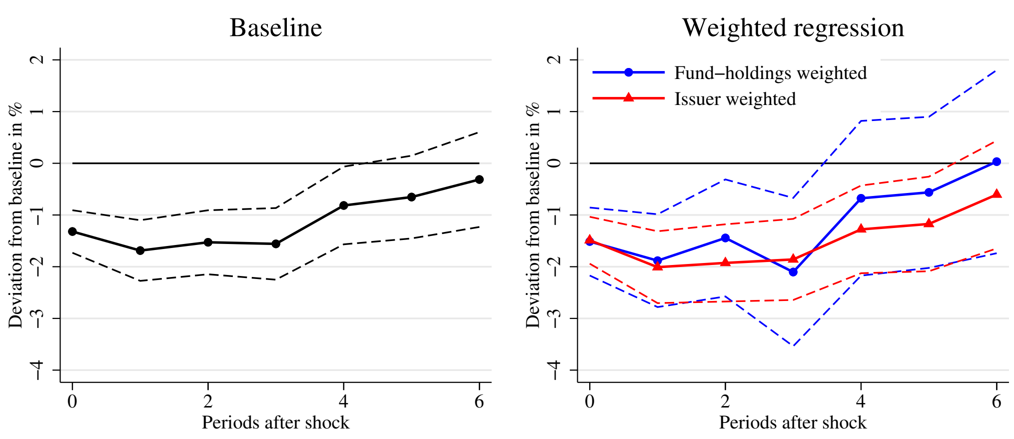
Note: The figure shows the number of observations that enter the regression sample for impulse-response horizon $\ell = 0$ *by characteristics. The left-hand side panel shows the number of observations in the regression sample by issuer and the middle panel by year. The right-hand side panel shows the number of observations used in the regressions for different impulse-response horizons* ℓ.

Figure B.12: Asia & euro area periphery sovereign debt portfolio shares



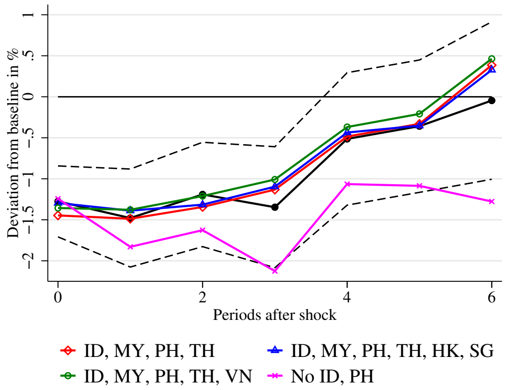
Note: The figure depicts the median portfolio share of Asian and euro area periphery sovereign debt, respectively, across the funds in the regression sample. The bars on the left-hand side show the portfolio weights for funds that hold both Asian and euro area periphery sovereign debt, and the bars in the middle (right-hand side) for funds that hold only Asian (euro area periphery) sovereign debt.]

Figure B.13: Effects of euro disaster risk shocks from weighted regressions



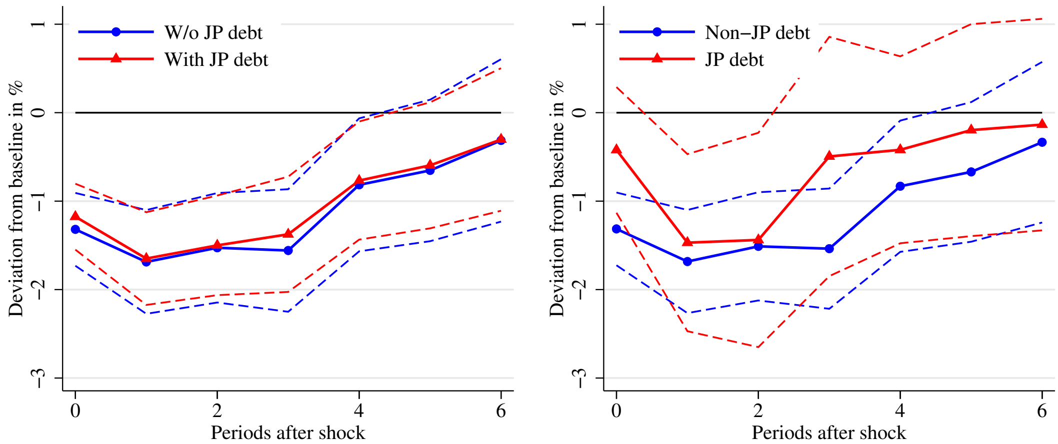
Note: The left-hand side panel presents our baseline results from Figure 15 and the right-hand side panel from analogous panel local projections estimated with issuer-specific fund holdings of Asian sovereign debt (blue diamond line) or issuer-specific outstanding amounts (red triangle line) as weights. See also the note to Figure 15.

Figure B.14: Effects of euro disaster risk shocks from different issuer samples



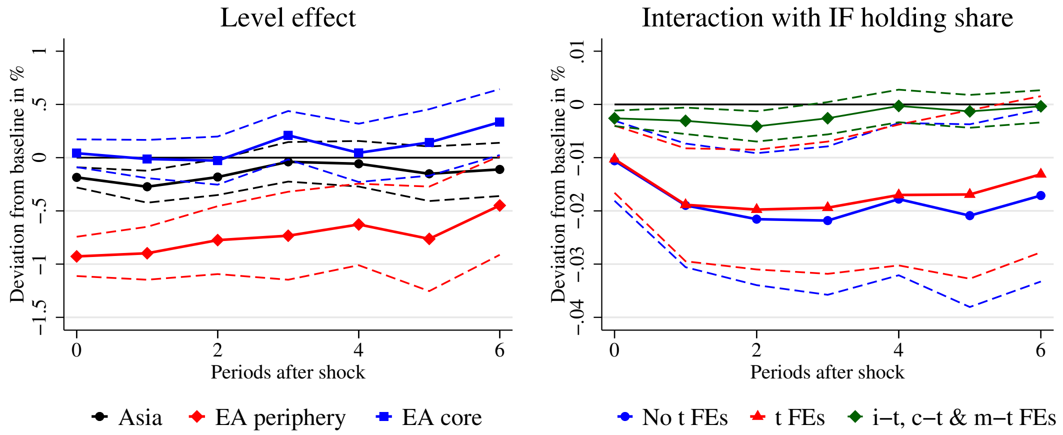
Note: The figure presents results for regressions of Equation (9) for alternative issuer samples. The baseline results are depicted by the black solid line with squared markers. Dashed lines indicate 90% confidence bands for the results from the baseline specification.

Figure B.15: Effects of euro disaster risk shocks on Asian sovereign debt holdings with Japan



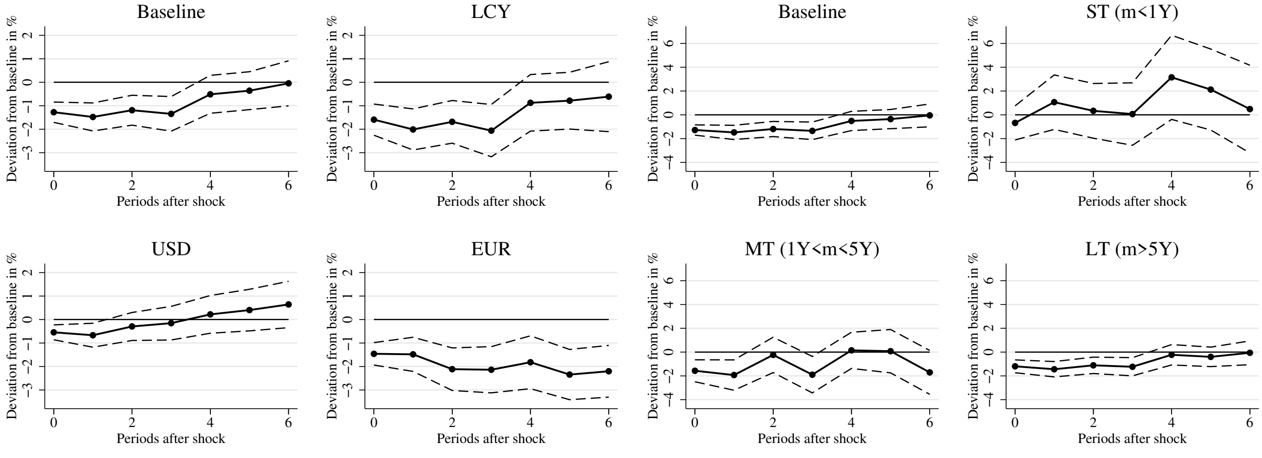
Note: The left-hand side panel presents the effect of euro disaster risk shocks on investment-fund holdings of Asian sovereign debt from regressions with (red triangle solid line) and without Japanese sovereign debt (blue circled solid line). The right-hand side panel additionally shows the effect of euro disaster risk shocks on fund holdings of Japanese sovereign debt (red triangle solid line).

Figure B.16: Effects of euro disaster risk shocks of Asian sovereign debt holdings for different investment-fund ISIN holding shares compared to euro area periphery and core



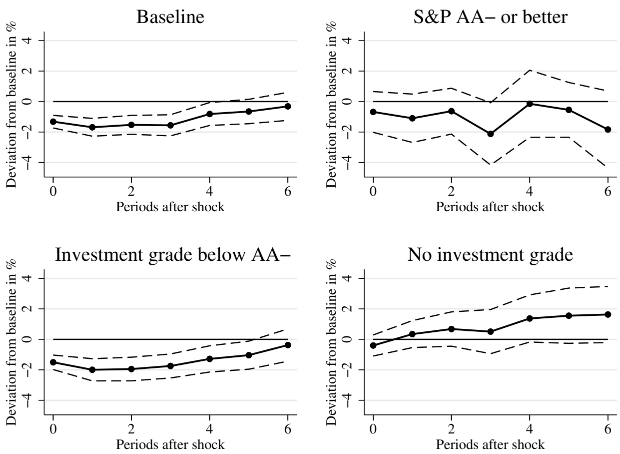
Note: The left-hand side panel shows the effect of euro disaster risk shocks on the bond price of the average Asian sovereign bond estimated from Equation (10). The black solid line with circle markers depicts results for Asian sovereign debt, the red solid line with diamond markers for euro area periphery and the blue solid line with square markers euro area core sovereign debt. The right-hand side panel shows the estimate of the interaction $\phi^{(\ell)}$ in Equations (11) and (12).

Figure B.17: Investment fund responses to euro disaster risk shocks across debt currency and residual maturity



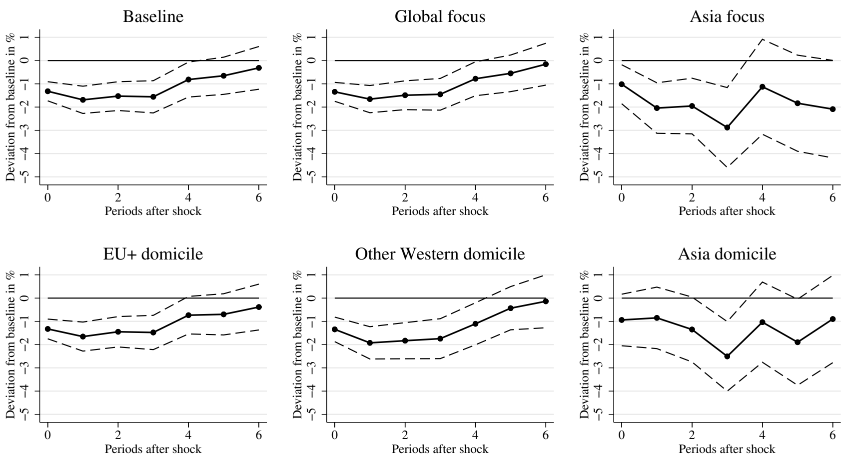
Note: The figure presents results for regressions of Equation (9) for subsamples of the baseline specification. The panels in the first two columns present results for regressions of Equation (9) for fund holdings of Asian sovereign debt denominated in different currencies, and the panels in the last two columns for fund holdings of Asian sovereign debt in different residual maturity buckets.

Figure B.18: Investment fund responses to euro disaster risk shocks across issuer characteristics



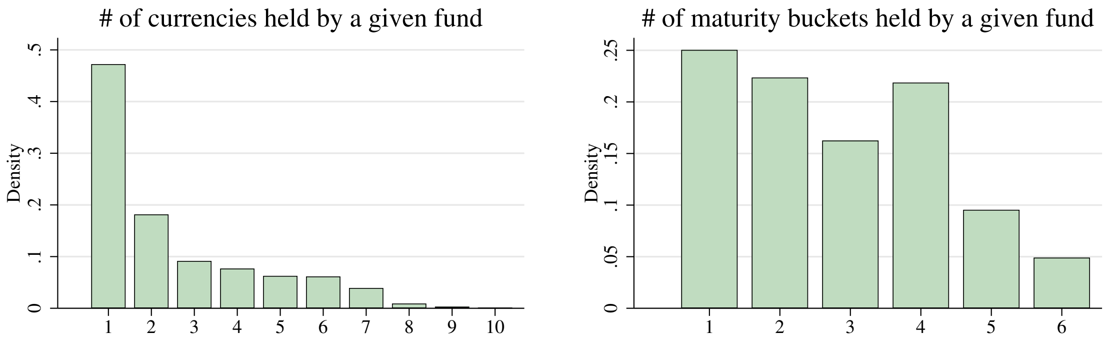
Note: The figure presents results for regressions of Equation (9) for subsamples of the baseline specification in terms of different issuer economy credit risk.

Figure B.19: Investment fund responses to euro disaster risk shocks across fund characteristics



Note: The figure presents results for regressions of Equation (9) for subsamples of the baseline specification in terms of different fund types.

Figure B.20: Number of currencies and maturities held by a given fund



Note: The left-hand side panel shows the distribution of the number of currency denominations on which investment funds in the sample hold Asian sovereign debt. The right-hand side panel shows the analogous distribution for the residual maturity buckets of less than six months, between six months and one year, between one and three years and three years, between three and five years, between five and ten years, and above ten years.

C Conceptual framework

C.1 Derivation of the proxy-variable equation

Consider K^w euro area issuer-specific variables $\boldsymbol{w}_{it}$ and K^η common variables $\boldsymbol{\eta}_t$ and assume they evolve according to

$$\boldsymbol{R}_0^w \boldsymbol{w}_{it} = \boldsymbol{R}_1^w \boldsymbol{w}_{i,t-1} + \mathbb{1}(i \in \mathcal{P})\boldsymbol{\Lambda}^{w,p}\boldsymbol{\eta}_t + \mathbb{1}(i \in \mathcal{C})\boldsymbol{\Lambda}^{w,c}\boldsymbol{\eta}_t + \boldsymbol{u}_{it}^w, \tag{C.1}$$

$$\boldsymbol{R}_0^\eta \boldsymbol{\eta}_t = \boldsymbol{R}_1^\eta \boldsymbol{\eta}_{t-1} + \boldsymbol{u}_t^\eta, \tag{C.2}$$

where $\mathbb{1}(i \in \mathcal{C})$ is an indicator variable that returns unity if issuer i is a euro area core economy. The reduced form of Equation (C.2) is

$$\boldsymbol{\eta}_t = \boldsymbol{\mathcal{R}}_1^\eta \boldsymbol{\eta}_{t-1} + \boldsymbol{\mathcal{R}}_0^\eta \boldsymbol{u}_t^\eta, \tag{C.3}$$

where $\boldsymbol{\mathcal{R}}_1^\eta \equiv (\boldsymbol{R}_0^\eta)^{-1}\boldsymbol{R}_1^\eta$ and $\boldsymbol{\mathcal{R}}_0^\eta \equiv (\boldsymbol{R}_0^\eta)^{-1}$.

Then, of the $i = 1, 2, \ldots, N_i$ euro area issuers, order the $N_{i,p}$ periphery issuers $i \in \mathcal{P}$ before all $N_{i,c}$ core issuers $i \in \mathcal{C}$ so that $\boldsymbol{w}_t \equiv (\boldsymbol{w}'_{1t}, \boldsymbol{w}'_{2t}, \ldots, \boldsymbol{w}'_{N_{i,p}t}, \boldsymbol{w}'_{N_{i,p}+1,t}, \boldsymbol{w}'_{N_{i,p}+2,t}, \ldots, \boldsymbol{w}'_{N_{i,p}+N_{i,c},t})'$, and stack Equation (C.1) for all issuers using matrix notation

$$(\boldsymbol{I}_{N_i} \otimes \boldsymbol{R}_0^w)\, \boldsymbol{w}_t = (\boldsymbol{I}_{N_i} \otimes \boldsymbol{R}_1^w)\, \boldsymbol{w}_{t-1} + \begin{bmatrix} \boldsymbol{e}_{N_{i,p}} \otimes \boldsymbol{\Lambda}^{w,p} \\ \boldsymbol{e}_{N_{i,c}} \otimes \boldsymbol{\Lambda}^{w,c} \end{bmatrix} \boldsymbol{\eta}_t + \boldsymbol{u}_t^w, \tag{C.4}$$

where $\boldsymbol{e}_k$ is a $k \times 1$ vector of ones for some positive number k. Solving for the reduced form gives

$$\boldsymbol{w}_t = \left[\boldsymbol{I}_{N_i} \otimes (\boldsymbol{R}_0^w)^{-1}\boldsymbol{R}_1^w\right] \boldsymbol{w}_{t-1} + \begin{bmatrix} \boldsymbol{e}_{N_{i,p}} \otimes (\boldsymbol{R}_0^w)^{-1}\boldsymbol{\Lambda}^{w,p} \\ \boldsymbol{e}_{N_{i,c}} \otimes (\boldsymbol{R}_0^w)^{-1}\boldsymbol{\Lambda}^{w,c} \end{bmatrix} \boldsymbol{\eta}_t + \left[\boldsymbol{I}_{N_i} \otimes (\boldsymbol{R}_0^w)^{-1}\right] \boldsymbol{u}_t^w \tag{C.5}$$

Then use the reduced form in Equation (C.3) to substitute the contenporaneous common variables $\boldsymbol{\eta}_t$ in Equation (C.5)

$$\begin{aligned} \boldsymbol{w}_t &= \left[\boldsymbol{I}_{N_i} \otimes (\boldsymbol{R}_0^w)^{-1}\boldsymbol{R}_1^w\right] \boldsymbol{w}_{t-1} + \begin{bmatrix} \boldsymbol{e}_{N_{i,p}} \otimes (\boldsymbol{R}_0^w)^{-1}\boldsymbol{\lambda}^{\psi,p} \\ \boldsymbol{e}_{N_{i,c}} \otimes (\boldsymbol{R}_0^w)^{-1}\boldsymbol{\lambda}^{\psi,c} \end{bmatrix} (\boldsymbol{\mathcal{R}}_1^\eta \boldsymbol{\eta}_{t-1} + \boldsymbol{\mathcal{R}}_0^\eta \boldsymbol{u}_t^\eta) + \left[\boldsymbol{I}_{N_i} \otimes (\boldsymbol{R}_0^w)^{-1}\right] \boldsymbol{u}_t^w \\ &= \left[\boldsymbol{I}_{N_i} \otimes (\boldsymbol{R}_0^w)^{-1}\boldsymbol{R}_1^w\right] \boldsymbol{w}_{t-1} + \begin{bmatrix} \boldsymbol{\Pi}^{\eta,p} \\ \boldsymbol{\Pi}^{\eta,c} \end{bmatrix} \boldsymbol{\eta}_{t-1} + \begin{bmatrix} \boldsymbol{\Phi}^{\eta,p} \\ \boldsymbol{\Phi}^{\eta,c} \end{bmatrix} \boldsymbol{u}_t^\eta + \left[\boldsymbol{I}_{N_i} \otimes (\boldsymbol{R}_0^w)^{-1}\right] \boldsymbol{u}_t^w. \end{aligned} \tag{C.6}$$

Next, define a selection vector $\boldsymbol{s}$ so that we obtain the periphery-core CDS spread

$$\boldsymbol{s}\boldsymbol{w}_t = \frac{1}{N_{i,p}}\sum\nolimits_{i\in\mathcal{P}} cds_{it} - \frac{1}{N_{i,p}}\sum\nolimits_{i\in\mathcal{C}} cds_{it} \equiv \overline{cds}_t^p - \overline{cds}_t^c, \tag{C.7}$$

that is $\boldsymbol{s}$ features $\frac{1}{N_{i,p}}$ at those positions that correspond to positions of the CDS spread for periphery issuer economies in $\boldsymbol{w}_t$, and $-\frac{1}{N_{i,c}}$ at those positions that correspond to positions of the CDS spread for core issuer economies in $\boldsymbol{w}_t$, and zeros elsewhere. Then, when left-multiplying Equation (C.6) by $\boldsymbol{s}$ and defining ℓ the position of the CDS spread in $\boldsymbol{w}_{it}$, we get for each individual component on the right-hand side

$$\begin{aligned}
\boldsymbol{s}\left[\boldsymbol{I}_{N_i}\otimes(\boldsymbol{R}_0^w)^{-1}\boldsymbol{R}_1^w\right]\boldsymbol{w}_{t-1} &= \boldsymbol{s}\left[\boldsymbol{I}_{N_i}\otimes\boldsymbol{\mathcal{W}}\right]\boldsymbol{w}_{t-1} \\
&= \frac{1}{N_{i,p}}\sum\nolimits_{i\in\mathcal{P}}\sum\nolimits_{j=1}^{K^w}\mathcal{W}_{\ell,j}w_{ij,t-1} - \frac{1}{N_{i,c}}\sum\nolimits_{i\in\mathcal{C}}\sum\nolimits_{j=1}^{K^w}\mathcal{W}_{\ell,j}w_{ij,t-1} \\
&= \sum\nolimits_{j=1}^{K^w}\mathcal{W}_{\ell,j}\left(\overline{w}_{j,t-1}^p - \overline{w}_{j,t-1}^c\right) \\
&= \boldsymbol{\varpi}\left(\overline{\boldsymbol{w}}_{t-1}^p - \overline{\boldsymbol{w}}_{t-1}^c\right),
\end{aligned} \tag{C.8}$$

and

$$\begin{aligned}
\boldsymbol{s}\begin{bmatrix}\boldsymbol{\Pi}^{\eta,p}\\ \boldsymbol{\Pi}^{\eta,c}\end{bmatrix}\boldsymbol{\eta}_{t-1} &= \frac{1}{N_{i,p}}\sum\nolimits_{i\in\mathcal{P}}\sum\nolimits_{j=1}^{K^\eta}\Pi_{\ell,j}^{\eta,p}\eta_{j,t-1} - \frac{1}{N_{i,c}}\sum\nolimits_{i\in\mathcal{C}}\sum\nolimits_{j=1}^{K^\eta}\Pi_{\ell,j}^{\eta,c}\eta_{j,t-1} \\
&= \sum\nolimits_{j=1}^{K^\eta}\left(\frac{1}{N_{i,p}}\sum\nolimits_{i\in\mathcal{P}}\Pi_{\ell,j}^{\eta,p} - \frac{1}{N_{i,c}}\sum\nolimits_{i\in\mathcal{C}}\Pi_{\ell,j}^{\eta,c}\right)\eta_{j,t-1} \\
&= \sum\nolimits_{j=1}^{K^\eta}\overline{\Pi}_{\ell,j}^{\eta}\eta_{j,t-1} \\
&= \overline{\boldsymbol{\pi}}^{\eta}\boldsymbol{\eta}_{t-1}
\end{aligned} \tag{C.9}$$

and

$$\begin{aligned}
\boldsymbol{s}\begin{bmatrix}\boldsymbol{\Phi}^{\eta,p}\\ \boldsymbol{\Phi}^{\eta,c}\end{bmatrix}\boldsymbol{u}_t^{\eta} &= \frac{1}{N_{i,p}}\sum\nolimits_{i\in\mathcal{P}}\sum\nolimits_{j=1}^{K^\eta}\Phi_{\ell,j}^{\eta,p}u_{jt}^{\eta} - \frac{1}{N_{i,c}}\sum\nolimits_{i\in\mathcal{C}}\sum\nolimits_{j=1}^{K^\eta}\Phi_{\ell,j}^{\eta,c}u_{jt}^{\eta} \\
&= \sum\nolimits_{j=1}^{K^\eta}\left(\frac{1}{N_{i,p}}\sum\nolimits_{i\in\mathcal{P}}\Phi_{\ell,j}^{\eta,p} - \frac{1}{N_{i,c}}\sum\nolimits_{i\in\mathcal{C}}\Phi_{\ell,j}^{\eta,c}\right)u_{jt}^{\eta} \\
&= \sum\nolimits_{j=1}^{K^\eta}\overline{\Phi}_{j}^{\eta}u_{jt}^{\eta} \\
&= \overline{\boldsymbol{\varphi}}^{\eta}\boldsymbol{u}_t^{\eta}
\end{aligned} \tag{C.10}$$

and finally

$$
\begin{aligned}
\boldsymbol{s}\left[\boldsymbol{I}_{N_i} \otimes (\boldsymbol{R}_0^w)^{-1}\right] \boldsymbol{u}_t^w &= \boldsymbol{s}\left[\boldsymbol{I}_{N_i} \otimes \boldsymbol{\mathcal{R}}_0^w\right] \boldsymbol{u}_t^w \\
&= \frac{1}{N_{i,p}} \sum\nolimits_{i\in\mathcal{P}} \sum\nolimits_{j=1}^{K^w} \mathcal{R}_{0,\ell,j}^w u_{ijt}^w - \frac{1}{N_{i,c}} \sum\nolimits_{i\in\mathcal{C}} \sum\nolimits_{j=1}^{K^w} \mathcal{R}_{0,\ell,j}^w u_{ijt}^w \\
&= \sum\nolimits_{j=1}^{K^w} \mathcal{R}_{0,\ell,j}^w \left(\frac{1}{N_{i,p}} \sum\nolimits_{i\in\mathcal{P}} u_{ijt} - \frac{1}{N_{i,c}} \sum\nolimits_{i\in\mathcal{C}} u_{ijt}^c \right) \\
&= \overline{\boldsymbol{r}}^w \left(\overline{\boldsymbol{u}}_t^{w,p} - \overline{\boldsymbol{u}}_t^{w,c} \right). \qquad \text{(C.11)}
\end{aligned}
$$

Using the latter equations, the evolution of the periphery-core CDS spread obtained from multiplying Equation (C.6) by $\boldsymbol{s}$ (recall Equation (C.7)) is given by

$$
\overline{cds}_t^p - \overline{cds}_t^c \;=\; \boldsymbol{\varpi}\left(\overline{\boldsymbol{w}}_{t-1}^p - \overline{\boldsymbol{w}}_{t-1}^c\right) + \overline{\boldsymbol{\pi}}^\eta \boldsymbol{\eta}_{t-1} + \overline{\boldsymbol{\varphi}}^\eta \boldsymbol{u}_t^\eta + \overline{\boldsymbol{r}}^w \left(\overline{\boldsymbol{u}}_t^{w,p} - \overline{\boldsymbol{u}}_t^{w,c}\right), \qquad \text{(C.12)}
$$

which is the proxy variable Equation (2) in the main text, apart from subtracting the lagged CDS spread from both sides and singling out the euro disaster risk shock from the common shocks $\boldsymbol{u}_t^\eta$.

C.2 Is the CDS spread a valid proxy variable?

We put forth three pieces of evidence to argue that the change in the CDS spread satisfies the relevance condition $\alpha \neq 0$ and the exogeneity condition $\boldsymbol{\vartheta}^\eta = \mathbf{0}$ in Equation (2) and hence is a valid proxy variable for euro disaster risk shocks: (i) the CDS spread usually hardly moves, but when it does then it changes a lot and at these spikes a narrative analysis of intra-daily real-time news articles archived by the ECB Communications department indicates the drivers are events related to euro disaster risk and not other common macro-financial shocks ($\alpha \neq 0$, $\boldsymbol{\vartheta}^\eta = \mathbf{0}$); (ii) also over the full sample period the CDS spread is not correlated with industry-standard measures of common macro-financial shocks ($\boldsymbol{\vartheta}^\eta = \mathbf{0}$), while (iii) it is correlated with industry-standard measures of disaster risk shocks ($\alpha \neq 0$).

C.2.1 Drivers of CDS spread variation at the largest spikes

We next argue that spikes in the CDS spread can all be attributed to events interpreted by financial markets first and foremost as signals about the probability of a euro-related, institutional rare disaster rather than some other common macro-financial shock. In other words, we argue that in the months with the largest spikes in the CDS spread we have $\alpha \neq 0$ and $\boldsymbol{\vartheta}^\eta = \mathbf{0}$ in Equation (2).

Consider the months with the three largest spikes in the CDS spread. In July 2011, Moody's, Standard & Poor's, and Fitch downgraded the sovereign credit ratings for Greece, Portugal, and Ireland. In the case of Greece, the downgrade did not occur because of a deliberate government decision to raise new debt, but because rating agencies reached the view that European policymakers would impose a debt restructuring and involve private bondholders. Similarly, in May 2012 Greece held a general election which resulted in a fragmented parliament and difficulties forming a coalition government that would continue honoring the economy's obligations vis-à-vis the Troika institutions. And in May 2018 the announced snap elections after political deadlock between Italy's Prime Minister and President over a cabinet appointment were widely expected to deliver an even stronger mandate for anti-establishment, euro-sceptic parties.

Table C.1 provides more detail on the key events during the months with the five largest positive spikes in the CDS spread. It suggests that these are all related to unexpected election outcomes, resignations, disagreements between national governments and international institutions, regulatory/supervisory events, or discontinuous actions of private agents such as rating agencies. None of these events is related to debt supply or common macro-financial shocks other than euro disaster risk shocks. Figure C.1 presents the terms that appeared most frequently in Real-time News reports on the days with the largest changes in the CDS spreads discussed in Table C.1. Almost all terms relate quite intuitively to euro disaster risk.

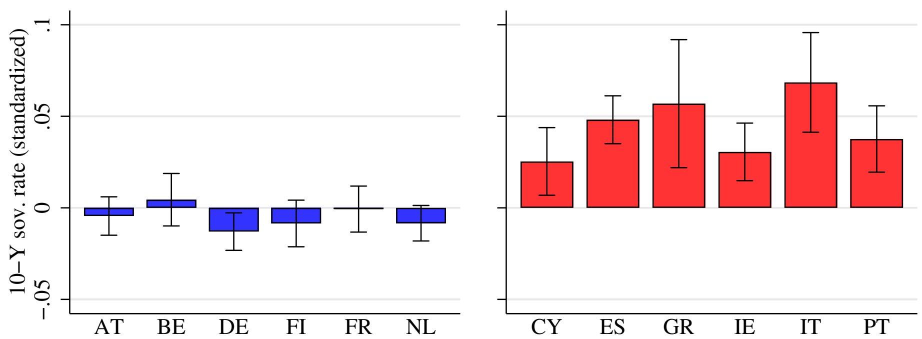
Analogous to Table C.1, Table C.2 considers the largest negative changes in the CDS spread. These events typically coincide with news about progress in reaching a political consensus on crisis responses and prevention such as the formation of the European Stability Mechanism (ESM) or the Single Supervisory Mechanism (SSM), agreements between national governments and international institutions, or ECB interventions. For example, the largest drop in the CDS spread occurred in October 2012 when the ECB's Governing Council announced the modalities of the Outright Monetary Transactions (OMT) program.

It is important to emphasize that although many of the events highlighted in Tables C.1 and C.2 were economy specific in terms of their geographical origin, given the frequency and time horizons of our analysis they are more usefully seen as common shocks. In particular, we treat geographically economy-specific shocks that induce large and synchronized spillovers and contagion already *within* the impact period t—a month in our case—as common shocks. Indeed, Figure C.2 documents that in the data we analyze increases in the CDS spread triggered an immediate, synchronized increase in sovereign

Figure C.1: Most frequent words in intra-daily real-time news reports on the days with the largest spikes in the CDS spread

Note: The figure shows a word cloud with the 150 terms that appeared most frequently in Real-time News reports on the days with the largest changes in the CDS spread discussed in Table C.1. The frequency of words is calculated using the Term-Document Matrix (TDM). TDM rows represent terms (words) and columns documents. The frequency of each word is calculated by summing the values in each row. The words are selected and plotted in different sizes based on their frequency. Words are excluded based on a list of common stopwords and additional specified terms, such as articles, conjunctions, prepositions, and other unimportant words like "and," "the," "or," month and day names, common verbs and words repeated in the Real-time News disclaimers.

Figure C.2: Contemporaneous, within-month changes in sovereign bond yields in response to increases in the CDS spread



Note: The panels show the impact-month effect of an increase in the CDS spread on 10-year sovereign bond yields in core (left-hand side) and periphery (right-hand side) economies. Estimates are obtained from economy-specific local projections estimated with monthly data. Whiskers indicate 90% confidence bands.

Table C.1: Prominent events occurring in the months with the five largest spikes in the periphery-core CDS spread

Date	$\Delta(\overline{cds}_t^p - \overline{cds}_t^c)$	**Event**
2018 May	*138.4bp*	
05/16	12.9bp	(Wed) Reports of draft agenda of the likely coalition parties of the populist, anti-establishment and euro-sceptic Five-Star Movement and the League that includes demands for the ECB to forgive EUR 250 billion of its Italian sovereign debt holdings (about 10% of outstanding stock) acquired under the Asset Purchase Program and a mechanism to allow leaving the euro if voters demand it.
05/21	16.1bp	(Mon) Reports the Five-Star Movement and the League leaders Luigi Di Maio and Matteo Salvini have agreed on forming coalition government with political newcomer Giuseppe Conte as Prime Minister to lead government coalition between the Five-Star Movement and the League.
05/23	15.3bp	(Wed) Uncertainty about whether President Sergio Mattarella will appoint Giuseppe Conte as Prime Minister.
05/25	16.5bp	(Fri) After President Sergio Mattarella appointed him as Prime Minister late on 05/23, Giuseppe Conte fails to agree on cabinet appointments with the Five-Star Movement and the League, including Paolo Savona as economy minister known for having questioned Italy's commitment to the euro area.
05/29	103.5bp	(Tue) After the withdrawal of Giuseppe Conte as Prime Minister due to the rejection of Paolo Savona as economy minister by President Sergio Mattarella, former IMF official Carlo Cottarelli is appointed as interim Prime Minister tasked with planning snap elections, which investors expect will deliver an even stronger mandate for the Five-Star Movement and the League.
2011 Jul	*119.6bp*	
07/06	19.2bp	(Wed) Moody's downgrades Portugal's sovereign credit rating to junk status Ba2 on 07/05.
07/08-11	30.7/41.6bp	(Fri/Mon) Euro area leaders and finance ministers in their meetings in Brussels on 07/08-10 (Friday-Sunday) discuss the ongoing sovereign debt crisis and possibilities for a restructuring of Greece's sovereign debt with private sector involvement.
07/18	20.4bp	(Mon) 5 Spanish and 2 Greek banks fail European Banking Authority (EBA) stress test, 16 others just passed.
07/25	25.7bp	(Mon) Euro area heads of state reach agreement on second bailout package for Greece on 07/21 (Thursday), including private sector participation (banks and other private investors to contribute to the bailout by taking a haircut on Greek debt holdings). Moody's downgrades Greece's sovereign credit rating arguing the proposed debt swap is equivalent to a default.
2012 May	*101.5bp*	
05/14	14.6bp	(Mon) After general election on 05/06 with fragmented parliament as outcome negotiations between party leaders of conservative New Democracy, Socialist Pasok and radical-leftist Syriza and Greek President Karolos Papoulias to form coalition government fail.
05/15	16.6bp	(Tue) President Karolos Papoulias announces new general elections must be held and caretaker government will be announced the next day.
05/23	20.6bp	(Wed) Outgoing Greek Prime Minister Lucas Papademos tells Wallstreet Journal on 05/22 risk of Greek exit from the euro area is "real" and he cannot rule out others might be preparing for return to the drachma. Reports that finance ministers decided at Eurogroup teleconference that euro area economies have to prepare contingency plans for Greek exit from the euro and ECB has put together team to prepare for this possibility. Bundesbank states euro area could cope with Greece backing out of the bailout program.
05/30	24.7bp	(Wed) Reports ECB rejected Spanish government plans to recapitalize troubled lender Bankia indirectly using ECB funds.
05/31	14.3bp	(Thu) Reports that the central bank of Greece refused to provide Emergency Liquidity Assistance (ELA) to French Credit Agricole for its Emporiki subsidiary that has recorded losses of EUR 6 billion.
2010 Aug	*85.0bp*	
08/11	14.1bp	(Wed) Slovak parliament reverses its previous decision and withdraws participation in the EU's bailout of Greece.
08/16	15.6bp	(Mon) Release of weak economic data accentuates concerns about the sustainability of Greece's public debt.
08/20	14.9bp	(Fri) EU Commission announces Greece should cut government spending by an additional EUR 4 billion to offset revenue shortfalls due to deepening recession.
08/24-25	12.8/12.9bp	(Tue-Wed) S&P downgrades Ireland's sovereign credit rating.
2010 Nov	*92.45bp*	
11/05	10.5bp	(Friday) Greece's opposition and ruling Socialist parties turn local elections on coming Sunday into referendum on the government's austerity measures. Prime Minister George Papandreou states he would have no choice but to call an early national election if voters reject austerity measures.
11/08	10.3bp	(Monday) German Chancellor Angela Merkel's coalition backs proposals to force private bondholders to participate in future bailouts of euro area economies.
11/22	12.7bp	(Monday) Ireland requests international bailout (on Sunday, 21 Nov).
11/23	10.4bp	(Tuesday) Ireland's coalition government under internal pressure of losing majority while it has to have the budget approved in parliament in order to receive assistance under the requested bailout. German Chancellor Angela Merkel states "Ireland is a cause for great concern" and the "euro is in an exceptionally serious situation", and German Finance Minister Schäuble states that "In this context, I want to say very clearly that our common currency is at risk".
11/26	14.0bp	(Friday) Euro area governments and the ECB reported to be urging Portugal to request a bailout. IMF and EU reported to be examining how senior bondholders could be compelled to participate in the costs of bailing out Ireland's banks.
11/29	21.3bp	(Monday) Ireland's Prime Minister Cowen announces Irish bailout (Sunday 11/28). Spain's and Portugal's sovereign CDS spreads soar to record highs through contagion.
11/30	11.1bp	(Tuesday) Borrowing costs for Portugal, Spain, Italy rise sharply through contagion as investors digest the implications of euro area finance ministers' decisions to impose losses on private bondholders.

Note: The table lists and provides information on key euro disaster risk events during the months with the five largest spikes in the CDS spread.

Table C.2: Prominent events occurring in the months with the five largest *negative* spikes in the periphery-core CDS spread

Date	$\Delta(cds_t^p - cds_t^c)$	**Event**
2012 Sep	*-99.9bp*	
09/03-05	-59.7bp	(Mon-Wed) ECB President Draghi and senior ECB officials communicate that the ECB buying euro area government bonds with maturities of up to three years would not violate European treaties. Draghi says the ECB's primary mandate compels it to intervene in bond markets to regain control of interest rates and ensure the euro's survival. FInancial markets expect an official ECB announcement for a bond-buying programme this week.
09/06	-42.5bp	(Thu) The ECB communicates the modalities of the Outright Monetary Transactions (OMT) programme, involving unlimited purchases of government debt that will be sterilized to assuage concerns about monetary financing. ECB President Draghi states that the OMT addresses bond market distortions and the unfounded fears of investors about the euro's irreversibility.
09/07	-39.5bp	(Fri) European heads of state praise the ECB's OMT announcement. German Finance Minister Wolfgang Schäuble bolsters the ECB announcement by saying its independence is something to value highly.
09/12	-18.8bp	(Wed) Germany's constitutional court rejects bids to halt the ratification of the European Stability Mechanism (ESM) treaty and the associated EUR 500 billion euro backstop. The EU publishes proposals for euro area bank oversight that require unprecedented cooperation between the ECB and national regulators.
2011 Jan	*-69.9bp*	
01/11-13	-38.3bp	(Tue-Thu) Greece, Spain and Portugal successfully auctioned EUR 1.95 billion, EUR 3 billion and EUR 1.25 billion respectively of government debt, calming financial market fears that Spain is on the brink of seeking a bailout.
2012 Jun	*-52.7bp*	
06/06-07	-30.7bp	(Wed-Thu) Reports that Spain is exploring the possibility of requesting up to 100 EUR billion in precautionary credit lines from the European Financial Stability Facility (EFSF) to support its ailing banks. German Chancellor Angela Merkel plays down expectations that a European summit at the end of the month could produce a master plan for the future of Europe but says it would come up with an agenda to integrate further.
06/19-20	-40.2bp	(Tue-Wed) Reports indicate that European leaders agree to move towards a more integrated banking system to stem a debt crisis that threatens the survival of the euro. After formally receiving an exploratory mandate from Greek President Karolos Papoulias, conservative New Democracy leader Antonis Samaras meets with other party heads to form an alliance to keep the promised reform policies on course.
06/29	-52.4bp	(Fri) European leaders agree to create the single supervisory mechanism (SSM) for euro area banks and to allow them to be recapitalized directly by the currency area's rescue funds without adding to government debt. European leaders also agree to ease repayment rules for emergency loans to Spanish banks and to relax conditions on potential help for Italy.
2012 Oct	*-51.8bp*	
10/05	-14.7bp	(Fri) Senior officials explain the ECB envisions buying large volumes of sovereign bonds for one to two months after the launch of its OMT programme.
10/16	-15.0bp	(Tue) Spanish Finance ministry gives first details of the economy's plan for seeking help with its debt problems from the newly founded European Stability Mechanism (ESM).
10/17	-38.4bp	(Wed) Troika institutions assess that Greece has made substantial progress on reform package needed to unlock further financial aids. European leaders spell out leading role for ECB in new euro area banking supervisory framework.
2013 Apr	*-29.1bp*	
04/02	-10.7bp	(Tue) The Cypriot government announced on Tuesday that the economy has concluded negotiations with its international creditors on the terms of its EUR 10 billion bailout and is set to receive its first installment of aid in May. Also, the International Monetary Fund reported that Latvia's "economic recovery is now well established," and the fund will close its resident representative office in Riga "in the summer of 2013."
04/10	-8.6bp	(Thu) European Central Bank President Mario Draghi indicated that the Governing Council is nearing action on interest rates and non-standard measures due to the struggling euro area economy. He mentioned extensive discussions about lowering borrowing costs and noted that economic weakness is spreading to more stable economies.
04/23	-11.7bp	(Tue) The European Commission reported a rise in its preliminary estimate for the headline measure of consumer confidence. Moreover, comments from European Central Bank policymakers, emphasizing falling inflation and poor growth prospects in the euro zone, suggest the ECB may consider a further cut in its main refinancing rate. ECB Vice-President Vitor Constancio noted that inflation had fallen and that a rate cut was "always a possibility."

Note: The table lists and provides information on key euro disaster risk events during the months with the five largest negative spikes in the CDS spread.

bond yields in key periphery but not core economies. In other words, spikes in the CDS spread typically sparked financial-market fears about *all* periphery economies' future in and thereby the *overall* integrity of the euro area.

In sum, given that the largest spikes in the CDS spread can straightforwardly be attributed to events associated with euro disaster risk but not other common macro-financial shocks implies that at least on these key dates $\alpha \neq 0$ and $\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$ in Equation (2).

C.2.2 Drivers of CDS spread variation over the full sample period

We next argue that also for our overall sample period the variation in the CDS spread is not due to common macro-financial shocks other than euro disaster risk shocks (i.e., $\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$ in Equation (2)). To do so, we estimate the proxy-variable Equation (2) with industry-standard measures of key common macro-financial shocks and show that none of them systematically affects the CDS spread.

Suppose we have measures for common macro-financial shocks other than euro disaster risk shocks

$$\widehat{\tilde{\boldsymbol{u}}}_t^{\eta} = \tilde{\boldsymbol{u}}_t^{\eta} + \boldsymbol{\tau}_t^{\tilde{u}}, \tag{C.13}$$

where $\boldsymbol{\tau}_t^{\tilde{u}}$ is a classical measurement error. Against the background of the proxy-variable Equation (2), we estimate

$$\Delta(\overline{cds}_t^p - \overline{cds}_t^c) = \boldsymbol{\varpi} \boldsymbol{d}_{t-1} + \boldsymbol{\vartheta}^{\eta} \widehat{\tilde{\boldsymbol{u}}}_t^{\eta} + \nu_t, \tag{C.14}$$

where $\boldsymbol{d}_{t-1} \equiv (\boldsymbol{w}_{t-1}^{p\prime} - \boldsymbol{w}_{t-1}^{c\prime}, \boldsymbol{\eta}_{t-1^{\prime}})^{\prime}$, $\boldsymbol{\varpi} \equiv (\boldsymbol{\varpi}^{w\prime}, \boldsymbol{\varpi}^{\eta\prime})^{\prime}$, and $\nu_t \equiv \alpha\phi_t - \boldsymbol{\vartheta}^{\eta}\boldsymbol{\tau}_t^{\tilde{u}}$. Our goal is to show that we cannot reject $H_0 : \boldsymbol{\vartheta}^{\eta} = \mathbf{0}$. Note that in general, Equation (C.14) is subject to attenuation bias in $\widehat{\boldsymbol{\vartheta}}^{\eta}$ as $Cov(\widehat{\tilde{\boldsymbol{u}}}_t^{\eta}, \nu_t) \neq 0$ by construction. However, the measures of the common macro-financial shocks we use are the industry standard in the literature and thus believed to be strong instruments with little measurement error (see e.g. Jarociński and Karadi 2020; Caldara and Iacoviello 2022; Känzig 2021).

Table C.3 shows the results. In Columns (1) and (2) we include the measures for conventional monetary policy (CMP) shocks and central bank information (CBI) effects for the US and the euro area from Jarociński and Karadi (2020); Column (1) uses the poor man's approach and Column (2) the rotational sign restrictions approach to construct these from asset price surprises around monetary policy announcements. Columns (3) and (4) additionally include unconventional monetary policy (UMP) shock measures. In particular, for the US, in Column (3) we include the conventional Federal funds rate, forward guidance and quantitative easing shock measures of Swanson (2021), and in Column (4) we include the conventional Federal funds rate, forward guidance, quantitative easing as well as the Delphic forward guidance (CBI effect) shock measures of Jarociński (2024). For the euro area we consider the target, timing, forward guidance and quantitative easing shock measures of Altavilla et al. (2019). In all columns, we also include the geopolitical risk acts and threats shock measures of Caldara and Iacoviello (2022) as well as the oil supply shock measure of Känzig (2021). All shock measures are signed so that a positive value is contractionary/adverse. While some estimates are statistically significant, the patterns are not systematic across specifications (Columns 1 and 2) or have the wrong sign (Column 4).

In sum, using industry-standard measures for key common macro-financial shocks, we cannot reject the hypothesis that the exogeneity condition $\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$ in Equation (2) is satisfied also in the sample period overall.

C.2.3 Direct comparison to existing measures for disaster risk shocks

Finally, we argue that the variation in the CDS spread is due to euro disaster risk shocks ($\alpha \neq 0$ in Equation (2)) over the whole sample period and not only on the key events discussed in Section C.2.1. To do so, we estimate the proxy-variable Equation (2) with industry-standard measures of broadly-defined disaster risk shocks and show that they systematically affect the CDS spread.

Suppose that analogously to Equation (C.14) we have a measure for euro disaster risk shocks

$$\widehat{\phi}_t = \phi_t + \tau_t^{\phi}, \tag{C.15}$$

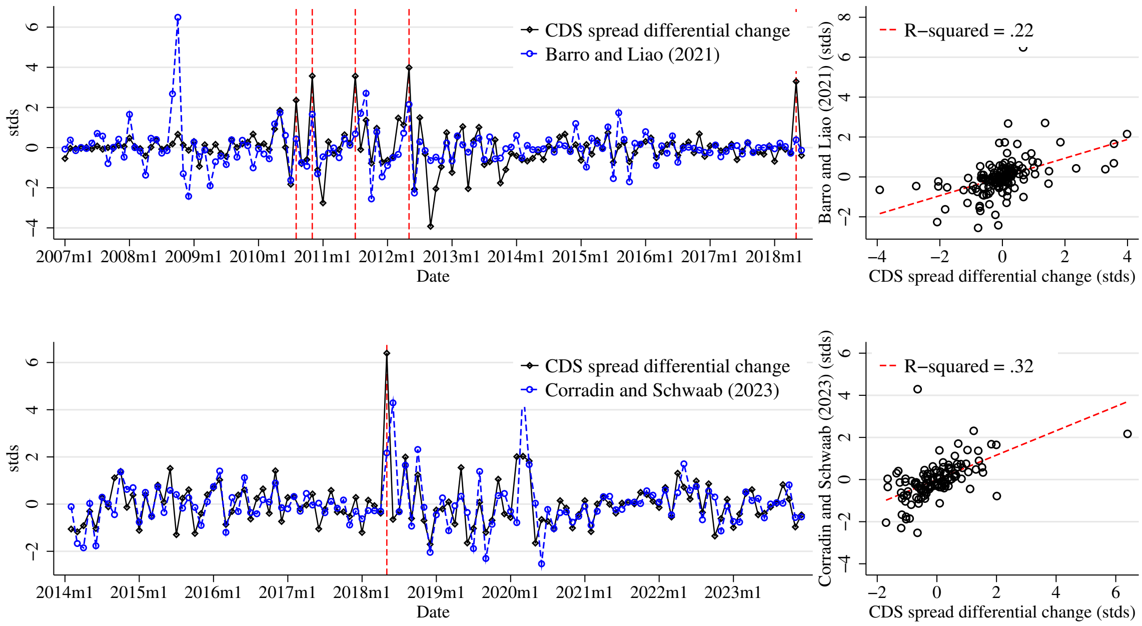
where τ_t^{ϕ} is again classical measurement error; the latter may capture that $\widehat{\phi}_t$ reflects the risk of a broader than only euro-related, institutional disaster. Against the background of the proxy variable Equation (2) we extend Equation (C.14) and estimate

$$\Delta(\overline{cds}_t^p - \overline{cds}_t^c) = \boldsymbol{\varpi}\boldsymbol{d}_{t-1} + \alpha\widehat{\phi}_t + \boldsymbol{\vartheta}^{\eta}\widehat{\widetilde{\boldsymbol{u}}}_t^{\eta} + \nu_t, \tag{C.16}$$

where now $\nu_t \equiv -\alpha\tau_t^{\phi} - \boldsymbol{\vartheta}^{\eta}\boldsymbol{\tau}_t^{\tilde{u}}$. For $\widehat{\phi}_t$ we consider the rare disaster risk measures of Barro and Liao (2021) and Corradin and Schwaab (2023), respectively. Barro and Liao (2021) estimate monthly rare disaster probabilities until June 2018 for several economies, including the euro area, based on stock market data and an options-pricing formula with recursive preferences. Corradin and Schwaab (2023) estimate an unobserved components model that decomposes sovereign bond yields into premia in terms of latent factors, of which we consider the sum of default and redenomination risk premia (identified using the so-called ISDA basis). For these components we then calculate the difference between the average for Italy and Spain and the average for Germany and France.

Figure C.3 compares the CDS spread with the measure of Barro and Liao (2021) from January 2007 to December 2018 and the measure of Corradin and Schwaab (2023) from January 2014 to December 2023. The correlation between the CDS spread and these disaster risk measures is striking, especially given that the estimators, data, and sample periods are quite different.

Figure C.3: Comparison of the CDS spread change with changes in existing euro area rare disaster risk measures



Note: The panels compare the change in the CDS spread to changes in the euro area rare disaster risk measures of Barro and Liao (2021) in the top row and the periphery-core in the (updated) redenomination/default risk premia measures of Corradin and Schwaab (2023) in the bottom row. In each row, the left-hand side panel plots the CDS spread and the existing rare disaster risk measure together over time and the the right-hand side presents a scatter plot of one against the other.

Table C.3 presents the results of the estimation of Equation (C.16). The coefficient estimates of the change in the disaster risk measure of Barro and Liao (2021) reported in the first row are highly statistically significant in all regressions. At the same time, the coefficients on all other common macro-financial shock measures are not statistically significant.

In sum, we interpret our findings in Sections C.2.1 to C.2.3 as suggesting that the CDS spread is a valid proxy variable for euro disaster risk shocks as $\alpha \neq 0$ and $\boldsymbol{\vartheta}^{\eta} = \mathbf{0}$

Table C.3: Correlation between CDS spread and standard measures of common macro-financial shocks including euro area rare disaster risk change measures

	(1) CMPs (poor man's)	(2) CMPs (rotational)	(3) UMPs (Altavilla et al) (Swanson)	(4) UMPs (Altavilla et al) (Swanson)
Barro & Liao (2021) rare disaster risk change	0.652***	0.558***	0.584***	0.589***
	(0.00)	(0.00)	(0.00)	(0.00)
ECB pure monetary policy shock	-0.033	0.105		
	(0.59)	(0.20)		
ECB information effect	0.009	-0.100		
	(0.95)	(0.49)		
Fed pure monetary policy shock	-0.173*	-0.143*		
	(0.07)	(0.05)		
Fed information effect	0.172	-0.074		
	(0.16)	(0.26)		
ECB conventional MP shock			-0.133	-0.130
			(0.31)	(0.32)
ECB timing factor shock			0.086	0.069
			(0.15)	(0.26)
ECB forward guidance shock			-0.006	0.000
			(0.94)	(1.00)
ECB QE shock			-0.097	-0.091
			(0.34)	(0.38)
Fed conventional policy shock			0.032	-0.064
			(0.65)	(0.27)
Fed forward guidance shock			-0.120	-0.063
			(0.19)	(0.51)
Fed QE shock			-0.057	-0.073
			(0.50)	(0.24)
Fed Delphic forward guidance shock				0.038
				(0.64)
Oil supply shock	0.098	0.154	0.132	0.117
	(0.20)	(0.16)	(0.16)	(0.17)
Geopolitical risk shock: Threats	0.278	0.337	0.258	0.246
	(0.18)	(0.15)	(0.25)	(0.27)
Geopolitical risk shock: Actions	-0.004	-0.046	-0.000	0.009
	(0.96)	(0.67)	(1.00)	(0.93)
$\boldsymbol{d}_{t-1}$	Yes	Yes	Yes	Yes
Observations	137	137	137	137

Note: The table reports results for regressions of Equation (C.16) with the euro rare disaster risk shock measure of Barro and Liao (2021) and the various measures of common shocks other than euro disaster risk shocks. In Columns (1) and (2) we include the pure monetary policy shocks and central bank information effects for the US and the euro area from Jarociński and Karadi (2020); Column (1) uses the poor man's approach and Column (2) the rotational sign restrictions approach to construct these. Columns (3) and (4) distinguish between conventional and unconventional monetary policy shocks. For the euro area we include the target, timing, forward guidance and quantitative easing factor surprises of Altavilla et al. (2019). For the US, in Column (3) we includes the conventional Federal funds rate, forward guidance and quantitative easing factors of Swanson (2021), and in Column (4) we include the conventional Federal funds rate, forward guidance, quantitative easing factors as well as the Delphic forward guidance (central bank information) effect of Jarociński (2024). In all columns we also include the geopolitical risk shocks in terms of acts and threats from Caldara and Iacoviello (2022) and the oil supply news from Känzig (2021). p-values are provided in parentheses below the point estimates. Asterisks indicate significance at 10%(*), 5%(**), and 1%(***). In $\boldsymbol{d}_{t-1}$ we include the lagged level of the CDS spread as well as lags of periphery-core spreads in year-on-year industrial production growth and the logarithm of the stock of central government debt outstanding.

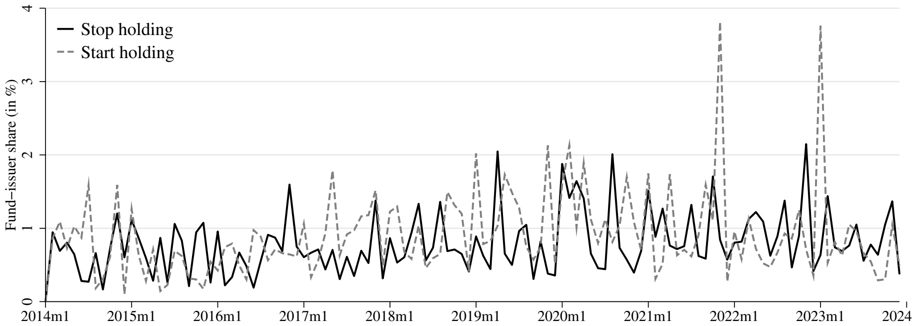
in Equation (2).

D Extensive vs. intensive-margin adjustments

In this appendix we document that the adjustments of fund holdings of Asian sovereign debt arise almost exclusively at the intensive margin.

Figure D.1 displays the evolution of the share of fund-issuer pairs that changes status from holding to non-holding and vice versa, that is $\sum_{i,f} \mathbb{1}(h_{fit} = 0 | h_{fi,t-1} > 0)/\sum_{i,f} \mathbb{1}(h_{fi,t-1} > 0)$ and $\sum_{i,f} \mathbb{1}(h_{fit} > 0 | h_{fi,t-1} = 0)/\sum_{i,f} \mathbb{1}(h_{fi,t-1} = 0)$, respectively.[18] With about 1% on average, the share of fund-issuer pairs that changes status is rather small.

Figure D.1: Evolution of the share of fund-issuer pairs changing holding status



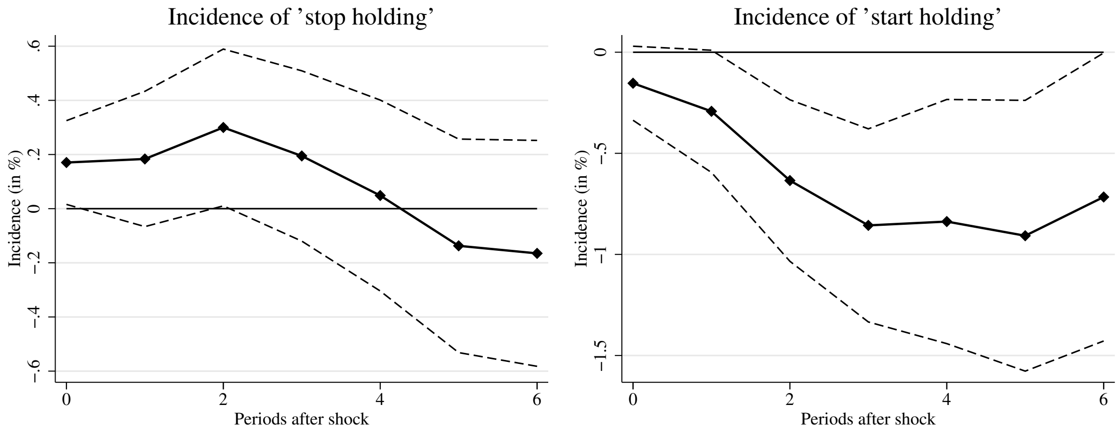
Note: The panels show for every period the share of fund-issuer pairs that changes from holding to non-holding status (solid line, $\sum_{i,f} \mathbb{1}(h_{fit} = 0 | h_{fi,t-1} > 0)/\sum_{i,f} \mathbb{1}(h_{fi,t-1} > 0)$, "Stop holding") and from non-holding to holding status (dashed line, $\sum_{i,f} \mathbb{1}(h_{fit} > 0 | h_{fi,t-1} = 0)/\sum_{i,f} \mathbb{1}(h_{fi,t-1} = 0)$, "Start holding").

We explore the role of extensive-margin adjustments more systematically using local projections. In particular, for each local-projection horizon ℓ we consider two different alternative dependent variables $\mathbb{1}(\cdot)$ in Equation (9) without lagged holdings: $\mathbb{1}(h_{fi,t+s} = 0 \text{ for some } 0 \leqslant s \leqslant \ell | h_{fi,t-1} > 0)$, which equals unity if a fund did not hold any debt of issuer i in some period $t+s$ with $\ell \geqslant s \geqslant 0$ after it did in period $t-1$; and $\mathbb{1}(h_{fi,t+s} > 0 \text{ for some } 0 \leqslant s \leqslant \ell | h_{fi,t-1} = 0)$, which equals unity if fund f held debt of issuer i in some period $t+s$ with $\ell \geqslant s \geqslant 0$ after it did not in $t-1$. Note that due to the survivorship bias in RL (see Section 4.2), we know that a fund for which $\mathbb{1}(h_{fit} = 0 | h_{fi,t-1} > 0) = 1$ does not drop out of the sample but only stops holding debt of sovereign issuer i, and analogously for $\mathbb{1}(h_{fit} > 0 | h_{fi,t-1} = 0) = 1$. This is because we only have funds in the full sample period that were still in the sample in December 2023.

[18]For the analysis of extensive-margin adjustments we insert zero entries for h_{fit} in every period in which RL reports a fund holds some other asset but information on holdings of Asian sovereign debt is originally missing.

Figure D.2 shows that a euro disaster risk shock increases the incidence that the average fund stops holding Asian sovereign debt by shedding all its holdings (left-hand side panel). The effect is statistically significant on impact with an increase in the incidence of stop holding by about 0.2%. In turn, a euro disaster risk shock reduces the incidence that the average fund which does not Asian debt purchases some, estimated relatively precisely (right-hand side panel). Table D.1 provides more information on the regression results at horizon $\ell = s = 0$, including the total number of observations, the number of funds, and the number of holding-status changes.

Figure D.2: Extensive-margin effects of euro disaster risk shocks on investment-fund holdings of euro area sovereign debt



Note: The left-hand side panel shows the impulse response of the incidence of the average fund that holds the corresponding debt stopping holding Asian sovereign debt. The right-hand side panel shows analogous results for the incidence of the average fund to start holding some Asian sovereign debt. The responses for horizon ℓ are obtained from regressions of Equation (9) without lagged holdings as control and using as dependent variables $\mathbb{1}(h_{fi,t+s} = 0 \text{ for some } 0 \leqslant s \leqslant \ell | h_{fi,t-1} > 0)$ and $\mathbb{1}(h_{fi,t+s} > 0 \text{ for some } 0 \leqslant s \leqslant \ell | h_{fi,t-1} = 0)$, $\ell = 0, 1, 2, \ldots, 12$. Dashed lines indicate 90% confidence bands. Standard errors are clustered at the fund level and issuer × time level. Periods refer to months.

We next explore how much of the change in fund holdings in response to euro disaster risk shocks in Figure 15 is due to adjustments at the intensive margin. To so so, we re-run the local projections in Equation (9) but drop all observations for which $\mathbb{1}(h_{fit} = 0 | h_{fi,t-1} > 0) = 1$, that is when a fund sheds all its holdings of issuer i debt.

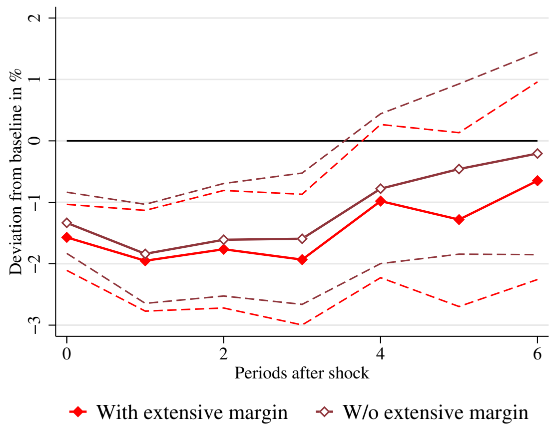
Figure D.3 presents the results. The lines with filled markers reproduce the baseline results from Figure 15, while the lines with hollow markers represent the results excluding the extensive margin. We find that almost the entire shedding of Asian sovereign debt in response to euro disaster risk shocks in Figure 15 is due to adjustments at the intensive margin. The difference between the responses of holdings with and without extensive-margin adjustment in Figure D.3 is small.

Table D.1: Regressions for extensive-margin effects

	(1) $\mathbb{1}$ (Stop holding)	(2) $\mathbb{1}$ (Start holding)
Euro disaster risk shock	0.170*	-0.153
	(0.07)	(0.17)
Proxy controls $\boldsymbol{d}_{t-1}$	Yes	Yes
Fund-issuer FEs	Yes	Yes
Total observations	293,645	321,932
Number of funds	3,640	3,256
Within R-squared	0.10	0.06
$\mathbb{1}(\cdot) = 1$	4,960	5,661

Note: The table reports results for the linear probability regressions based on Equation (9). The dependent variable in the regression underlying the results in Column (1) is given by $\mathbb{1}(h_{fit} = 0 | h_{fi,t-1} > 0)$, which equals unity if a fund did not hold any debt of issuer i in t after it did in the previous period $t-1$. The dependent variable in the regression underlying the results in Column (2) is given by $\mathbb{1}(h_{fit} > 0 | h_{fi,t-1} = 0)$, which equals unity if a fund held debt of issuer i in t after it did not do so in the previous period $t-1$. p-values are provided in parentheses below the point estimates. Asterisks indicate significance at 10%(*), 5%(**), and 1%(***). See also the notes to Table 2.

Figure D.3: Effects of euro disaster risk shocks on investment-fund holdings of euro area sovereign debt without extensive-margin adjustment



Note: The left-hand side panel shows the impulse response of a fund's holdings of Asian sovereign debt for the baseline specification which does not distinguish between extensive and intensive-margin adjustments (solid red line with filled diamonds) and for the specification in which the extensive-margin adjustment is excluded (solid maroon line with hollow diamonds). The right-hand side panel shows analogous results for core debt holdings. The responses for the intensive margin at horizon ℓ are obtained from regressions of Equation (9) excluding observations with $\mathbb{1}(h_{fit} = 0 | h_{fi,t-1} > 0) = 1$. Standard errors are clustered at the fund level and issuer × time level. Dashed lines indicate 90% confidence bands. Periods refer to months.

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