

## Have U.S. Treasuries Lost Their Momentum? Evidence From a New Taxonomy of Safe Assets

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### ABSTRACT

Is the departure of US Treasuries from conventional safe-haven behavior a US-specific phenomenon, or part of a broader reconfiguration of safe-asset markets? To answer this question, we develop a new empirical taxonomy of safe haven behavior, applied to a broad cross-section of sovereign and corporate bonds, currencies, and alternative assets over 2003-2026. US Treasuries rank among the strongest safe haven assets over the full sample, alongside a small set of other G10 sovereign bonds. However, we document a structural break since the pandemic: nominal and real rates US Treasuries now exhibit markedly weaker safe haven properties, both in absolute terms and relative to other global safe assets. This deterioration is not unique to the United States but reflects a broader pattern also affecting other advanced-economy sovereign bonds, and is associated with high inflation, elevated public debt, and changing debt investor-composition. By contrast, the US dollar retains its dominant safe haven status, pointing to a growing divergence between the safe haven properties of US Treasuries and those of the US dollar.

**Keywords:** Safe Assets, Safe Haven, U.S. Treasuries, Asset Pricing, Risk Aversion.

**JEL classification:** F31, E44, G01, G12, G15

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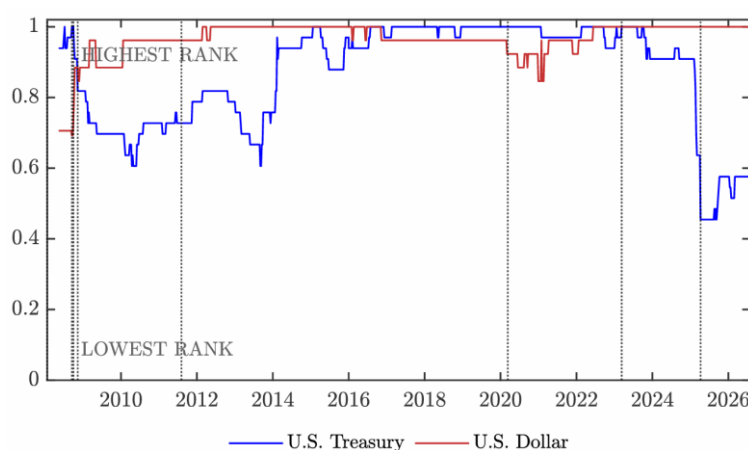
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## NON-TECHNICAL SUMMARY

Safe assets play a fundamental role in the global financial system because they are expected to preserve their value during periods of economic and financial stress. For many decades, US Treasury securities have been considered the global benchmark safe asset. However, recent events, including the COVID-19 crisis and subsequent episodes of market turbulence, have raised questions about whether US Treasuries still provide the same degree of protection during periods of heightened uncertainty. In this paper, we investigate whether these developments are specific to US Treasuries or whether they reflect broader changes in the behavior of safe assets more generally.

We examine a wide range of financial instruments, including government and corporate bonds, major currencies, and alternative assets such as gold and Bitcoin. Using over two decades of data, we evaluate how these assets behave during episodes of acute risk aversion and develop a framework to compare their safe haven characteristics. Our analysis identifies distinct groups of assets with different levels of resilience during market stress. We find that US Treasuries remain among the most robust safe assets, alongside the sovereign bonds of several advanced economies. We also show that some corporate bond markets exhibit characteristics similar to those of traditional safe assets. Among currencies, the US dollar, Japanese yen, and Swiss franc emerge as the most reliable safe haven currencies, while gold appears particularly effective during periods of geopolitical tension.

**Figure 1. Safe haven ranking of US Treasuries and the US Dollar on a 5-Year rolling window**



Note: US Treasuries (UST) are ranked relative to other global sovereign and corporate bonds; the US dollar (USD) is ranked relative to other currencies. Higher values correspond to higher rankings; the index ranges between 0 and 1. Vertical dotted lines highlight episodes of acute risk aversion. Rankings are computed using a 5-year rolling window.

We further analyze how the safe haven properties of assets have evolved over time. Our results indicate that US Treasuries have recently become less effective as safe havens relative to other traditionally safe assets. However, this decline is not unique to the United States; it reflects a broader weakening in safe-haven behavior across several asset classes. In contrast, the US dollar continues to hold its dominant position as the leading safe haven currency (Figure 1). We argue that these changes are associated with factors such as higher inflation, rising public debt, and changing debt investor-composition. Overall, our findings contribute to a better understanding of how safe assets are evolving in a changing global financial environment.

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# Les bons du Trésor américain ont-ils perdu de leur attrait ? Enseignements d'une nouvelle taxonomie des actifs sûrs

## RÉSUMÉ

Le recul du rôle traditionnel des bons du Trésor américain comme valeurs refuges est-il un phénomène propre aux États-Unis ou s'inscrit-il dans une reconfiguration plus large des marchés d'actifs refuges ? Pour répondre à cette question, nous développons une nouvelle taxonomie empirique du comportement de valeur refuge, appliquée à un vaste échantillon d'obligations souveraines et d'entreprises, de devises et d'actifs alternatifs sur la période 2003-2026. Sur l'ensemble de l'échantillon, les bons du Trésor américain figurent parmi les actifs refuges les plus performants, aux côtés d'un petit groupe d'autres obligations souveraines du G10. Nous mettons toutefois en évidence une rupture structurelle depuis la pandémie : les taux nominaux et réels des bons du Trésor américain présentent désormais des propriétés de valeur refuge nettement plus faibles, tant en termes absolus que relativement aux autres actifs refuges mondiaux. Cette détérioration n'est pas propre aux États-Unis ; elle reflète une tendance plus générale qui touche également les obligations souveraines d'autres économies avancées. Elle est associée à une inflation élevée, à un endettement public important et à une évolution de la composition de la base d'investisseurs en dette publique. À l'inverse, le dollar américain conserve son statut dominant de valeur refuge, ce qui met en évidence une divergence croissante entre les propriétés de valeur refuge des bons du Trésor américain et celles du dollar.

**Mots-clés :** actifs sûrs, valeurs refuges, obligations du Trésor américain, prix des actifs, aversion au risque.

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# 1 Introduction

Safe assets are central in modern financial systems. They serve as a store of value, which is expected to be preserved during adverse events (Caballero et al., 2017). As such, they are used as collateral in financial transactions, support prudential requirements and provide benchmark for asset pricing. The demand and supply of safe assets contribute to the determination of global equilibrium interest rates (Ferreira and Shousha, 2023; Szőke et al., 2024). For decades, US Treasury securities have been widely regarded as the benchmark safe asset in the international monetary system (Gourinchas and Rey, 2007).

Recent episodes of financial stress, however, have raised questions about the stability of this role. In particular, the response of US Treasury prices to risk-off shocks has at times departed from their conventional safe haven behavior. During the COVID-19 crisis, Treasury prices temporarily declined amid severe market stress, an unusual development given that Treasury prices typically rise in periods of financial turmoil (Vissing-Jorgensen, 2021; Eisenbach and Phelan, 2026; Adrian et al., 2025). In the years that followed, we observe gradual changes in the behavior of Treasury securities across episodes of risk aversion (Figure 1) coinciding with heightened geopolitical tensions, global monetary policy tightening cycle and fiscal expansion.

These developments raise the following question: Are these movements specific to US Treasuries, or do they reflect broader changes of behavior among safe assets?

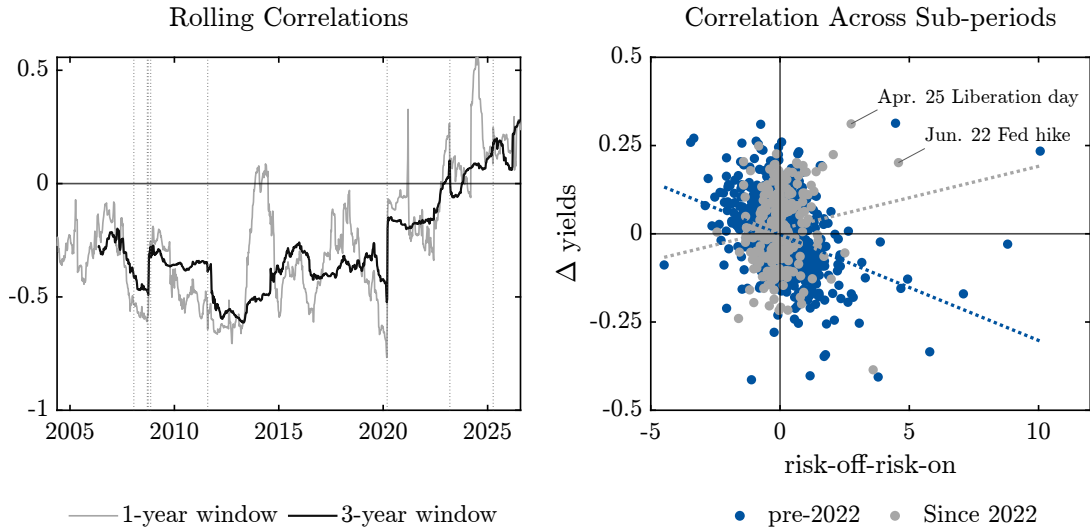


**Figure 1: Correlation between risk aversion and changes in US Treasury yields**

*Notes:* The left panel reports rolling correlations between the risk-on–risk-off index from Chari et al. (2023) and weekly changes in 10-year US Treasury yields, computed using 1-year and 3-year rolling windows. Vertical dotted lines indicate episodes of heightened risk aversion corresponding to realizations of the risk-on–risk-off index above its 99th percentile. The right panel reports the correlations for two subsamples: May 2003–December 2021 and January 2022–July 2026.

In this article, we provide an empirical assessment of the *relative* safe haven properties of a broad set of financial instruments classified based on a novel taxonomy of safe assets.

Using this framework we empirically evaluate the extent to which US Treasury safe haven behavior has deteriorated in the recent years relative to other global safe assets. Our analysis is conducted in two steps.

In the first part of the chapter, we provide a taxonomy of assets based on a k-means clustering methodology to group bonds according to economic fundamentals. We identify three groups of assets, which we label ex-post as “global safe assets”, “shallow-market assets” and “emerging market assets”. Within these groups, we rank the relative safe haven behavior of each asset based on a multidimensional set of criteria. We find that US Treasuries rank among the assets with the most pronounced safe haven behavior, alongside Swedish, Australian, German and British sovereign bonds. A limited set of corporate bond markets (particularly in Norway and Australia) rank relatively high among global safe assets. Among currencies, the US dollar, Japanese yen, and Swiss franc rank as the strongest safe haven reserve currencies, while the Australian dollar, the Canadian dollar and the Norwegian krone rank relatively lower compared to the ranking of their respective sovereign bonds, likely due to carry trade mechanisms. Finally, we show that, based on our multi-criteria taxonomy, gold performs well as a safe haven during periods of acute geopolitical risk, but exhibits moderate safe haven properties during typical episodes of risk aversion.

In the second part of the chapter, we reassess the relative safe haven properties of US Treasuries and the US dollar. To this end, we proceed in two steps. First, we translate our criteria into testable empirical specifications that allow us to assess *absolute* changes in the safe haven behavior of assets. Second, we implement our *relative* ranking approach over rolling windows to capture the dynamic reconfiguration of safe haven properties within the cluster of safe assets. Our results for recent periods indicate that although US Treasuries have exhibited weaker safe haven characteristics relative to other global safe assets in recent years, the same is not true for the US dollar, which continues to rank as the leading safe haven currency. We further show that the deterioration in the absolute safe haven performance of US Treasuries (also in real terms) is not unique to the United States. Rather, it reflects a broader pattern that affects other assets traditionally considered safe havens. We argue that weaker safe haven behavior is partly associated with heightened inflationary pressures, rising public debt levels, and lower share of price-sensitive investors holding the debt.

This chapter contributes to the safe asset literature in two main ways. First, the literature has long sought to identify which assets qualify as safe assets. This includes bond securities (Caballero et al., 2017; Cuevas, 2024), currencies (Habib and Stracca, 2012; Fatum et al., 2017), and alternative assets (see Baur and Lucey (2010) for gold). We contribute to this line of research by proposing a novel taxonomy of safe assets that ranks assets based on their relative safe haven properties within economically meaningful

groups.

Second, the safe asset literature has recently regained attention due to the unusual behavior of US Treasuries' yields. [Duffie \(2020\)](#) and [He et al. \(2022\)](#) show that the large-scale issuance of government debt following the pandemic revealed limits in the US Treasury market, as the intermediary sector struggled to absorb the resulting supply shock. [Gómez-Cram et al. \(2024\)](#) provide high-frequency evidence from the COVID-19 episode linking increases in US Treasury yields to negative news about future government surpluses. More recently, the tariff announcements in 2025 confirmed this atypical behavior of Treasury yields, pointing to a reduced willingness of foreign investors to pay a premium for the safety of dollar-denominated assets, including US Treasuries ([Jiang et al. \(2025\)](#)). [Du et al. \(2026\)](#) document a decoupling between the convenience yield on the US dollar and that on US Treasuries. Our work contributes to this strand of the literature by adopting a relative perspective: we assess the safe haven properties of US Treasuries not only in isolation, but in comparison with other fixed-income assets and across time, from the early 2000s to the present.

## 2 Defining safe (haven) assets

The notion of a *safe asset* has been the subject of a substantial and growing body of literature in international finance and macroeconomics ([Gorton, 2017](#); [Caballero et al., 2017](#); [Habib et al., 2020](#)). At its most fundamental level, a safe asset is an instrument that can be valued and transacted without expensive and prolonged research ([Gorton, 2017](#)). In the canonical formulation of [Gorton \(2017\)](#), no private actor has an incentive to produce information about the value of such asset because its value is common knowledge. This public information shared among market participants implies the absence of adverse selection concerns, allowing safe assets to serve simultaneously as a medium of exchange, a store of value, and a form of collateral. As a consequence, safe assets typically command a “convenience yield” that reflects the liquidity and safety services they provide to holders ([Krishnamurthy and Vissing-Jorgensen, 2012](#)). The status of a safe asset depends on fundamentals such as historical behavior of the asset, good institutions and the size of debt market ([Habib et al., 2020](#)).

A related concept is that one of the *safe haven* asset, which typically exhibits a negative beta: they preserve value, and even appreciate, when the aggregate market declines, making them valuable as portfolio insurance ([Baur and Lucey, 2010](#)). During financial distress (i.e. systemic banking crises, stock market crashes, geopolitical shocks, or global pandemics), investors tend to exhibit a flight-to-safety behavior by dis-investing from risky assets, such as equities and high-yield bonds, and reallocating capital toward instruments perceived as safe. While these definitions permit safe assets and safe haven assets to be mutually exclusive in principle, empirical evidence suggests that assets ful-

filling the structural criteria for safety also tend to exhibit safe haven behavior during acute stress episodes ([Habib et al., 2020](#); [Caballero et al., 2017](#)).

The lion share of studies focus on the dominant role of US Treasuries and the US dollar in the global financial system. Others explore whether alternative assets, such as emerging market bonds, gold, or cryptocurrencies, can also provide safe haven behavior.

Empirical evidence shows that Treasuries command a significant convenience yield reflecting their liquidity and collateral value ([Krishnamurthy and Vissing-Jorgensen, 2012](#)). However, recent research highlights potential fragility during episodes of extreme market stress. During the COVID-19 shock in March 2020, Treasury prices fell alongside equities amid a broad “dash-for-cash,” reflecting liquidity-driven sales by multiple investor classes ([Eisenbach and Phelan, 2026](#)). The episode was characterized by unusually high yield volatility, widening bid-ask spreads, and large-scale Federal Reserve interventions to stabilize market functioning ([Kahn and Nguyen, 2022](#)). These findings suggest that the safety of Treasuries depends not only on their credit quality but also on the resilience of the market infrastructure through which they are traded.

Sovereign bonds from emerging economies may provide safety services in global portfolios. The development of local-currency debt markets and the growing participation of international investors have transformed the landscape of emerging market sovereign borrowing. Foreign holdings of emerging market sovereign bonds increased substantially following the global financial crisis, raising the possibility that some of these instruments may generate safety premia similar to those observed for advanced-economy sovereign debt ([Arslanalp and Tsuda, 2014b](#)). Recent work finds evidence that local-currency sovereign bonds in several emerging economies exhibit convenience yields, particularly during episodes of country-specific risk ([Cuevas, 2024](#)).

Private debt instruments may provide safety services when traditional safe assets are scarce. Highly rated corporate bonds may act as partial substitutes for sovereign safe assets when investors demand collateral-like securities with low default risk ([Mota, 2023](#)). Empirical evidence suggests that investment-grade corporate bonds can exhibit safe haven characteristics during periods of market stress, particularly when correlations with equities decline in the lower tail of the return distribution ([Wang et al., 2025](#)).

Gold has long been considered a traditional safe haven and empirical studies generally confirm its ability to preserve value during periods of financial stress ([Gurdgiev and Petrovskiy, 2024](#)). More recent work extends this debate to digital assets such as Bitcoin. While some studies document episodic hedging or safe haven behavior, the evidence suggests that such properties are conditional and not structural, largely reflecting the asset’s high volatility and sensitivity to macro-financial shocks.

## 3 Data

In this section, we describe the data used in the analysis. We first present the risk-on–risk-off (RORO) indicator, which is used to identify episodes of heightened *global* financial stress, along with alternative measures. Second, we introduce the set of financial indices, macroeconomic fundamentals, and cyclical variables used in the analysis. The main results are based on a sample spanning from May 2003 to July 2026, which reflects the availability of data for the RORO indicator. For robustness analyzes and additional discussions based on alternative identification approaches, we extend the sample back to January 1990.

### 3.1 Identifying Risk Aversion Episodes

To identify episodes of acute risk aversion, we rely on the RORO index developed by [Chari et al. \(2023\)](#) and provided by the Kansas City Fed. This index provides a multifaceted<sup>1</sup> measure of realized variation in investor risk appetite, making it particularly well-suited for the analysis of safe assets. Its explicit *global* dimension is essential to capture the shifts in risk-bearing capacity that transcend national financial markets.

A higher value of the RORO index corresponds to a risk-off environment, that is, a deterioration in investors’ willingness to bear risk and elevated perceived uncertainty. Conversely, a lower value signals a risk-on environment characterized by strong risk appetite. Periods of risk aversion are typically characterized by a broad flight to safe assets, while periods of heightened risk appetite are associated with buoyant capital flows toward riskier assets. We consider several percentile-based thresholds of the RORO distribution to identify risk-off episodes. As illustrated in [Figure 2](#), focusing first on the top 1 percent of risk-off realizations isolates the most severe stress events in the global financial cycle since the early 2000s. These include the peak of the Global Financial Crisis, most notably the bankruptcy of Lehman Brothers and the market panic of October 2008, as well as the height of the COVID-19 crisis, characterized by sharp market sell-offs and pronounced flight-to-safety dynamics in March 2020. This upper tail also captures other well-known stress episodes, including the August 2011 global equity crash following the US sovereign downgrade, the banking stress of March 2023, and the period of elevated volatility associated with the introduction of new US tariff policies in April 2025.

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<sup>1</sup>The RORO index is constructed as the first principal component of daily changes across four categories of financial indicators: (i) advanced-economy credit risk (e.g., corporate and sovereign spreads), (ii) equity market volatility (e.g., the VIX), (iii) funding conditions (e.g., TED spread, FX swap basis), and (iv) currencies and gold (e.g., currency appreciation, gold prices). Each underlying series is standardized prior to the principal component extraction so that all dimensions contribute comparably to the index. The resulting index captures the dominant common factor driving co-movement across these markets. By construction, the index is normalized to have zero mean and unit variance over the sample period.

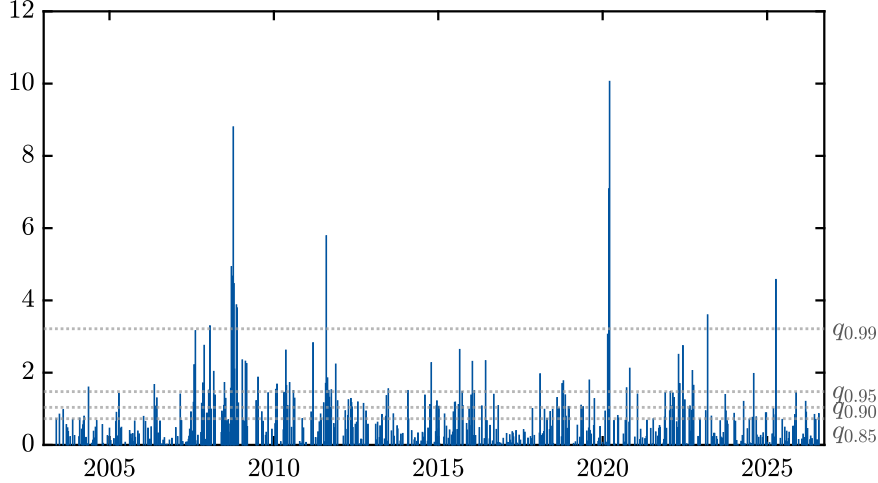


**Figure 2: Identification of Global Risk Aversion Episodes**

*Notes:* The figure reports positive realizations of the risk-on-risk-off (RORO) index, which correspond to risk-off episodes. Horizontal dotted lines denote thresholds corresponding to the upper 1%, 5%, 10% and 15% of the RORO distribution. The 99th, 95th, 90th, 85th, and 75th percentiles are 3.22, 1.48, 1.04 and .73, respectively. The sample spans May 2003 to July 2026. The RORO index is constructed by [Chari et al. \(2023\)](#).

Expanding the threshold to the top 5 percent allows us to capture a broader set of risk-off episodes. These include the pre-Lehman subprime turmoil in 2007, the escalation and aftermath of the Global Financial Crisis through 2009, episodes of the European sovereign debt crisis in 2010, and the taper tantrum of June 2013. This threshold also identifies market stress following Russia’s invasion of Ukraine in February 2022. In Appendix, Table B1 we detail the different key episodes of these different thresholds. We adopt the 90 percent threshold as our benchmark, while systematically assessing robustness to both more restrictive and more permissive cutoffs. Overall, the identified stress periods underscore the multifactorial nature of global financial stress and support the use of a common global indicator.

Table 1 reports the relative contribution of each underlying component of the multifaceted RORO index during acute risk-off episodes across subperiods. The results suggest that, since 2020, risk-off episodes have been driven primarily by credit-risk and equity-volatility factors. While equity-market volatility remains the dominant contributor throughout the sample period, the contribution of credit-risk factors is substantially higher than in previous decades. A similar pattern is observed for the currency-and-gold component, whose contribution has increased relative to earlier periods. By contrast, funding and liquidity conditions account for only a limited share of fluctuations in the RORO index, although their contribution is somewhat larger than during the immediate pre-pandemic period. Overall, these findings indicate that recent episodes of global risk aversion, as captured by the RORO index developed by [Chari et al. \(2023\)](#), have been

characterized by heightened concerns about credit conditions than was typically the case in earlier periods.

| Periods   | N  | Credit Spreads | Equity Volatility | Liquidity | Gold & Currency |
|-----------|----|----------------|-------------------|-----------|-----------------|
| 2003–2007 | 12 | 33.5           | 34.4              | 31.7      | 0.4             |
| 2008–2013 | 51 | 41.7           | 47.4              | 11.5      | -0.6            |
| 2014–2019 | 31 | 18.5           | 82.2              | 0         | -0.7            |
| 2020–2026 | 26 | 42.7           | 49.3              | 5.6       | 2.4             |

**Table 1: Contribution of sub-components to the RORO index**

*Note:* The table shows the proportion of variation, in percent, in the RORO index explained by each of its four sub-components. Contributions are calculated from the covariance between each subindex and the fitted value of the headline index, expressed relative to the total variance of the fitted index. The fitted index is obtained from a regression of the headline RORO index on all four sub-components. Negative values indicate that a subindex moved in the opposite direction of the fitted headline index during the estimation window.  $N$  is the number of acute risk-off episodes by each periods at upper 10% threshold.

In the robustness analysis, we consider alternative measures of risk appetite. First, we construct an orthogonalized version of the RORO index controlling for US monetary policy shocks provided by [Acosta et al. \(2025\)](#). This approach ensures that our results are not contaminated by monetary policy surprises in times of elevated risk aversion. Second, we purge the RORO index from the currency and gold component to discard any potential endogeneity issue when identifying acute risk-off episodes. Third, we rely on the widely used, albeit U.S.-centric, expected volatility of the S&P 500 Index derived from option prices, namely the VIX (see; [Bruno and Shin \(2015\)](#); [Avdjiev et al. \(2020\)](#); [Habib et al. \(2020\)](#)). Similar to the RORO index, an increase in the VIX is associated with higher risk aversion and, therefore, with states of the world in which safe assets are expected to become relatively more attractive. Available VIX data starts from January 1990. Finally, we consider the geopolitical risk (GPR) index developed by [Caldara and Iacoviello \(2022\)](#). This index quantifies adverse geopolitical events and the associated uncertainty by measuring the frequency of newspaper articles covering geopolitical tensions. While the VIX is positively correlated with the RORO (correlation coefficient of 0.38; see Figure B1 in the Appendix), this is not the case for the GPR index, which is essentially orthogonal to the RORO (correlation coefficient of -0.01; see Figure B2 in the Appendix).

### 3.2 Market Data

We construct a weekly panel dataset that spans from January 1990 to December 2025, covering sovereign bond markets and foreign exchange rates across 39 countries.<sup>2</sup> For sovereign bonds, we focus on 10-year zero-coupon yields in local currencies, which repre-

<sup>2</sup>The sample period and country coverage are determined by data availability. The exhaustive list of variables is reported in Tables B2 and B3.

sent the standard benchmark maturity in the safe haven literature (see, e.g., [Baur and Lucey, 2010](#)). Long-term yields offer a key advantage over shorter maturities because they are less directly influenced by the monetary policy stance. Consequently, 10-year yields tend to exhibit a stronger and more pronounced reaction to shifts in investor risk sentiment and flight-to-safety episodes than short-term rates. As part of our robustness analysis, we primarily consider Treasury Inflation-Protected Securities (TIPS), which provide returns adjusted for inflation risk. We also consider overnight index swaps (OIS) and term premia at comparable maturities. We complement our analysis with a broader set of corporate bond and alternative asset price series. Specifically, we include investment-grade corporate bond yields for a large cross-section of advanced and emerging market economies in local currencies, as well as four alternative assets: gold, silver, crude oil, and Bitcoin. Finally, we proxy global risky asset returns using the MSCI World Index, which provides a broad value-weighted measure of equity market performance across the world.

### 3.3 Economic Fundamentals and Cyclical Variables

Our exercise to identify safe assets relies on both the safe haven behavior of assets *and* their economic fundamentals. We include six fundamentals that reflect the economic determinants of an asset’s safe status. First, following [Obstfeld et al. \(2018\)](#) and [Habib et al. \(2020\)](#), we incorporate a measure of *de jure* capital account liberalization, updated by [Chinn and Ito \(2006\)](#). This variable captures the extent of restrictions on cross-border capital flows. Second, as a proxy for market size, we control for the outstanding stock of sovereign and corporate debt securities denominated in US dollars, as reported in the BIS debt securities statistics. Market size is relevant insofar as global investors tend to allocate capital toward larger and more liquid markets. Third, we proxy the level of local-currency market development using the share of debt issued in local currency, as provided by [Arslanalp and Tsuda \(2014a,b\)](#). Fourth, we include country credit ratings from [Kose et al. \(2022\)](#). For investment-grade corporate bond securities, we use the average investment-grade rating. Fifth, we control for institutional quality by including a measure of the rule of law drawn from the World Bank Group’s Worldwide Governance Indicators. Finally, to control for a country’s external position, following [Habib et al. \(2020\)](#), we include the stock of net foreign assets (NIIP) relative to GDP. [Habib and Stracca \(2012\)](#) find that external sustainability is the most consistent driver of safe haven currency status.

We also rely on cyclical variables that may explain changes in the safe haven behavior of assets. We collect data on inflation, debt-to-GDP ratios and the share of government debt held by domestic central banks. Unlike the fundamental variables listed above, which help discriminate across the cross-section of assets, these cyclical variables shed light on

the temporal dimension that may explain movements in bond yields. The descriptions of these variables are provided in Table B4.

## 4 Empirical strategy

Our empirical strategy proceeds in two steps. First, we cluster assets according to their macroeconomic and financial fundamentals to identify distinct categories of *safe assets*. Second, using this novel taxonomy, we rank assets within each category according to their *safe haven* properties, as revealed by their conditional response to global risk-off episodes.

### 4.1 Clustering assets

Clustering assets prior to ranking is important because safe-asset status and safe haven behavior capture different dimensions of asset safety. An asset may exhibit strong performance during episodes of global stress without possessing the structural characteristics required to qualify as a safe asset, for instance because of limited market depth, liquidity, or capital account openness. By conditioning the assessment of safe haven behavior on structural safe-asset characteristics, our approach avoids conflating episodic crisis performance with safe-asset status and ensures that safe haven properties are compared across economically similar assets. The resulting classification provides a global taxonomy of safe assets that captures both their structural characteristics and their ability to provide insurance during periods of heightened global risk.

We cluster bond securities using a  $k$ -means clustering algorithm to ensure meaningful comparisons across assets. We rely on a set of six macroeconomic and financial fundamentals described in Section 3.3. The  $k$ -means procedure partitions assets into a predetermined number of clusters<sup>3</sup> by minimizing within-cluster variance. Each asset is assigned to the cluster whose centroid is closest in the multidimensional space spanned by the selected variables, ensuring that subsequent rankings are conducted within homogeneous groups of comparable assets.

### 4.2 Safe haven criteria

We assess the safe haven properties of financial assets through the lens of their price dynamics. During risk-off episodes, two opposing forces shape equilibrium prices. On the one hand, investors facing heightened liquidity needs or funding constraints may

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<sup>3</sup>The number of clusters is selected using the “elbow” and “silhouette” methods. The former identifies the point at which adding an additional cluster no longer substantially improves within-cluster fit. The latter assesses clustering quality by measuring how similar each observation is to its own cluster relative to the nearest alternative cluster, with higher silhouette values indicating better-defined and more clearly separated clusters. The number of clusters is chosen based on the highest values provided by these two methods.

liquidate positions to raise cash, exerting downward pressure on prices. On the other hand, investors seeking capital preservation may reallocate their portfolios toward assets perceived as safe, increasing demand and driving prices upward. In equilibrium, price dynamics reflect the relative strength of these two forces across heterogeneous market participants. When the capital-preservation motive prevails, prices are expected to appreciate. We therefore define safe haven behavior as the tendency of an asset to deliver systematically positive returns during risk-off episodes.

For equities and currencies, we compute annualized average log returns as

$$r_t^{(h)} = \frac{\ln P_{t+h} - \ln P_t}{h} \times 52 \quad h = \{1, 2, 3, 4, 5\} \quad (1)$$

where  $P_t$  denotes the equity price index or the exchange rate. We consider multiple horizons to capture the degree of persistence in asset price movements over time.

For bond securities, we compute cumulative changes in yields over  $h$ -ahead periods:

$$\Delta y_t^{(h)} = y_{t+h} - y_t \quad h = \{1, 2, 3, 4, 5\} \quad (2)$$

where  $y_t$  denotes continuously compounded zero-coupon yields observed at weekly frequency.

Let  $M_t^{(h)}$  denote a generic measure of investor demand pressure for a given asset, defined as  $r_t^{(h)}$  for equities and currencies and  $-\Delta y_t^{(h)}$  for bonds. We reverse the sign of cumulative yield changes to ensure consistent interpretation across asset classes. During risk-off periods, safe haven assets typically experience price appreciation and yield compression, whereas risky assets tend to suffer price declines and negative returns. Since bond prices move inversely with yields, multiplying cumulative yield changes by  $-1$  ensures that positive values of  $M_t^{(h)}$  uniformly reflect increased demand for the asset, regardless of the asset class.

We standardize returns and yield changes by their respective full-sample standard deviations. This normalization is particularly relevant for emerging market assets, where structural volatility is materially higher than in advanced economies, ensuring that the analysis captures relative standardized performance and facilitates cross-asset comparisons. Finally, to mitigate the influence of outliers, we winsorize all series at the 1st and 99th percentiles within each asset class.

Based on the definition of safe haven assets (see Section 2), we define five normalized criteria based on  $M_t$  to evaluate the extent to which assets exhibit safe haven behavior during risk-off episodes. Each criterion is designed to capture a distinct dimension of safe haven dynamics, including differences in the level and distribution of asset demand pressure between risk-on and risk-off regimes across a broad cross-section of financial as-

sets. We evaluate the safe haven properties of an asset based on its score on each criterion.

*Criterion 1: Average Performance during Risk-off Episodes.*

$$C_1^{(h)} = \mathbb{E}[M_t^{(h)} | \text{risk}_t = 1] \quad (3)$$

where  $\text{risk}_t$  is a binary indicator equal to 1 during risk-off periods, defined using the benchmark threshold identified in section 3.1, and 0 otherwise. A positive value of  $C_1^{(h)}$  indicates that demand pressure for the asset is, on average, elevated relative to the full-sample mean during stress episodes, a defining characteristics of safe haven assets (Baur and Lucey, 2010).

*Criterion 2: Difference in the Frequency of Positive Performances Across Regimes.*

$$C_2^{(h)} = \mathbb{P}(M_t^{(h)} > 0 | \text{risk}_t = 1) - \mathbb{P}(M_t^{(h)} > 0 | \text{risk}_t = 0)$$

We measure the change in the probability of observing a positive demand realization during stress periods relative to normal conditions. A positive value indicates that safe haven-type movements become more frequent during risk-off episodes. With  $C_1$ , the frequency criterion  $C_2$  reconstructs the favorable side of the distribution of safe haven performance.

*Criterion 3 and 4: Upper- and Lower-Tail Demand Pressure during Risk-off Episodes.*

$$C_3^{(h)} = q_{.75}(M_t^{(h)} | \text{risk}_t = 1)$$

$$C_4^{(h)} = q_{.25}(M_t^{(h)} | \text{risk}_t = 1)$$

Criterion 3 characterizes the upper tail (75th percentile) of the demand-pressure distribution during stress periods. Rather than focusing on central tendencies, it examines whether large favorable realizations of  $M_t^{(h)}$ , consistent with safe haven inflows, are particularly pronounced during risk-off episodes for a given asset. In contrast, Criterion 4 characterizes the lower tail (25th percentile) of the distribution of demand pressure during risk-off episodes. It assesses whether an asset's price fails to exhibit safe haven behavior precisely when protection is most valuable. Importantly, this criterion distinguishes assets which deterioration reflects a worsening of the left tail of the distribution, from those for which the observed change merely results from a contraction of the right tail.

*Criterion 5: Hedging Properties Against Risky Asset Prices during Risk-off Episodes.*

$$C_5^{(h)} = -\text{corr} \left( M_t^{(h)}, S_t^{(h)} \mid \text{risk}_t = 1 \right)$$

where  $S_t^{(h)}$  denotes the return on a global risky asset benchmark, proxied by a world equity price index. A negative conditional correlation between  $M_t^{(h)}$  and  $S_t^{(h)}$  during risk-off periods is indicative of the asset's ability to hedge against declines in risky asset markets. We reverse the sign of the correlation so that higher values of  $C_5^{(h)}$  correspond to a stronger negative comovement with risky assets and, therefore, to greater portfolio diversification benefits during stress episodes.

Figure A1 illustrates the scoring for each criterion using the distribution of one-week changes in 10-year US Treasury yields (with the sign reversed),  $M_t^{(1)}$ , during acute risk-off episodes ( $\text{risk} = 1$ ) and tranquil periods ( $\text{risk} = 0$ ). The figure highlights a marked shift in the distribution during risk-off episodes relative to tranquil periods. In particular, the mean of  $M_t$  is positive ( $C_1$ ), the probability of observing a positive value is higher during risk-off periods than during normal times ( $C_2$ ), and the distribution exhibits greater skewness, with relatively pronounced upper and lower tails ( $C_3$  and  $C_4$ ). The fifth panel,  $C_5$ , further shows that Treasury returns are generally weakly correlated with risky assets, consistent with their role as a safe asset.

### 4.3 Ranking assets based on safe haven behavior

We construct an asset ranking based on the asset's scoring across the five standardized criteria. Let  $a \in \{1, \dots, A\}$  index assets and  $h \in \{1, 2, 3, 4, 5\}$  denote the horizon length in weeks. For criterion  $j$  and asset  $a$  at horizon  $h$ , let  $C_{j,a}^{(h)}$  denote the baseline scoring metric. The ranking procedure proceeds in three steps. First, for each asset  $a$  and criterion  $j$ , we compute a weighted average across horizons using a harmonic-type scheme that assigns lower weights to longer horizons.

Second, to account for the high cross-criterion correlation (see Table B5), we perform a dimensionality reduction via principal component analysis (PCA). Specifically, we aggregate the weighted scores across the six criteria,  $\{\tilde{C}_{j,a}\}_{j=1}^5$ , using the first principal component,  $\mathcal{P}_{1,a}$ , estimated from a PCA applied to the pooled cross-section of assets<sup>4</sup>. We argue that this first principal component reflects market-implied perception of *safety*. As reported in Table 2, the first principal component alone accounts for more than 90% of the total variation of the scores on each criteria.

Third, we rank assets according to  $\mathcal{P}_{1,a}$ . The rank of asset  $a$ ,  $x_a$ , is defined as the

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<sup>4</sup>The sample includes  $N$  observations covering  $N_b$  bond securities,  $N_{\text{NEER}}$  nominal effective exchange rates,  $N_{\text{FX}}$  bilateral exchange rates, and four alternative assets.

|                  | $\mathcal{P}_1$ | $\mathcal{P}_2$ | $\mathcal{P}_3$ | $\mathcal{P}_4$ | $\mathcal{P}_5$ |
|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| $C_1$            | 0.47            | 0.13            | 0.09            | 0.27            | -0.83           |
| $C_2$            | 0.46            | 0.29            | -0.19           | -0.82           | 0.02            |
| $C_3$            | 0.45            | 0.32            | -0.53           | 0.50            | 0.41            |
| $C_4$            | 0.45            | 0.07            | 0.80            | 0.10            | 0.38            |
| $C_5$            | 0.41            | -0.89           | -0.18           | -0.05           | 0.06            |
| Cum. % Explained | 90.33           | 95.94           | 99.09           | 99.85           | 100             |

**Table 2: Principal component loadings of safe haven criteria**

*Notes:* The table reports the principal component loadings of the scores associated with each safe-haven criterion. The final row reports the cumulative percentage of variance explained.

number of assets with a strictly lower score, plus one:

$$x_a = 1 + \#\{b \neq a : \mathcal{P}_{1,b} < \mathcal{P}_{1,a}\}. \quad (4)$$

## 5 A ranking of relative safe haven performance

This section presents the results of our safe assets taxonomy in a broad set of financial indices using data from May 2003 to July 2026. We analyze the safe haven behavior of bond securities, grouped into economically meaningful clusters, as well as that of currencies and alternative assets.

### 5.1 Debt securities

We consider a broad set of sovereign and corporate bonds from both advanced and emerging markets. The substantial cross-sectional heterogeneity in their macroeconomic, institutional, and financial characteristics provides a suitable basis for identifying economically meaningful groups of debt securities. We exploit this variation to construct a taxonomy of safe assets that distinguishes between structurally different segments of global bond markets.

**Clustering.** Based on economic fundamentals, our clustering exercise identifies three distinct groups of debt securities, including both sovereign and corporate bonds. We label these categories as: (i) “global safe assets”, (ii) “shallow-market assets”, and (iii) “emerging market assets”, each of which comprises both sovereign and corporate bond securities. Table 3 summarizes the main characteristics of each group.

The first cluster, which we label *global safe assets*, is characterized by high capital account openness, large domestic debt markets (for which a high share is issued in local currency), positive NIIP, strong sovereign credit ratings, and robust rules of law.

|                        | OPEN            | SIZE            | LC              | NIIP            | RATG            | ROL             | $\mathcal{P}_1$ |
|------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Global safe assets     | 0.63<br>(0.29)  | 0.43<br>(0.83)  | 0.55<br>(0.40)  | 0.57<br>(0.99)  | 0.61<br>(0.68)  | 0.75<br>(0.44)  | 2.03<br>(1.56)  |
| Shallow-market assets  | 0.39<br>(0.45)  | -0.68<br>(0.53) | -0.02<br>(0.91) | -0.84<br>(0.77) | -0.30<br>(0.81) | 0.08<br>(0.51)  | 0.73<br>(1.26)  |
| Emerging market assets | -1.45<br>(0.60) | -0.14<br>(1.23) | -0.94<br>(1.12) | -0.23<br>(0.41) | -0.78<br>(0.98) | -1.37<br>(0.44) | -0.16<br>(1.36) |

**Table 3: Taxonomy of bond securities and fundamentals**

*Notes:* The table reports means and standard deviations (in parentheses).  $\mathcal{P}_1$  corresponds to the first principal component of the scaled scores on the five safe-haven criteria ( $C_1, C_2, C_3, C_4, C_5$ ). “OPEN” denotes the degree of capital account liberalization; “SIZE” refers to the size of the debt securities market; “LC” denotes the share of local-currency debt securities in total debt securities; “NIIP” denotes the net international investment position; “RATG” refers to the sovereign credit rating; and “ROL” denotes the degree of rule of law.

Consistent with these characteristics, the assets in this group show the strongest average safe haven behavior, as summarized by  $\mathcal{P}_1$ , which corresponds to the first principal component of the scaled scores on the five safe haven criteria introduced in section 4. The second cluster, labeled *shallow-market assets*, exhibits weaker safe haven behavior despite relatively high capital account openness. This group is distinguished by smaller debt markets, weaker NIIP positions, and lower sovereign credit ratings. The third cluster comprises *emerging-market assets*. These assets are generally associated with relatively closed capital accounts, weaker institutional quality, a larger share of debt issued in foreign currency, and lower credit ratings. Although their domestic debt markets are of moderate size, these less favorable structural characteristics are associated with the weakest safe haven behavior in our sample, as reflected in the lowest average value of  $\mathcal{P}_1$ .

This classification into clusters is important because it distinguishes market structure from the observed safe haven behavior of individual assets. More specifically, it operationalizes the distinction between *safe assets*, which are sufficiently liquid and reliable to provide safety and liquidity services, and *safe haven assets*, whose returns exhibit defensive properties during periods of stress. Accounting for these market characteristics is therefore essential when assessing and ranking safe haven behaviors.

**Ranking.** We rank assets within each cluster using the five criteria of safe haven behavior presented in Section 4. Figure 3 reports the ranking of each asset (y-axis) and its safe haven score for each criterion (x-axis), as well as the “average” score (i.e.  $\mathcal{P}_1$ ), highlighted in filled marker. A detailed description of each clusters is provided in Tables B6, B7 and B8, in Appendix.

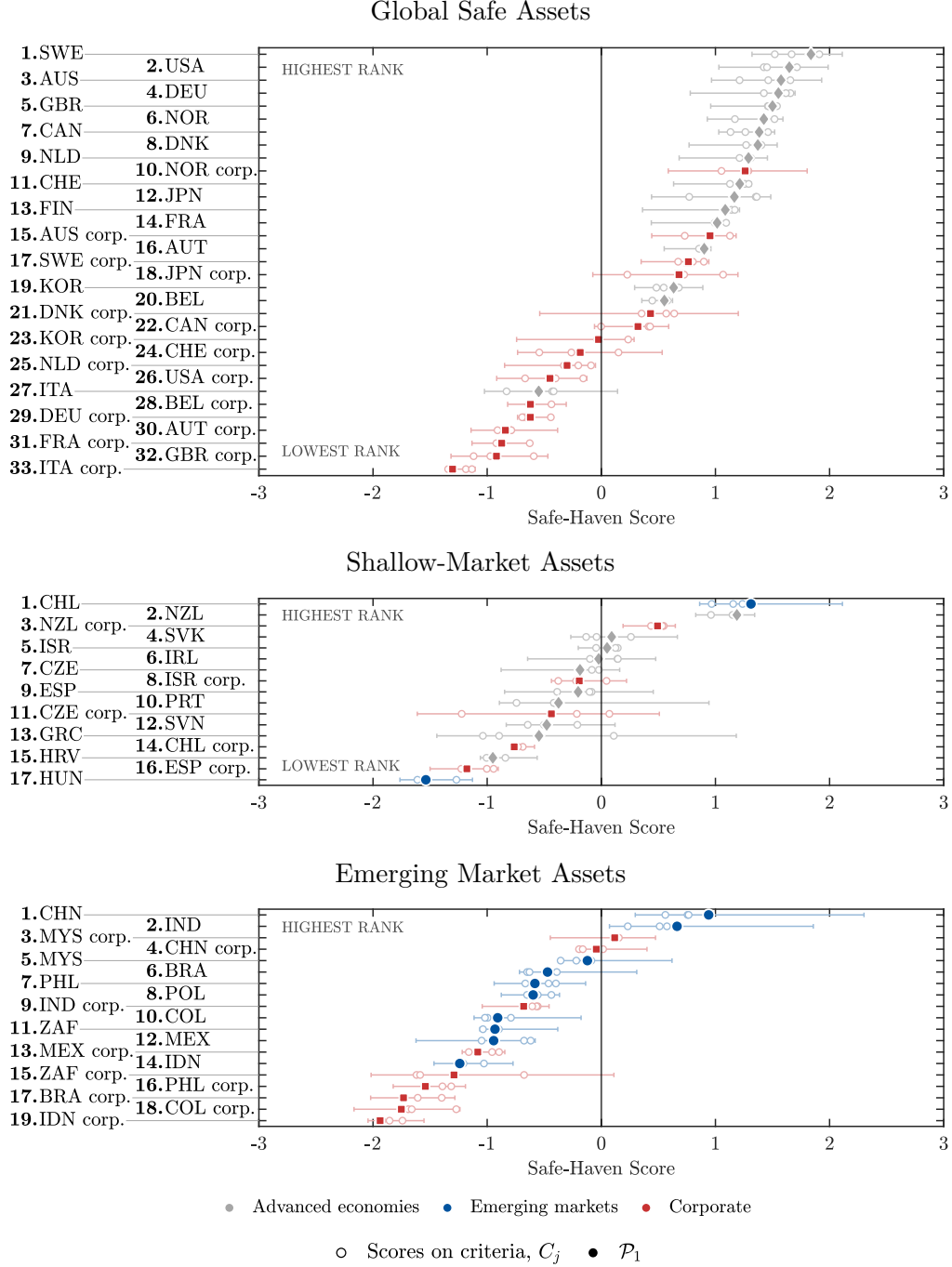


**Figure 3: Ranking based on safe haven behavior by asset groups**

*Notes:* Each point represents an asset's score on a given safe haven criterion. The horizontal bar indicates the range between the highest and lowest criterion scores for each asset. Acute risk-off periods are identified as observations in which the risk-on/risk-off index exceeds its 90th percentile

Sovereign bonds generally rank at the top of their respective clusters. Within the *global safe assets* cluster, US Treasuries rank among the leading assets, alongside Swedish sovereign bonds, which rank first, and Australian government bonds, which rank third. The cluster also includes sovereign bonds issued by other G10-currency economies, including Germany (4th), the United Kingdom, Norway, Canada, and Denmark. Besides

German bunds, several core euro area sovereigns also appear in this group, with the Netherlands, Finland, France, and Austria ranking relatively high, while Belgium and Italy are positioned in the lower half of the distribution. Within the *shallow-market assets* cluster, Chile and New Zealand display comparatively strong safe haven behavior. The remaining advanced economies in this group are largely peripheral euro area countries or economies closely integrated with the euro area, including Israel, Ireland, Czechia, Spain, Portugal, Slovenia, and Greece. Their sovereign bonds nevertheless exhibit relatively weak safe haven properties compared with those in the global safe-asset cluster. Finally, within the *emerging market assets* cluster, Chinese and Indian sovereign bonds exhibit relatively strong safe haven behavior compared with other emerging-market securities. China has comparatively large domestic debt markets, including in local currency, and relatively favorable credit characteristics within this group (Table B8). However, restrictions on capital mobility and weaker institutional quality limit the ability of sovereign Chinese bonds to attain the status of global safe assets. The relative high safe haven scoring may reflect limited supply of alternative low-risk investment opportunities, which generate a strong demand from domestic investors (Ioannidou et al., 2024).

Across asset groups, corporate bonds exhibit weaker safe haven behavior. A few exceptions are nevertheless noteworthy. Norwegian and Australian corporate bonds rank relatively highly, in some cases alongside sovereign bonds issued by advanced economies. This feature would be consistent with the notion that corporations supply quasi-safe assets (Mota, 2023). However, these results should be interpreted with caution, as movements in corporate bond indices may partly reflect changes in the underlying risk-free rate rather than variations specific to the corporate bond index. Figure B3 therefore repeats the analysis using orthogonalized corporate bond returns with respect to changes in long-term sovereign bond yields, thus removing the component associated with movements in the risk-free benchmark. The resulting rankings indicate substantially weaker safe haven behavior for Norwegian and Australian corporate bonds. Some corporate securities nevertheless remain relatively highly ranked after this adjustment. Danish and Korean corporate bonds, for example, continue to rank above Italian sovereign bonds. A similar pattern emerges in the emerging-market cluster, where Malaysian corporate bonds remain relatively resilient to orthogonalization and rank above several sovereign securities within the same group.

Although the safe haven criteria are highly correlated (Table B5), Figure 3 shows that asset rankings remain relatively sensitive to the specific criterion considered, hence the usefulness to gather a large set of criteria. The principal-component approach helps extract the common component of safe haven behavior from criterion-specific variation and measurement noise. Tables B6, B7, and B8, in Appendix, assess the sensitivity of the rankings to alternative aggregation methods. Specifically, alongside rankings based on the first principal component (column 1), we report rankings based on the arithmetic mean

of the safe haven scores (column 2) and on the mean rank across the individual criteria (column 3). The resulting rankings are highly consistent across aggregation methods, indicating that our classification is robust to the way in which the individual safe haven criteria are summarized.

## 5.2 Safe haven currencies

Alike safe haven assets, safe haven currencies are those that give hedging benefits in times of financial distress (Habib and Stracca, 2012). We repeat our analysis, ranking currencies across a pool of advanced and emerging markets currencies. We report ranking based on the first principal component of our 5 criteria of safe haven. Figure 4 presents a comparison between the pooled rankings of sovereign bond returns and currency returns, measured both in nominal effective exchange rate (NEER) terms and bilaterally against the US dollar. Our estimates clearly reaffirms the status of the US dollar among safe haven currencies over the 2003-2026 sample, in line with the established literature.

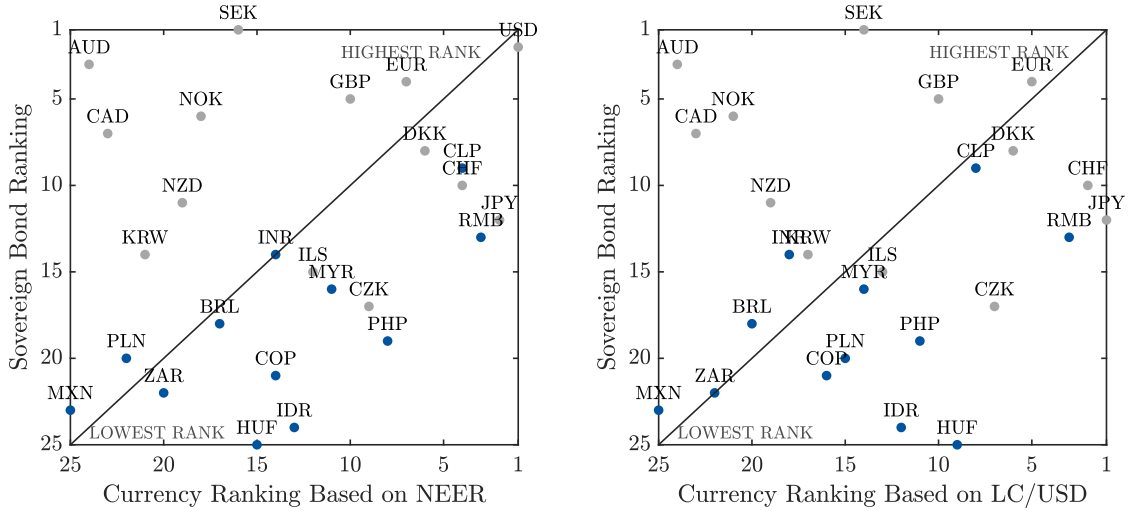


**Figure 4: Comparison of relative safe haven behavior between currencies and sovereign bonds**

*Notes:* The figure reports the relative safe haven behavior ranking of sovereign bond securities (y-axis) and the returns on national currencies (x-axis). For the Euro, German bunds are used as benchmark sovereign bonds. In the left panel, the broad nominal effective exchange rate is used, while in the right panel, the exchange rate relative to the US dollar is used. Acute risk-off periods are identified using the 90th percentile of the risk-on–risk-off index.

A first-order result is that traditional reserve currencies systematically display relatively strong safe haven behavior within the sample. The “safest” reserve currencies are the US Dollar, the Japanese Yen and the Swiss Franc as the NEER appreciates significantly vis-à-vis all other possible tested currencies considered as risk aversion reaches a certain threshold. This is consistent with Fatum and Yamamoto (2016) and Grisse and Nitschka (2015). Hossfeld and MacDonald (2015) confirm that the safe haven status of

the USD and Swiss Franc are robust to carry trade reversals while this is not the case for Japanese yen.

A more nuanced pattern emerges when comparing currencies to their associated sovereign bond markets. In the case of the euro and the British pound, sovereign bonds (notably German Bunds for the euro area) tend to exhibit relatively stronger safe haven characteristics than the currencies themselves. Conversely, Switzerland and Japan display the opposite configuration, with currencies providing an additional, distinct layer of safe haven demand beyond what the bond itself captures, as reflected by their greater deviation from the 90-degree benchmark line. These patterns remain robust when returns are computed using bilateral exchange rates against the US dollar.

This decoupling between currency and sovereign bond behavior becomes even more pronounced among G10 commodity-exporting currencies: the Australian dollar, the Canadian dollar, the Norwegian krone, and the New Zealand dollar<sup>5</sup>. While their sovereign bonds retain relatively strong safe haven characteristics, their currencies do not exhibit comparable *relative* performance. This is consistent with the carry-trade literature, which shows that, in normal times, investors tend to borrow in low-yielding safe haven currencies (JPY, CHF) and invest in high-yielding commodity currencies (AUD, NZD, CAD, NOK). When risk-off episodes hit, this trade unwinds, putting pressure on the long-leg currencies (Brunnermeier et al., 2008; Lustig et al., 2011; De Bock and de Carvalho Filho, 2015). This reflects a feature of commodity-exporting countries whose exchange rates are structurally more procyclical (Ready et al., 2017).

Among emerging market currencies, a subset, including the Chinese renminbi and the Chilean peso rank relatively high within the sample. While these currencies may demonstrate resilience during periods of global stress, structural constraints, such as limited capital account openness, negative NIIP and small sovereign market size prevent them from acting as global safe haven currencies. Besides, Cheng et al. (2021) and Fatum et al. (2017) cast doubt on the ability of the renminbi to hedge against stock market crashes. For Chile, one possible explanation is that the peso serves as a regional safe-haven asset for investors with mandates focused on Latin American or emerging-market securities. During periods of heightened risk aversion, these investors may reallocate their portfolios toward Chilean assets, thereby supporting the peso and contributing to its relatively high ranking. The remainder of emerging market currencies rank significantly lower, broadly consistent with the behavior observed in their corresponding sovereign bond markets.

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<sup>5</sup>A long literature has shown the “commodity currency” properties of the Australian, Canadian, and New Zealand dollars and the Norwegian krone. See Chen and Rogoff (2003); Cashin et al. (2004); Wang and Cheung (2023), among others.

### 5.3 Alternative assets and geopolitical risks

Alternative stores of value, including gold, silver, oil, and Bitcoin, have also been considered as potential safe haven assets, although the evidence is the strongest for gold (Gurdgiev and Petrovskiy, 2024). We therefore include these assets in the ranking exercise to benchmark their safe haven properties against those of sovereign and corporate bonds.

Figure 5, left panel, shows that, with the exception of gold, these assets generally rank in the lower half of the distribution, indicating limited safe haven properties. Silver, oil, and Bitcoin behave more like risk-sensitive assets during stress episodes. Gold stands out as the only alternative asset exhibiting consistent safe haven characteristics across indicators, although it still ranks below many sovereign and corporate bonds.

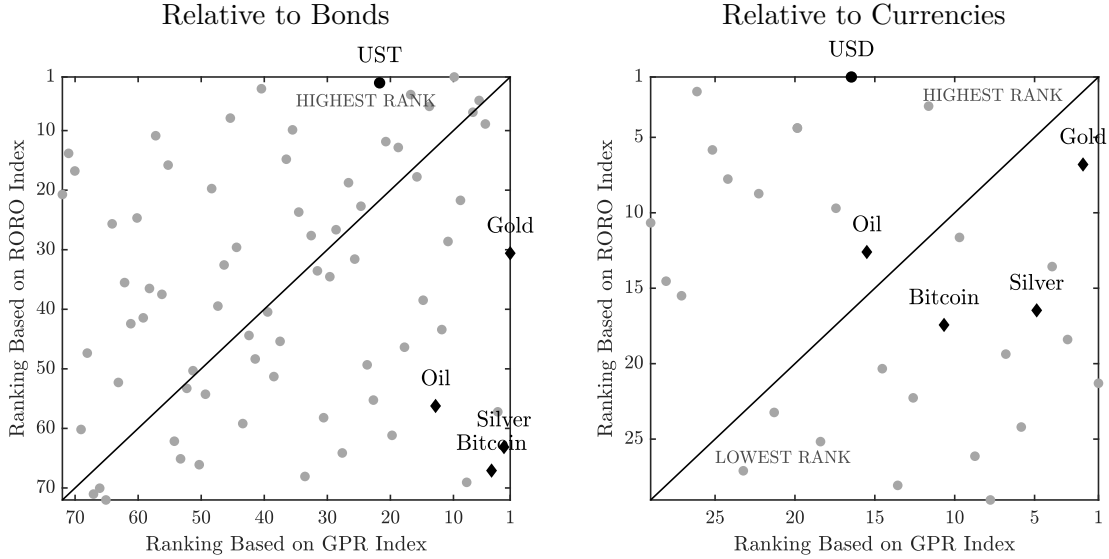


**Figure 5: Risk-off vs. geopolitical risk for alternative assets**

*Notes:* Each point corresponds to a different asset. Acute risk-off periods are identified using the 90th percentile of the risk-on-risk-off index Chari et al. (2023). Acute geopolitical tensions are identified using the 90th percentile of the GPR index by Caldara and Iacoviello (2022)

When risk-off episodes are identified using measures of geopolitical risk (Figure 5, right panel), all alternative assets (not only gold) tend to exhibit stronger safe haven behavior. Gold ranks first, while silver, Bitcoin, and oil also outperform most sovereign bonds, including US Treasuries. This pattern remains robust for gold and silver when alternative assets are compared with currencies, but is less pronounced for Bitcoin and oil. Overall, these findings highlight the dominant role of fixed-income securities in providing safety services during episodes of financial stress, while suggesting that alternative assets tend to appreciate more strongly during geopolitical risk events. They are also consistent with evidence that gold’s safe haven properties may weaken during episodes of acute market turmoil, when investors liquidate even highly liquid assets to meet funding and

margin requirements. By contrast, geopolitical shocks tend to increase demand for gold as a reserve and safe asset, reinforcing its role as a hedge against geopolitical uncertainty (Arvai et al., 2026).

## 6 The changing landscape of safe asset risk properties

The COVID-19 episode has been a significant test for US Treasury markets, which are generally viewed as among the most important liquid and safe assets in the world and, accordingly, command a price premium (Longstaff, 2004; Krishnamurthy and Vissing-Jorgensen, 2012). However, the large-scale issuance of government debt revealed the limits of this market, as the intermediary sector struggled to absorb the supply shock of US Treasuries (see Duffie, 2020; He et al., 2022). As a result, Treasury prices did not react in line with the behavior typically expected of safe haven assets. Figure 6 illustrates that this pattern was observed for both nominal Treasuries and real government bonds, as proxied by US Treasury Inflation-Protected Securities (TIPS), whereas the US dollar appears to have been comparatively unaffected. Gómez-Cram et al. (2024) provide high-frequency evidence from the COVID-19 episode linking increases in US Treasury yields to negative news about future government surpluses. More recently, the tariff announcements of 2025 confirmed this unusual reaction of Treasury yields, pointing to a reduced willingness of foreign investors to pay a premium for the safety of dollar-denominated assets, including US Treasuries (Jiang et al. (2025)).

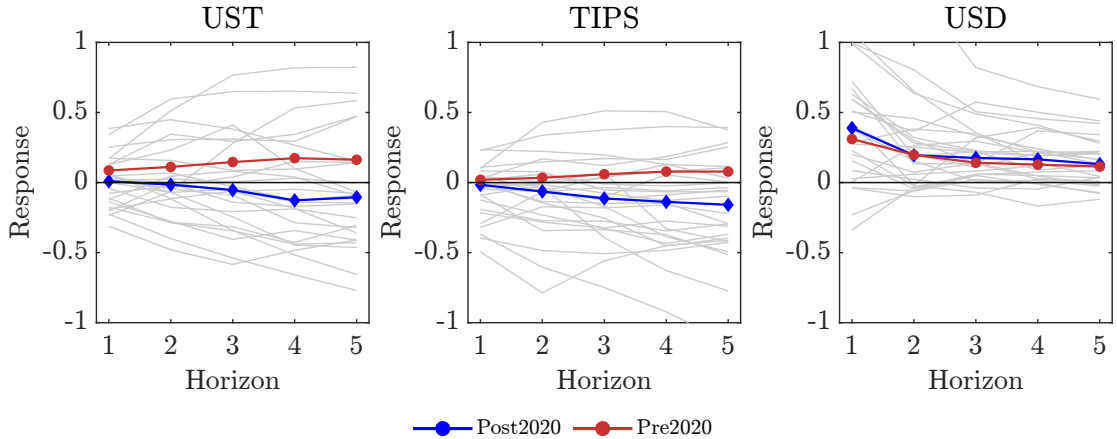


**Figure 6: Median demand pressure for US assets during risk-off episodes**

*Notes:* The charts represent median demand pressures for US assets captured by  $M_t^{(h)}$  at each horizon  $h$ . “UST” denotes US Treasuries, “TIPS” denotes US Treasuries Inflation-Protected Securities and “USD” refers to US Dollar. Gray lines represent post 2020 realizations of  $M_t^{(h)}$ . Post 2020 starts from the last week of February 2020, which includes 26 events.

This section investigates whether these developments are unique to US Treasuries or

indicative of a broader reconfiguration of the safe-asset landscape.

## 6.1 UST versus USD

We test whether the safe haven behavior of US Treasuries and the US dollar during risk-off episodes has changed since the COVID-19 pandemic. To this end, we translate each of the five safe haven criteria into an empirical specification that allows their behavior to differ between the pre- and post-2020 periods.

For  $C_1$  and  $C_2$ , we estimate the following OLS regression:

$$Y_t = \alpha + \beta_1 \text{Risk}_t + \beta_2 (\text{Risk}_t \times D_{>2020}) + \delta D_{>2020} + \epsilon_t. \quad (5)$$

where  $\text{Risk}_t$  is a dummy variable equal to one during episodes of acute risk aversion, identified as observations above the 90th percentile of the RORO index, and  $D_{>2020}$  identifies the period since the onset of the COVID-19 pandemic, dated from the last week of February 2020 onward. For  $C_1$ , the dependent variable is the asset return measure by  $M_t$ . For  $C_2$ , the dependent is an indicator equal to one when  $M_t > 0$ , so that equation (5) is estimated as a linear probability model and captures changes in the likelihood of a positive return during risk-off episodes. In both specifications,  $\beta_1$  measures the risk-off effect in the pre-2020 period, while  $\beta_1 + \beta_2$  gives the corresponding effect after the onset of the pandemic in 2020.

For  $C_3$  and  $C_4$ , we estimate quantile regressions to capture tail demand pressure during risk-off episodes:

$$Q_q(Y_t | \cdot) = \alpha + \beta_1 \text{Risk}_t + \beta_2 (\text{Risk}_t \times D_{>2020}) + \delta D_{>2020}. \quad (6)$$

where  $q = .75$  for  $C_3$  and  $q = .25$  for  $C_4$ . These specifications capture changes in the upper and lower tails of the return distribution, respectively. As above,  $\beta_1 + \beta_2$  measures the post-2020 risk-off effect at the corresponding conditional quantile.

Finally,  $C_5$  captures the hedging properties of the asset with respect to global risky assets during risk-off episodes. The sample is therefore restricted to periods for which  $\text{Risk}_t = 1$ , and both the asset return and the global equity-market return are standardized within asset. We estimate

$$Y_t = \alpha + \beta_1 S_t + \beta_2 (S_t \times D_{>2020}) + \delta D_{>2020} + \epsilon_t. \quad (7)$$

where  $S_t$  denotes the standardized return on the world equity index. A lower, and in particular more negative, exposure indicates stronger hedging properties against risky assets.

To account for serial correlation, inference in the linear regressions is based on Newey-

West standard errors with five lags, consistent with the five-week horizon embedded in  $M_t$ . For the quantile regressions, inference is based on moving-block bootstrap standard errors using five-week blocks.

**Nominal yields.** Table 4 reports estimates of Equations (5)-(7) for long-term US *nominal* Treasury yields. Prior to 2020, Treasury yields display a strong and statistically significant response to risk-off episodes, with  $M_t$  increasing across all four risk-based criteria during periods of acute stress. The correlation between US Treasuries and global risky assets is statistically insignificant. Taken together, these results confirm the traditional safe haven role of US Treasuries during episodes of heightened risk aversion. The results for  $C_5$  should nevertheless be interpreted with caution given the relatively small sample size ( $N = 121$ ).

|                        | $C_1$               | $C_2$                | $C_3$               | $C_4$                | $C_5$               |
|------------------------|---------------------|----------------------|---------------------|----------------------|---------------------|
| Constant               | -0.065<br>(0.042)   | 0.490***<br>(0.024)  | 0.469***<br>(0.038) | -0.575***<br>(0.057) | 0.170<br>(0.119)    |
| Risk                   | 0.794***<br>(0.100) | 0.362***<br>(0.041)  | 0.881***<br>(0.121) | 0.927***<br>(0.129)  |                     |
| S                      |                     |                      |                     |                      | -0.060<br>(0.097)   |
| Post2020               | -0.062<br>(0.087)   | -0.047<br>(0.048)    | -0.102<br>(0.087)   | -0.078<br>(0.113)    | -0.738**<br>(0.267) |
| Risk $\times$ Post2020 | -0.765*<br>(0.342)  | -0.459***<br>(0.116) | -0.066<br>(0.769)   | -1.296*<br>(0.543)   |                     |
| S $\times$ Post2020    |                     |                      |                     |                      | 0.190<br>(0.335)    |
| $\beta_1 + \beta_2$    | 0.029<br>(0.326)    | -0.097<br>(0.108)    | 0.815<br>(0.755)    | -0.369<br>(0.517)    | 0.129<br>(0.319)    |
| $R^2$                  | 6.48                | 4.22                 |                     |                      | 8.48                |
| $N$                    | 1209                | 1209                 | 1209                | 1209                 | 121                 |

**Table 4: Regression coefficients for US Treasuries**

*Notes:* Columns  $C_1$ ,  $C_2$  and  $C_5$  report estimates from linear regressions with Newey-West standard errors using five lags. Columns  $C_3$  and  $C_4$  report quantile-regression estimates at the 75th and 25th percentiles, respectively, with inference based on a five-week moving-block bootstrap. The row  $\beta_1 + \beta_2$  reports the post-2020 marginal effect of Risk, or of  $S$  in column  $C_5$ , obtained as the sum of the baseline coefficient and its interaction with Post2020. Standard errors are reported in parentheses.

This safe haven response weakens markedly in the post-2020 period. The interaction term between Risk and Post2020 is significantly negative for  $C_1$ ,  $C_2$ , and  $C_4$ , while it is statistically insignificant for  $C_3$  and  $C_5$ . These estimates point to a decline in the average magnitude and frequency of positive Treasury performance during risk-off episodes, together with a significant weakening in lower-tail protection. Consistent with this pattern, the post-2020 marginal effects,  $\beta_1 + \beta_2$ , are no longer statistically different from zero

across the risk-based criteria. For some criteria, the point estimates even turn negative, suggesting that the traditional safe haven response of US Treasuries has weakened substantially in more recent period.

**Real Yields.** The post-2020 period, however, coincides with a shift from a growth-shock-dominated regime to one increasingly driven by inflation shocks, under which the stock-bond correlation is known to turn positive for reasons unrelated to the underlying safety of government bonds (Campbell et al., 2017; Cieslak and Pflueger, 2023; Duffee, 2023). The weaker safe haven performance of nominal Treasuries during inflation-driven episodes may therefore reflect the erosion of their nominal payoff by inflation rather than a deterioration in their intrinsic safety. To assess whether our headline results are driven by this mechanism, we turn to real yields. If inflation is the main force behind the observed deterioration, inflation-protected Treasuries should continue to display safe haven properties during inflation-driven sell-offs.

|                        | $C_1$              | $C_2$               | $C_3$               | $C_4$                | $C_5$               |
|------------------------|--------------------|---------------------|---------------------|----------------------|---------------------|
| Constant               | -0.001<br>(0.038)  | 0.520***<br>(0.024) | 0.467***<br>(0.039) | -0.400***<br>(0.046) | 0.136<br>(0.141)    |
| Risk                   | 0.257<br>(0.138)   | 0.122*<br>(0.059)   | 0.509*<br>(0.221)   | 0.275<br>(0.147)     |                     |
| S                      |                    |                     |                     |                      | 0.181<br>(0.164)    |
| Post2020               | -0.060<br>(0.085)  | -0.060<br>(0.047)   | 0.045<br>(0.088)    | -0.149<br>(0.106)    | -0.552*<br>(0.253)  |
| Risk $\times$ Post2020 | -0.755*<br>(0.303) | -0.274*<br>(0.112)  | -0.855<br>(0.490)   | -1.383**<br>(0.436)  |                     |
| S $\times$ Post2020    |                    |                     |                     |                      | 0.285<br>(0.204)    |
| $\beta_1 + \beta_2$    | -0.498<br>(0.268)  | -0.152<br>(0.094)   | -0.345<br>(0.429)   | -1.108**<br>(0.412)  | 0.465***<br>(0.124) |
| $R^2$                  | 1.69               | 0.94                |                     |                      | 14.01               |
| $N$                    | 1209               | 1209                | 1209                | 1209                 | 121                 |

**Table 5: Regression coefficients for US TIPS**

*Notes:* Columns  $C_1$ ,  $C_2$  and  $C_5$  report estimates from linear regressions, with Newey-West standard errors using five lags. Columns  $C_3$  and  $C_4$  report quantile-regression estimates at the 75th and 25th percentiles, respectively, with inference based on a five-week moving-block bootstrap. Standard errors are reported in parentheses.

The corresponding results are reported in Table 5. Overall, prior to 2020, real yields respond less strongly to risk-off episodes than nominal yields, with smaller coefficient magnitudes and weaker statistical significance across the safe haven criteria. Nevertheless, the post-2020 period is associated with a deterioration in safe haven behavior of a magnitude comparable to that observed for nominal Treasuries, with several interac-

tion terms statistically significant, including the stock-bond correlation criteria ( $C_5$ ). As a result, the post-2020 marginal effect of acute risk-off episodes turns negative for the upper-tail demand criterion,  $C_4$ , while the comovement with global risky assets becomes positive.

**US Dollar.** Turning to the US dollar, we find a robust positive response to risk-off episodes, consistent with an appreciation of the currency during periods of market stress. Its correlation with the world equity index is also significantly negative. In contrast to both nominal and real US Treasuries, these relationships remain broadly unchanged after 2020. As a result, the overall marginal effect of risk-off episodes on the safe haven behavior of the US dollar remains positive and statistically significant throughout the sample.

|                        | $C_1$               | $C_2$               | $C_3$               | $C_4$                | $C_5$               |
|------------------------|---------------------|---------------------|---------------------|----------------------|---------------------|
| Constant               | -0.082<br>(0.044)   | 0.463***<br>(0.026) | 0.415***<br>(0.051) | -0.611***<br>(0.049) | -0.016<br>(0.144)   |
| Risk                   | 0.877***<br>(0.129) | 0.337***<br>(0.051) | 1.029***<br>(0.170) | 0.832***<br>(0.187)  |                     |
| S                      |                     |                     |                     |                      | -0.457**<br>(0.141) |
| Post2020               | 0.014<br>(0.082)    | 0.025<br>(0.050)    | 0.043<br>(0.097)    | -0.016<br>(0.079)    | 0.102<br>(0.254)    |
| Risk $\times$ Post2020 | 0.208<br>(0.223)    | 0.021<br>(0.087)    | 0.068<br>(0.312)    | 0.059<br>(0.323)     |                     |
| S $\times$ Post2020    |                     |                     |                     |                      | 0.094<br>(0.199)    |
| $\beta_1 + \beta_2$    | 1.085***<br>(0.181) | 0.357***<br>(0.070) | 1.097***<br>(0.263) | 0.891***<br>(0.263)  | -0.363**<br>(0.140) |
| $R^2$                  | 10.94               | 3.97                |                     |                      | 17.39               |
| $N$                    | 1209                | 1209                | 1209                | 1209                 | 121                 |

**Table 6: Regression coefficients for the US Dollar**

*Notes:* The regressions are estimated using the safe-haven performance of the U.S. dollar, measured by its NEER. Columns  $C_1$ ,  $C_2$  and  $C_5$  report estimates from linear regressions with Newey-West standard errors using five lags. Columns  $C_3$  and  $C_4$  report quantile-regression estimates at the 75th and 25th percentiles, respectively, with inference based on a five-week moving-block bootstrap. Standard errors are reported in parentheses.

**Dynamic results.** To further investigate these dynamics, we regress  $Y_t$  on risk-off-risk-on index from [Chari et al. \(2023\)](#) directly instead of a dummy variable. The rolling window is chosen to ensure a sufficiently large number of observations, with a baseline specification based on a five-year window (approximately 261 weekly observations)

The estimated coefficients are reported in [Figure 7](#) for both nominal and real treasuries. Overall, the results corroborate the structural break analysis for nominal and real yields, pointing to a marked shift in the relationship between our indicators and risk-off

periods. The correlation between US Treasury yields and equity prices becomes significantly positive after 2022, signaling a reversal relative to earlier periods. These results are also consistent with the stronger reversal for real yields that display a negative coefficient at the end of the sample.

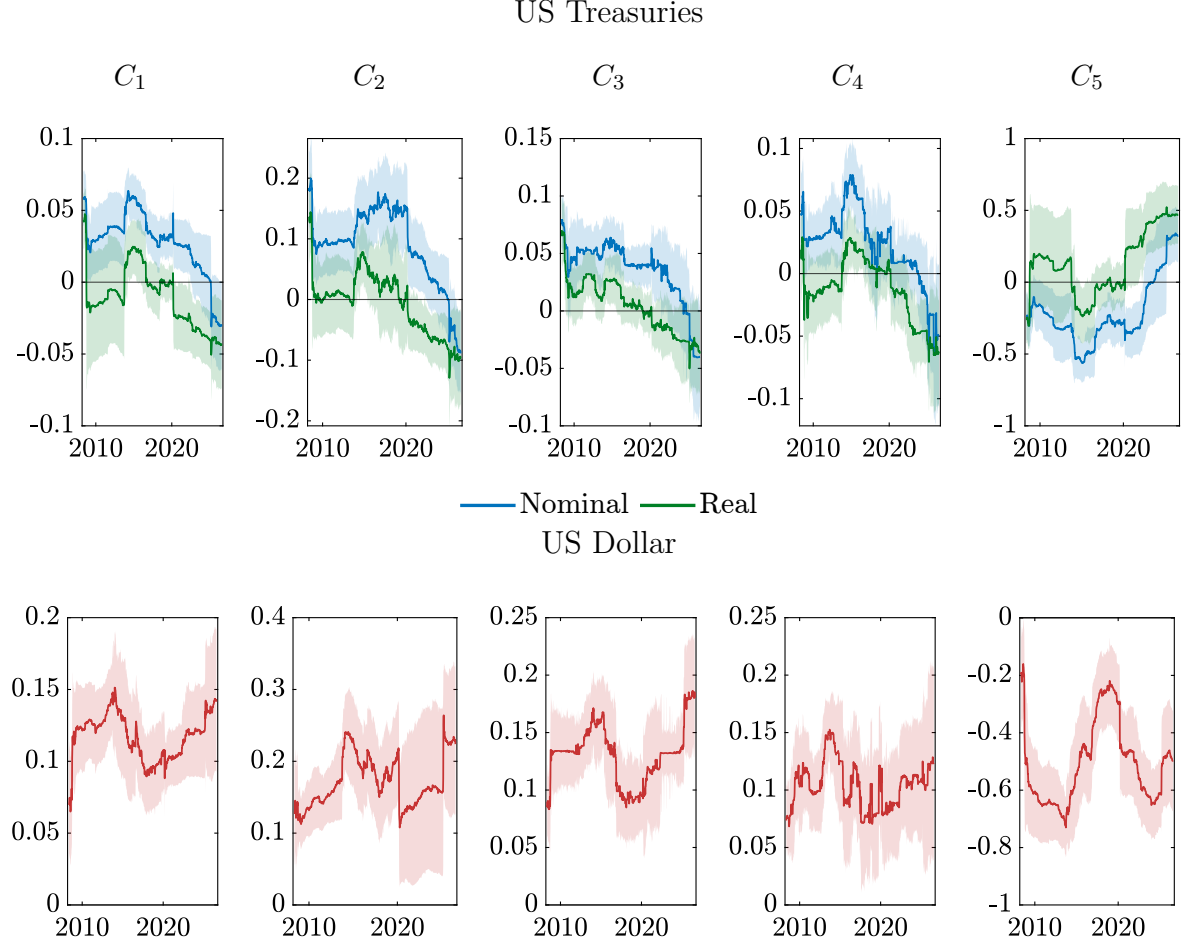


**Figure 7: Rolling coefficient for US Treasuries, TIPS and US Dollar on a 5-Year rolling window**

*Notes:* 95% confidence interval reported.

By contrast, the results for the US dollar (lower panel) are both clearer and more stable, and broadly consistent with the previous analysis. We do not observe clear evidence of a structural break; if anything, the relationship appears to strengthen toward the end of the sample. The correlation between the US dollar and equity prices remains significantly negative throughout, in sharp contrast with the evolving behavior of US Treasuries.

**Robustness.** To assess whether the structural break identified above is robust across the US Treasury market, we replicate the analysis using a range of alternative fixed-income instruments. First, we examine whether the results extend to shorter maturities by considering 2-year and 5-year Treasury yields, as well as Treasury bills. Second, we

examine the behavior of overnight indexed swap (OIS) rates and Treasury term premia. The results indicate that the documented changes are not confined to long-term Treasury yields. Similar patterns emerge for shorter maturities, OIS rates and to a lesser extent term premia (see Table B9), suggesting that the decline in safe haven properties reflects a broad-based shift in the US Treasury market.

These results are also robust to alternative identification strategies for risk-off episodes. Tables B10, B11, and B12 report the sensitivity analyses for US Treasuries, TIPS, and the US dollar, respectively. In particular, the results remain robust when risk-off episodes are identified using alternative measures, including the U.S.-centric VIX, which excludes other candidate safe assets from the construction of the risk indicator. The findings are also robust to changes in the composition of the RORO index. Holding the index composition fixed supports that the documented post-2020 change in safe haven properties is not driven by changes in the underlying composition of the risk measure.

## 6.2 Only a US phenomenon?

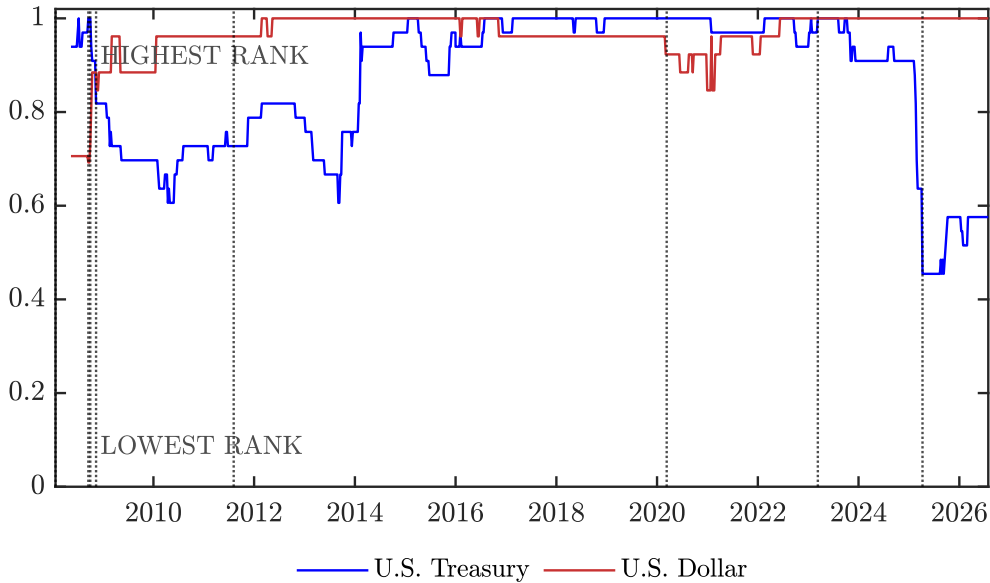


**Figure 8: Safe haven ranking of US Treasuries and the US Dollar on a 5-Year rolling window**

*Notes:* US Treasuries (UST) are ranked relative to global safe assets (cf. Table B6); the US dollar (USD) is ranked relative to other currencies (based on NEER). Higher values correspond to higher rankings; the index is bounded between 0 and 1. Vertical dotted lines highlight episodes corresponding to the 99<sup>th</sup> percentile of risk-off realizations of the index. Rankings are computed using a 5-year rolling window.

Figure 8 provides additional evidence on the evolution of the safe haven properties of US Treasuries during risk-off episodes. It reports five-year rolling rankings of US Treasuries relative to other safe assets (as defined in Section 5.1) and of the US dollar relative to other currencies. Rankings are normalized to the unit interval, where 0 denotes the lowest-ranked asset and 1 the highest-ranked asset. This approach allows us to track changes in the relative safe haven status of US assets over time while abstracting from rank-level differences across asset classes. The results indicate substantial time variation in the relative safe haven properties of Treasuries. In particular, their ranking declines following the Global Financial Crisis, consistent with market dislocations, unstable stock-bond correlations, and the emergence of competing safe assets during the euro area sovereign debt crisis. Although Treasuries regain a more stable role thereafter, their ranking declines again after the pandemic. By contrast, the ranking of the US dollar remains persistently high throughout the sample. These findings suggest, first, that the safe haven properties of US Treasuries are time-varying and, second, that the decoupling documented by Du et al. (2026) is also evident in high-frequency (weekly) returns dynamics following risk-off episodes. Results are robust to alternative rolling windows (cf. Figure B4).

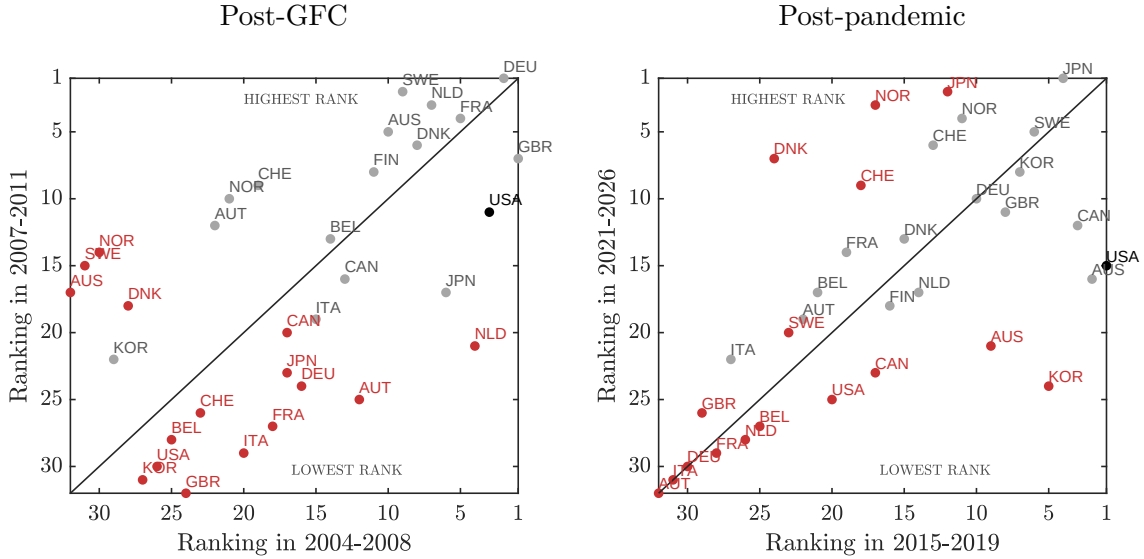


**Figure 9: Safe haven ranking of selected safe assets**

*Notes:* Each point corresponds to the ranking of a global safe asset listed in Table B6. Grey points denote advanced economy sovereign bonds and red points denote corporate bonds.

Figure 9 provides a detailed decomposition of changes in the relative ranking of US Treasuries across different periods, compared with other global safe assets. We highlight two episodes associated with a relative deterioration in the ranking of US Treasuries: the post-GFC period and the post-pandemic period. In both episodes, sovereign bonds issued by Sweden, Germany, and the United Kingdom display relatively more safe haven behavior compared to US Treasuries. During the post-GFC period, this deterioration

primarily reflected a decline in the ranking of US Treasuries relative to other sovereign bonds. By contrast, in the post-pandemic period, several corporate bond markets in G10 economies also gain relative to US Treasuries, including those of Japan, Norway, Denmark, and Switzerland. In each of these cases, the improvement in the ranking of corporate bonds was broadly comparable to that of their sovereign counterparts, hinting to a common safe component. Overall, the post-pandemic period provides additional evidence that the current dynamics differ in important aspects from those observed after the GFC.

|                 | $C_1$               |                      | $C_2$               |                     | $C_3$               |                     | $C_4$               |                      | $C_5$             |                     |
|-----------------|---------------------|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|-------------------|---------------------|
|                 | $\beta_1$           | $\beta_1 + \beta_2$  | $\beta_1$           | $\beta_1 + \beta_2$ | $\beta_1$           | $\beta_1 + \beta_2$ | $\beta_1$           | $\beta_1 + \beta_2$  | $\beta_1$         | $\beta_1 + \beta_2$ |
| <b>Nominal</b>  |                     |                      |                     |                     |                     |                     |                     |                      |                   |                     |
| DEU             | 0.746***<br>(0.100) | -0.069<br>(0.282)    | 0.456***<br>(0.073) | 0.433*<br>(0.189)   | 0.757***<br>(0.139) | 0.780<br>(0.434)    | 0.986***<br>(0.143) | -0.220<br>(0.658)    | -0.060<br>(0.090) | 0.272<br>(0.318)    |
| GBR             | 0.696***<br>(0.094) | -0.139<br>(0.262)    | 0.375***<br>(0.078) | 0.264<br>(0.161)    | 0.672***<br>(0.093) | 0.306<br>(0.404)    | 0.827***<br>(0.105) | -0.256<br>(0.502)    | -0.110<br>(0.085) | 0.247<br>(0.267)    |
| <b>Real</b>     |                     |                      |                     |                     |                     |                     |                     |                      |                   |                     |
| DEU             | 0.401***<br>(0.110) | -0.439<br>(0.305)    | 0.305***<br>(0.077) | 0.275<br>(0.227)    | 0.417**<br>(0.127)  | -0.004<br>(0.339)   | 0.337<br>(0.215)    | -1.611<br>(0.928)    | 0.053<br>(0.090)  | 0.645**<br>(0.210)  |
| GBR             | 0.696***<br>(0.094) | -0.139<br>(0.262)    | 0.375***<br>(0.078) | 0.264<br>(0.161)    | 0.672***<br>(0.093) | 0.306<br>(0.404)    | 0.827***<br>(0.105) | -0.256<br>(0.502)    | -0.110<br>(0.085) | 0.247<br>(0.267)    |
| <b>Currency</b> |                     |                      |                     |                     |                     |                     |                     |                      |                   |                     |
| EUR             | -0.081<br>(0.138)   | 0.092<br>(0.279)     | 0.127<br>(0.120)    | 0.672*<br>(0.340)   | 0.035<br>(0.222)    | 0.169<br>(0.551)    | -0.250<br>(0.191)   | -0.214<br>(0.166)    | 0.056<br>(0.115)  | -0.479**<br>(0.171) |
| GBP             | -0.116<br>(0.110)   | -0.830***<br>(0.209) | -0.072<br>(0.063)   | -0.056<br>(0.140)   | 0.034<br>(0.085)    | -0.575**<br>(0.211) | -0.121<br>(0.209)   | -1.027***<br>(0.296) | 0.177<br>(0.093)  | 0.612***<br>(0.104) |

**Table 7: Regression coefficients for Germany and the United Kingdom**

*Notes:* The table reports the estimated coefficients  $\beta_1$  and  $\beta_1 + \beta_2$  for criteria  $C_1$ – $C_5$ . The nominal block reports nominal government bond yield responses for Germany (DEU) and the United Kingdom (GBR). The real block reports real government bond yield responses for Germany and the United Kingdom. The currency block reports responses of the euro (EUR) and pound sterling (GBP), respectively. Standard errors are reported in parentheses. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

In Table 7, we extend the analysis beyond the United States and report results for German and UK bonds, as well as for the British pound and the euro. For most criteria, the results indicate a clear loss of statistical significance since 2020, in both nominal and real terms. This deterioration is nevertheless less pronounced than for the United States, where the signs of several coefficients reverse for real Treasury returns.

Interestingly, prior to 2020, neither the British pound nor the euro exhibited a statistically significant response to risk-off episodes. For the British pound, however, this muted response has deteriorated since the pandemic, with the marginal effects turning negative for  $C_1$ ,  $C_3$ , and  $C_4$ . In addition, its correlation with equity returns becomes significantly positive, pointing to a diminished hedging role during risk-off episodes in

the post-pandemic period. The results for the euro are less pronounced. If anything, they suggest somewhat stronger safe haven properties since the pandemic, reflected in a higher probability of appreciation relative to non-risk-off episodes ( $C_2$ ) and stronger hedging properties under criterion  $C_5$ .

The rolling relative ranking of German and British sovereign bonds and currencies are reported in Appendix (Table B5). It illustrates the dive of British pounds in relative terms and the relative resilience of the euro.

### 6.3 The role of cyclical macroeconomic conditions

The regressions reported above establish whether the safe haven properties of US Treasuries have changed over time, but remain silent on the underlying macroeconomic conditions that may be associated with amplifying or dampening these properties. We therefore investigate whether the safe haven behavior of US Treasuries (as measured by criteria  $C_1$  through  $C_5$ ) is systematically associated to cyclical macroeconomic variables. Specifically, we augment the baseline regressions with three variables and their interaction with the risk-off indicator: the year-on-year inflation rate, the general government gross debt-to-GDP ratio, and the share of sovereign debt held by price-sensitive investors.

The choice of these three variables is motivated as follows. First, inflation erodes the real return on nominal bonds, potentially weakening their appeal as safe haven instruments during stress episodes when investors reassess real purchasing power. Second, a rising debt-to-GDP ratio signals deteriorating fiscal sustainability, which may reduce the perceived safety of government bonds and lower the premium investors are willing to pay for their safety properties. Third, the composition of sovereign debt holders, particularly the role of price-sensitive investors, may influence safe-haven properties. We proxy the presence of such investors using the share of sovereign debt held by non-bank investors, based on the data of [Arslanalp and Tsuda \(2014b\)](#).<sup>6</sup> Non-bank investors tend to exhibit greater price responsiveness than other investor groups and play an important role in absorbing sovereign debt issuance ([Fang et al., 2025](#)). A larger share of these investors may therefore increase the price elasticity of demand for sovereign debt, facilitating the absorption of additional issuance with smaller adjustments in yields. All three variables exhibit meaningful cyclical variation over our sample period, making them well suited to capture time-varying macroeconomic conditions that may interact with the safe haven demand for US Treasuries. The results are reported in Table 8.

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<sup>6</sup>This category is heterogeneous and includes pension funds, insurance companies, mutual and investment funds, other asset managers, and hedge funds, as well as potentially non-financial corporations and households.

|                      | $C_1$               |                      |                   | $C_2$               |                     |                   | $C_3$               |                     |                   | $C_4$                |                      |                    | $C_5$               |                     |                    |
|----------------------|---------------------|----------------------|-------------------|---------------------|---------------------|-------------------|---------------------|---------------------|-------------------|----------------------|----------------------|--------------------|---------------------|---------------------|--------------------|
|                      | Infl.               | Debt                 | Inv.              | Infl.               | Debt                | Inv.              | Infl.               | Debt                | Inv.              | Infl.                | Debt                 | Inv.               | Infl.               | Debt                | Inv.               |
| <i>United States</i> |                     |                      |                   |                     |                     |                   |                     |                     |                   |                      |                      |                    |                     |                     |                    |
| Constant             | -0.120<br>(0.176)   | -0.089<br>(0.517)    | -0.728<br>(0.925) | 0.478***<br>(0.038) | 0.586***<br>(0.119) | 0.304<br>(0.212)  | 0.885***<br>(0.169) | 1.680***<br>(0.451) | 0.034<br>(0.857)  | -0.977***<br>(0.201) | -1.822***<br>(0.608) | -0.713<br>(1.124)  | 0.243<br>(0.216)    | 1.319**<br>(0.577)  | -1.953*<br>(1.133) |
| Risk-off             | 1.925***<br>(0.440) | 4.897***<br>(1.336)  | -3.118<br>(2.469) | 0.357***<br>(0.081) | 0.707***<br>(0.221) | -0.372<br>(0.427) | 2.300***<br>(0.722) | 3.595***<br>(1.264) | -2.420<br>(2.955) | 1.373**<br>(0.564)   | 5.984***<br>(1.687)  | -5.552*<br>(3.092) |                     |                     |                    |
| $S$                  |                     |                      |                   |                     |                     |                   |                     |                     |                   |                      |                      |                    | -0.500**<br>(0.224) | 0.428<br>(0.527)    | -1.445<br>(0.905)  |
| $Z$                  | -0.031<br>(0.206)   | -0.048<br>(0.458)    | 0.630<br>(0.938)  | 0.001<br>(0.037)    | -0.098<br>(0.108)   | 0.190<br>(0.213)  | 0.264<br>(0.214)    | -0.541<br>(0.404)   | 1.072<br>(0.849)  | -0.433*<br>(0.252)   | 0.515<br>(0.544)     | -0.561<br>(1.114)  | -0.233<br>(0.219)   | -1.265**<br>(0.593) | 1.972*<br>(1.066)  |
| Risk-off $\times Z$  | -0.642<br>(0.448)   | -3.406***<br>(1.302) | 4.429*<br>(2.410) | -0.117<br>(0.078)   | -0.440**<br>(0.218) | 0.612<br>(0.415)  | -0.651<br>(0.806)   | -1.888<br>(1.282)   | 4.011<br>(2.850)  | -0.307<br>(0.580)    | -4.763***<br>(1.675) | 6.417**<br>(2.916) |                     |                     |                    |
| $S \times Z$         |                     |                      |                   |                     |                     |                   |                     |                     |                   |                      |                      |                    | 0.457**<br>(0.197)  | -0.453<br>(0.521)   | 1.378*<br>(0.820)  |
| Adj. $R^2$           | 4.7                 | 5.6                  | 5.3               | 2.6                 | 3.0                 | 2.8               | —                   | —                   | —                 | —                    | —                    | —                  | 10.4                | 8.7                 | 7.4                |
| $N$                  | 1212                | 1202                 | 1141              | 1212                | 1202                | 1141              | 1212                | 1202                | 1141              | 1212                 | 1202                 | 1141               | 121                 | 121                 | 119                |

**Table 8: Cyclical drivers of safe haven behavior: US Treasuries**

*Notes:* OLS regressions for  $C_1$  and  $C_2$ ; quantile regressions ( $\tau = 0.75$  and  $\tau = 0.25$ ) for  $C_3$  and  $C_4$ , respectively; OLS regression for  $C_5$ . The dependent variable for  $C_1$ - $C_4$  is the momentum measure  $M_t$ . For  $C_1$ - $C_4$ , the main regressor is the risk-off dummy **ROR090**, equal to one when the RORO index exceeds its 90th percentile. For  $C_5$ , the sample is restricted to risk-off periods and the main regressor is the world equity return  $S_t$ , capturing hedging properties against risky asset prices during stress episodes. The interaction  $S_t \times Z_{t-1}$  captures how these hedging properties vary with the cyclical variable. The cyclical variable  $Z$  corresponds to the inflation rate (Infl.), the government gross debt-to-GDP ratio (Debt), or price-sensitive investors (Inv.), all lagged one period. Newey-West standard errors with five lags are reported in parentheses for OLS; five-week fixed moving-block bootstrap standard errors are reported for quantile regressions.

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

Our results confirm the importance of inflation for the stock–bond correlation. Inflation is positively and statistically significant associated to weaker hedging properties of US Treasuries ( $C_5$ ). Interestingly, the other safe haven criteria are not significantly related to inflation, suggesting that its main effect operates through the stock–bond correlation. By contrast, a higher debt-to-GDP ratio is associated with weaker safe haven properties, as indicated by a negative and statistically significant interaction coefficient, while Treasury hedging properties remain unaffected by this state variable. Finally, the role of price-sensitive investors is ambiguous. A greater presence of such investors is associated with stronger safe-haven characteristics (criteria 1 and 5), but with weaker hedging properties (criterion 5). These results are consistent with the post-pandemic US environment, characterized by higher public debt, higher inflation, and a lower share of price-sensitive investors. Specifically, average debt-to-GDP increased from 120% over 2004-2019 to 143% since 2020, average inflation rose from 2.1% to 3.9%, and the share of price-sensitive investors declined from 60% to 54%.

We report the results for Germany and the United Kingdom in Appendix (Table B14). The findings are more heterogeneous for both countries. While UK government bonds appear largely unaffected by the level of inflation, inflation is strongly associated with the safe haven properties of German bonds. By contrast, bond hedging properties are generally unaffected by macro-financial conditions. When significant, higher public indebtedness and a lower share of price-sensitive investors are associated with weaker safe-haven characteristics.

## 7 Conclusion

The safe haven status of US Treasuries, for long taken as a structural feature of the international monetary system, has come under renewed scrutiny following a series of episodes in which Treasury prices failed to respond as conventional flight-to-safety dynamics would predict. This article assesses whether this apparent fragility is specific to US Treasuries or symptomatic of a broader reconfiguration of safe asset markets. To this end, we develop a multi-criteria empirical of safe haven behaviour and apply it to a broad cross-section of sovereign and corporate bonds clustered into a novel taxonomy of safe assets as well as to currencies, and alternative assets spanning more than two decades.

Over the full sample, US Treasuries rank among the assets displaying the strongest safe haven behavior, alongside G10 sovereign bonds, notably Swedish and Australian debt. Corporate bonds exhibit safe haven characteristics only in a limited number of cases, while among currencies, the US dollar, the Japanese yen, and the Swiss franc emerge as the dominant safe havens. Gold stands out among alternative assets as the only one displaying consistent safe haven properties across both risk-off episodes and episodes of acute geopolitical stress.

Our central finding, however, concerns the evolution of this behavior over time. We document a marked structural break in the safe haven properties of US Treasuries, both nominal and inflation-indexed, since the onset of the COVID-19 pandemic, both in absolute terms and relative to other global safe assets. This deterioration is not an isolated US phenomenon: a comparable, if more heterogeneous, pattern emerges across other advanced-economy sovereign bonds, and is associated with rising inflation, higher public indebtedness, and changing investor-composition of the debt. The US dollar, by contrast, shows no evidence of a comparable break and retains its dominant safe haven status throughout the sample. This growing wedge between the safe haven properties of US Treasuries and those of the US dollar constitutes, in our view, the chapter's most striking result.

Taken together, these findings point to an increasingly fragmented safe asset landscape, in which safety is no longer concentrated in a single dominant instrument but distributed unevenly across asset classes, and even within the US policy space itself. This reconfiguration carries implications for investors' portfolio allocation, for the pricing of sovereign risk, and for the broader functioning of the international monetary system.

These results also suggest several directions for future research. A natural extension would be to examine how shifts in safe haven rankings feed through to sovereign debt-servicing costs and fiscal space, thereby quantifying the economic value attached to safe asset status. A second avenue concerns the role of monetary policy: to the extent that credible policy frameworks help sustain safe asset status, central banks may exert an indirect influence on the safety premium of domestic sovereign debt, while a continued erosion of safe haven properties may warrant a reassessment of the interventions required to preserve market stability in periods of stress. We view the relationship between safe asset status, fiscal capacity, and monetary policy credibility as a promising agenda for future work.

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# A Appendix

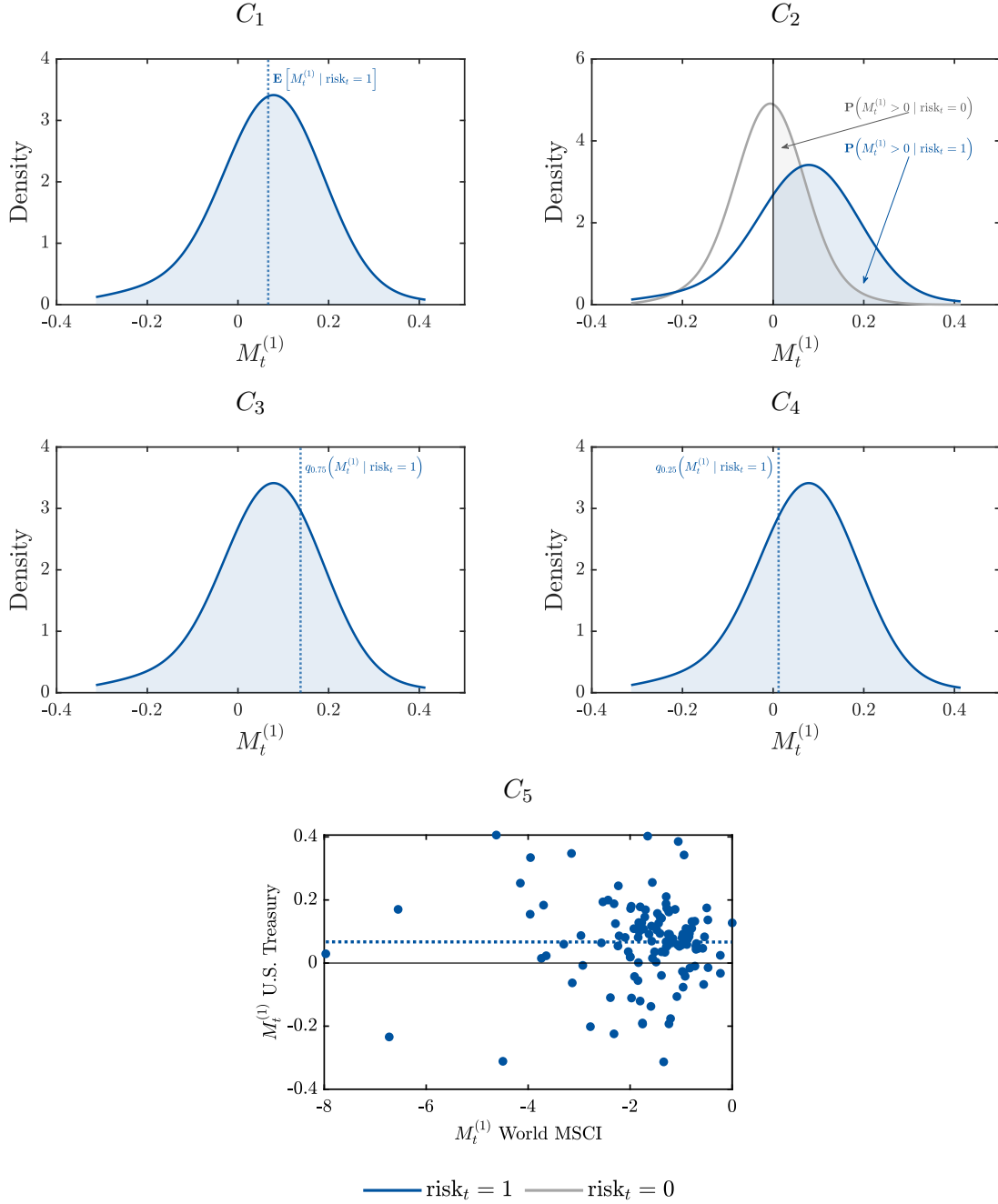


**Figure A1: Illustration of scoring of US Treasury for each criteria at  $h = 1$**

*Notes:* The figure reports approximated probability density function of realization of  $M_t^{(1)}$  based on US Treasury long-term yields and the associated criteria.  $C_5$  reports the correlation between  $M_t^{(1)}$  based on US Treasuries and  $S_t^{(1)}$  based MSCI World index.

## B Appendix

| Year                          | Month | Week | Days  | $z_{\text{RORO}}$ | Event Description                                                           |
|-------------------------------|-------|------|-------|-------------------|-----------------------------------------------------------------------------|
| <b>Largest 1%</b>             |       |      |       |                   |                                                                             |
| 2008                          | Jan.  | 4    | 21–25 | 3.30              | Early Global Financial Crisis tensions                                      |
| 2008                          | Sep.  | 38   | 15–19 | 4.93              | Lehman Brothers bankruptcy shock                                            |
| 2008                          | Sep.  | 40   | 29–03 | 4.67              | Escalation of global financial panic                                        |
| 2008                          | Oct.  | 41   | 06–10 | 8.80              | Peak of Global Financial Crisis                                             |
| 2008                          | Oct.  | 42   | 13–17 | 4.47              | Persistent post-Lehman market stress                                        |
| 2008                          | Nov.  | 46   | 10–14 | 3.88              | Financial system stabilization phase                                        |
| 2008                          | Nov.  | 47   | 17–21 | 3.80              | Continued deleveraging and risk aversion                                    |
| 2011                          | Aug.  | 32   | 08–12 | 5.79              | US sovereign downgrade and Euro-area debt crisis                            |
| 2020                          | Mar.  | 11   | 09–13 | 7.09              | COVID-19 global market sell-off begins                                      |
| 2020                          | Mar.  | 12   | 16–20 | 10.06             | Peak COVID-19 panic and flight to safety                                    |
| 2023                          | Mar.  | 11   | 13–17 | 3.60              | Global banking stress episode                                               |
| 2025                          | Apr.  | 15   | 07–11 | 4.58              | Heightened volatility following US tariff announcements                     |
| <b>Selected largest 2-5%</b>  |       |      |       |                   |                                                                             |
| 2007                          | Aug.  | 33   | 13–17 | 3.16              | Onset of subprime mortgage crisis and global liquidity stress               |
| 2020                          | Feb.  | 09   | 24–28 | 3.06              | Initial global market reaction to COVID-19 outbreak                         |
| 2011                          | Mar.  | 11   | 14–18 | 2.83              | Japan earthquake and escalation of euro-area sovereign debt concerns        |
| 2022                          | Jun.  | 24   | 13–17 | 2.75              | Peak inflation fears and tightening-driven market stress                    |
| <b>Selected largest 6-10%</b> |       |      |       |                   |                                                                             |
| 2010                          | Aug.  | 32   | 09–13 | 1.51              | Elevated sovereign risk concerns amid fragile post-crisis recovery          |
| 2022                          | Jan.  | 04   | 24–28 | 1.48              | Monetary policy tightening repricing and early geopolitical tensions        |
| 2015                          | Sep.  | 39   | 21–25 | 1.48              | Persistent global risk aversion following China slowdown and market turmoil |
| 2010                          | Apr.  | 17   | 26–30 | 1.46              | Escalation of Greek sovereign debt crisis and euro-area financial stress    |
| 2026                          | Mar.  | 10   | 02–06 | 1.21              | Escalation of U.S.-Israel-Iran conflict triggered an energy-supply shock    |

Table B1: Identified risk-off episodes based on the RORO index

| Country                   | ISO | Long-rate |            | FX      | NEER          |
|---------------------------|-----|-----------|------------|---------|---------------|
|                           |     | Mnemonic  | Start date |         |               |
| Advanced economies        |     |           |            |         |               |
| United States             | USA | TRUS10T   | Jan. 1990  | —       | BISBUSN Index |
| Euro area                 | EUR | —         | —          | TEUSDSP | BISBEUN Index |
| Germany                   | DEU | TRBD10T   | Jan. 1990  | —       | —             |
| United Kingdom            | GBR | TRUK10T   | Jan. 1990  | TSUSDSP | BISBGBN Index |
| Canada                    | CAN | TRCN10T   | Jan. 1990  | TDCADSP | BISBCAN Index |
| France                    | FRA | TRFR10T   | Jan. 1990  | —       | —             |
| Italy                     | ITA | TRIT10T   | Mar. 1991  | —       | —             |
| Spain                     | ESP | TRES10T   | Jun. 1991  | —       | —             |
| Greece                    | GRC | TRGR10T   | Jan. 1999  | —       | —             |
| Sweden                    | SWE | TRSD10T   | Jan. 1990  | TDSEKSP | BISBSEN Index |
| Korea                     | KOR | TRKR10T   | Dec. 2000  | TDKRWSP | BISBKRN Index |
| Netherlands               | NLD | TRNL10T   | Jan. 1990  | —       | BISBEUN Index |
| Ireland                   | IRL | TRIE10T   | Jan. 1990  | —       | —             |
| Portugal                  | PRT | TRPT10T   | Jun. 1994  | —       | —             |
| Czechia                   | CZE | TRCZ10T   | May 2000   | TDCZKSP | BISBCZN Index |
| Slovakia                  | SVK | TRSK10T   | Jan. 2004  | —       | —             |
| Japan                     | JPN | TRJP10T   | Jan. 1990  | TDJPYSP | BISBJPN Index |
| Croatia                   | HRV | TRHR10T   | Jan. 2008  | —       | —             |
| Israel                    | ISR | TRIL10T   | May 2002   | ISUSDSP | BISBILN Index |
| Finland                   | FIN | TRFN10T   | Nov. 1991  | —       | —             |
| Austria                   | AUT | TROE10T   | Jan. 1990  | —       | —             |
| Denmark                   | DNK | TRDK10T   | Jan. 1990  | TDDKKSP | BISBDKN Index |
| Switzerland               | CHE | TRSW10T   | Feb. 1994  | TDCHFSP | BISBCHN Index |
| Australia                 | AUS | TRAU10T   | Jan. 1990  | TDAUDSP | BISBAUN Index |
| Slovenia                  | SVN | TRSI10T   | Apr. 2007  | —       | —             |
| Belgium                   | BEL | TRBG10T   | Jan. 1990  | —       | —             |
| Norway                    | NOR | TRNW10T   | Jan. 1990  | TDNOKSP | BISBNON Index |
| New Zealand               | NZL | TRNZ10T   | Jan. 1990  | TDNZDSP | BISBNZN Index |
| Emerging market economies |     |           |            |         |               |
| Brazil                    | BRA | TRBR10T   | Jan. 1999  | TDBRLSP | BISBBRN Index |
| Mexico                    | MEX | TRMX10T   | Aug. 2001  | TDMXNSP | BISBMXN Index |
| South Africa              | ZAF | TRSA10T   | Jun. 1995  | TDZARSP | BISBZAN Index |
| Colombia                  | COL | TRCO10T   | Oct. 2002  | TDCOPSP | BISBCON Index |
| Chile                     | CHL | TRCL10T   | Apr. 2007  | TDCLPSP | BISBCHN Index |
| India                     | IND | TRIN10T   | Aug 1994   | TDINRSP | BISBINN Index |
| China                     | CHN | TRCH10T   | Jun. 2002  | TDCNYSP | BISBCNN Index |
| Hungary                   | HUN | TRHN10T   | Feb. 1999  | TDHUFSP | BISBHUN Index |
| Poland                    | POL | TRPO10T   | Dec. 1999  | TDPLNSP | BISBPLN Index |
| Indonesia                 | IDN | TRID10T   | Feb. 2005  | TDIDRSP | BISBIDN Index |
| Malaysia                  | MYS | TRMY10T   | Nov. 2001  | TDMYRSP | BISBMYN Index |
| Philippines               | PHL | TRPH10T   | Feb. 2001  | TDPHPSP | BISBPHN Index |

**Table B2: Panel data of sovereign bond yields, exchange rates, and NEER**

*Notes:* Long-rate series are based on local-currency sovereign bond securities. NEER refers to the BIS broad nominal effective exchange rate index.

| Country / Asset                  | ISO | Mnemonic       | Source       | Start date |
|----------------------------------|-----|----------------|--------------|------------|
| <b>Corporate bond securities</b> |     |                |              |            |
| United States                    | USA | SPUIGBD        | S&P          | Apr. 1993  |
| Germany                          | DEU | I09894EU Index | Bloomberg    | Oct. 2004  |
| United Kingdom                   | GBR | I09901GB Index | Bloomberg    | Oct. 2004  |
| Canada                           | CAN | SPCICAL        | S&P          | Feb. 1998  |
| France                           | FRA | I09893EU Index | Bloomberg    | Oct. 2004  |
| Italy                            | ITA | I09895EU Index | Bloomberg    | Oct. 2004  |
| Spain                            | ESP | I09898EU Index | Bloomberg    | Oct. 2004  |
| Sweden                           | SWE | SPSEICR        | S&P          | Feb. 1998  |
| Korea                            | KOR | JBMXKRYM       | Bloomberg    | Jan. 2002  |
| Netherlands                      | NLD | I09896EU Index | Bloomberg    | Oct. 2004  |
| Czechia                          | CZE | JBMXCZYM       | Bloomberg    | Apr. 2012  |
| Japan                            | JPN | SPJPICJ        | S&P          | Feb. 1998  |
| Israel                           | ISR | JBMXILYM       | Bloomberg    | Jun. 2003  |
| Austria                          | AUT | I09891EU Index | Bloomberg    | Oct. 2004  |
| Denmark                          | DNK | SPDKICD        | S&P          | Feb. 1998  |
| Switzerland                      | CHE | SPCHICC        | S&P          | Feb. 1998  |
| Australia                        | AUS | SPAUICA        | S&P          | Jan 2005   |
| Belgium                          | BEL | I09892EU Index | Bloomberg    | Oct. 2004  |
| Norway                           | NOR | SPNOICN        | S&P          | Jan. 2000  |
| New Zealand                      | NZL | SPNZICZ        | S&P          | Feb. 1998  |
| Brazil                           | BRA | JBMXBRYM       | Bloomberg    | Jul. 2003  |
| Mexico                           | MEX | JBMXMXYM       | Bloomberg    | Jan. 2002  |
| South Africa                     | ZAF | JBMXZAYM       | Bloomberg    | Dec. 2009  |
| Colombia                         | COL | JBMXCOYM       | Bloomberg    | Jul. 2007  |
| Chile                            | CHL | JBMXCLYM       | Bloomberg    | Jan. 2002  |
| India                            | IND | JBMXINYM       | Bloomberg    | Jun. 2004  |
| China                            | CHN | JBMXCNYM       | Bloomberg    | May 2002   |
| Indonesia                        | IDN | JBMXIDYM       | Bloomberg    | Jul. 2012  |
| Malaysia                         | MYS | JBMXMYYM       | Bloomberg    | Jan. 2002  |
| Philippines                      | PHL | JBMXPHYM       | Bloomberg    | Nov. 2013  |
| <b>Other assets</b>              |     |                |              |            |
| Gold Spot                        | —   | GSGCSPT        | S&P          | Jan. 1990  |
| Silver Spot                      | —   | GSSISPT        | S&P          | Jan. 1990  |
| Bitcoin                          | —   | BTCTOU\$       | LSEG         | Sep. 2011  |
| Oil (Brent)                      | —   | EIAEBRT        | EIA          | Jan. 1990  |
| MSCI World Equity                | —   | MSWRLD         | MSCI         | Jan. 1990  |
| 10y OIS                          | USA | OIUSD10        | LSEG         | Aug. 2011  |
| 10y Term premia                  | USA | USTTP10        | Fed New York | Jan. 1990  |
| 10y TIPS                         | USA | TRUSI10        | LSEG         | Feb. 1997  |

**Table B3: Panel data of corporate bond yields and alternative assets**

*Note:* For corporate securities, we take yield to maturities. Investment grade corporate bonds.

| Variables                       | Acronym | Sources                                                                  | Description                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|---------|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Fundamental</b>              |         |                                                                          |                                                                                                                                                                                                                                                                                                                                                                                           |
| Capital Account Openness        | OPEN    | <a href="#">Chinn and Ito (2006)</a>                                     | Degree of capital account openness. 2000-2023 average.                                                                                                                                                                                                                                                                                                                                    |
| Market Debt Size                | SIZE    | Bank of International Settlement, CEIC                                   | Total outstanding debt (sovereign or corporate) in Q4 2025 (total debt securities) expressed in billion USD. Corporate includes financial. Sovereign corresponds to the general government. Due to data lack of available data, domestic debt securities has ben taken for Colombia. For New Zealand and India, net government debt from CEIC is used as proxied for corporate debt size. |
| Sovereign Credit Rating         | RATG    | <a href="#">Kose et al. (2022)</a>                                       | 2000-2024 average foreign currency long-term sovereign debt ratings                                                                                                                                                                                                                                                                                                                       |
| Rule of Law                     | ROL     | World Bank                                                               | World Governance Indicator measuring adherence to universal rule of law principles. 2000-2024 average.                                                                                                                                                                                                                                                                                    |
| Local Currency Market           | LC      | <a href="#">Arslanalp (2014a,b)</a> and <a href="#">Tsuda</a> , Eurostat | Share of local currency in total sovereign debt (total debt for emerging market; debt securities for advanced economies). 2000-2024 average.                                                                                                                                                                                                                                              |
| Net International Inv. Position | NIIP    | <a href="#">Lane and Milesi-Ferretti (2018)</a>                          | Net International Investment Position (NIIP) as % of GDP in domestic currency. 2000-2024 average.                                                                                                                                                                                                                                                                                         |
| <b>Cyclical</b>                 |         |                                                                          |                                                                                                                                                                                                                                                                                                                                                                                           |
| Inflation                       | INF     | OECD                                                                     | Year-on-year change in the Consumer Price Index. Data at monthly frequency                                                                                                                                                                                                                                                                                                                |
| Debt-to-GDP                     | DEBT    | Oxford Economics                                                         | General gross government debt as % of GDP. Data at quarterly (or annual) frequency                                                                                                                                                                                                                                                                                                        |
| Price-sensitive investors       | FF      | <a href="#">Arslanalp (2014a,b)</a> and <a href="#">Tsuda</a>            | Share of total sovereign debt held by the non-bank private insitutions                                                                                                                                                                                                                                                                                                                    |

Table B4: Panel data of macroeconomic cyclical variables and fundamentals

| Variables | Mean  | SD    | Correlation |       |       |       |       |      |      |      |      |      |      |
|-----------|-------|-------|-------------|-------|-------|-------|-------|------|------|------|------|------|------|
|           |       |       | $C_1$       | $C_2$ | $C_3$ | $C_4$ | $C_5$ | OPEN | SIZE | LC   | NIIP | RATG | ROL  |
| $C_1$     | -0.01 | 0.33  | 1.00        |       |       |       |       |      |      |      |      |      |      |
| $C_2$     | 0.00  | 0.18  | 0.96        | 1.00  |       |       |       |      |      |      |      |      |      |
| $C_3$     | 0.62  | 0.37  | 0.94        | 0.94  | 1.00  |       |       |      |      |      |      |      |      |
| $C_4$     | -0.52 | 0.31  | 0.93        | 0.87  | 0.79  | 1.00  |       |      |      |      |      |      |      |
| $C_5$     | -0.11 | 0.15  | 0.78        | 0.75  | 0.67  | 0.75  | 1.00  |      |      |      |      |      |      |
| OPEN      | 0.79  | 0.29  | 0.36        | 0.48  | 0.43  | 0.32  | 0.18  | 1.00 |      |      |      |      |      |
| SIZE      | 6.37  | 1.69  | 0.24        | 0.32  | 0.28  | 0.15  | 0.18  | 0.09 | 1.00 |      |      |      |      |
| LC        | 0.90  | 0.12  | 0.41        | 0.49  | 0.39  | 0.42  | 0.37  | 0.42 | 0.43 | 1.00 |      |      |      |
| NIIP      | -0.09 | 0.48  | 0.41        | 0.39  | 0.34  | 0.41  | 0.21  | 0.15 | 0.15 | 0.24 | 1.00 |      |      |
| RATG      | 16.85 | 2.75  | 0.63        | 0.61  | 0.70  | 0.56  | 0.27  | 0.50 | 0.12 | 0.39 | 0.37 | 1.00 |      |
| ROL       | 72.57 | 14.68 | 0.63        | 0.69  | 0.64  | 0.59  | 0.39  | 0.83 | 0.12 | 0.56 | 0.34 | 0.65 | 1.00 |

**Table B5: Correlation matrix of safe haven criteria and economic fundamentals**

*Notes:* "SD" denotes the sample standard deviation.  $C_1$ - $C_5$  denote the five safe-haven criteria. "OPEN" denotes the degree of capital account liberalization; "SIZE" refers to the size of the debt securities market; "LC" denotes the share of local-currency debt securities in total debt securities; "NIIP" denotes the net international investment position; "RATG" refers to the sovereign credit rating; and "ROL" denotes the rule of law.

| ISO       | Group     | $\mathcal{P}_1$ | OPEN  | SIZE  | LC    | NIIP  | RATG  | ROL   | Ranking |     |     |
|-----------|-----------|-----------------|-------|-------|-------|-------|-------|-------|---------|-----|-----|
|           |           |                 |       |       |       |       |       |       | (1)     | (2) | (3) |
| Sovereign |           |                 |       |       |       |       |       |       |         |     |     |
| SWE       | Advanced  | 1.84            | 0.74  | -0.77 | -0.55 | 0.17  | 1.45  | 1.12  | 1       | 1   | 1   |
| USA       | Advanced  | 1.65            | 0.74  | 2.40  | 0.84  | -0.59 | 1.44  | 0.53  | 2       | 2   | 2   |
| AUS       | Advanced  | 1.57            | 0.14  | 0.03  | 0.76  | -0.88 | 1.39  | 0.88  | 3       | 4   | 4   |
| DEU       | Euro Area | 1.55            | 0.74  | 0.94  | 0.68  | 0.83  | 1.51  | 0.88  | 4       | 3   | 3   |
| GBR       | Advanced  | 1.50            | 0.74  | 1.09  | 0.84  | 0.01  | 1.19  | 0.71  | 5       | 5   | 5   |
| NOR       | Advanced  | 1.42            | 0.74  | -1.07 | 0.84  | 3.10  | 1.51  | 1.23  | 6       | 6   | 7   |
| CAN       | Advanced  | 1.38            | 0.74  | 0.76  | -0.22 | 0.37  | 1.43  | 0.87  | 7       | 8   | 8   |
| DNK       | Advanced  | 1.37            | 0.74  | -0.93 | 0.52  | 0.69  | 1.48  | 1.22  | 8       | 6   | 6   |
| NLD       | Euro Area | 1.29            | 0.74  | -0.09 | 0.76  | 0.54  | 1.50  | 1.01  | 9       | 9   | 9   |
| CHE       | Advanced  | 1.21            | 0.74  | -0.76 | 0.84  | 2.37  | 1.51  | 1.10  | 11      | 12  | 10  |
| JPN       | Advanced  | 1.17            | 0.74  | 1.55  | 0.84  | 1.31  | 0.46  | 0.54  | 12      | 10  | 11  |
| FIN       | Euro Area | 1.09            | 0.74  | -0.57 | 0.03  | -0.04 | 1.36  | 1.29  | 13      | 13  | 13  |
| FRA       | Euro Area | 1.02            | 0.74  | 1.09  | 0.60  | -0.12 | 1.17  | 0.37  | 14      | 15  | 14  |
| AUT       | Euro Area | 0.90            | 0.74  | -0.14 | 0.27  | 0.14  | 1.36  | 1.03  | 16      | 16  | 16  |
| KOR       | Advanced  | 0.63            | -0.34 | 0.27  | 0.68  | 0.34  | 0.03  | 0.10  | 19      | 19  | 19  |
| BEL       | Euro Area | 0.55            | 0.69  | 0.14  | 0.68  | 1.13  | 0.81  | 0.50  | 20      | 21  | 20  |
| ITA       | Euro Area | -0.55           | 0.74  | 1.00  | 0.68  | -0.04 | -0.48 | -0.41 | 27      | 26  | 29  |
| Corporate |           |                 |       |       |       |       |       |       |         |     |     |
| NOR       | Advanced  | 1.26            | 0.74  | -0.14 | 0.84  | 3.10  | 0.05  | 1.23  | 10      | 10  | 12  |
| AUS       | Advanced  | 0.95            | 0.14  | 0.73  | 0.76  | -0.88 | 0.05  | 0.88  | 15      | 14  | 15  |
| SWE       | Advanced  | 0.76            | 0.74  | 0.17  | -0.55 | 0.17  | 0.05  | 1.12  | 17      | 17  | 17  |
| JPN       | Advanced  | 0.68            | 0.74  | 0.92  | 0.84  | 1.31  | 0.05  | 0.54  | 18      | 18  | 18  |
| DNK       | Advanced  | 0.43            | 0.74  | 0.11  | 0.52  | 0.69  | 0.05  | 1.22  | 21      | 19  | 21  |
| CAN       | Advanced  | 0.32            | 0.74  | 0.87  | -0.22 | 0.37  | 0.05  | 0.87  | 22      | 22  | 22  |
| KOR       | Advanced  | -0.02           | -0.34 | 0.65  | 0.68  | 0.34  | 0.05  | 0.10  | 23      | 23  | 23  |
| CHE       | Advanced  | -0.18           | 0.74  | 0.21  | 0.84  | 2.37  | 0.05  | 1.10  | 24      | 24  | 24  |
| NLD       | Euro Area | -0.30           | 0.74  | 0.79  | 0.76  | 0.54  | 0.05  | 1.01  | 25      | 25  | 25  |
| USA       | Advanced  | -0.45           | 0.74  | 2.28  | 0.84  | -0.59 | 0.05  | 0.53  | 26      | 26  | 26  |
| BEL       | Euro Area | -0.62           | 0.69  | -0.21 | 0.68  | 1.13  | 0.05  | 0.50  | 28      | 29  | 27  |
| DEU       | Euro Area | -0.62           | 0.74  | 0.83  | 0.68  | 0.83  | 0.05  | 0.88  | 29      | 28  | 28  |
| AUT       | Euro Area | -0.84           | 0.74  | -0.32 | 0.27  | 0.14  | 0.05  | 1.03  | 30      | 30  | 30  |
| FRA       | Euro Area | -0.87           | 0.74  | 1.05  | 0.60  | -0.12 | 0.05  | 0.37  | 31      | 31  | 31  |
| GBR       | Advanced  | -0.92           | 0.74  | 1.00  | 0.84  | 0.01  | 0.05  | 0.71  | 32      | 31  | 32  |
| ITA       | Euro Area | -1.30           | 0.74  | 0.36  | 0.68  | -0.04 | 0.05  | -0.41 | 33      | 33  | 33  |

**Table B6: Clustering: global safe assets**

*Notes:* (1) ranks assets based on the first principal component of the safe-haven scores; (2) ranks assets based on the arithmetic average of the safe-haven scores; and (3) reports the mean rank across the individual safe-haven criteria.

| ISO       | Group     | $\mathcal{P}_1$ | OPEN  | SIZE  | LC    | NIIP  | RATG  | ROL   | Ranking |     |     |
|-----------|-----------|-----------------|-------|-------|-------|-------|-------|-------|---------|-----|-----|
|           |           |                 |       |       |       |       |       |       | (1)     | (2) | (3) |
| Sovereign |           |                 |       |       |       |       |       |       |         |     |     |
| CHL       | Emerging  | 1.31            | -0.07 | -0.82 | -1.53 | -0.17 | -0.22 | 0.19  | 1       | 1   | 1   |
| NZL       | Advanced  | 1.19            | 0.74  | -0.91 | 0.52  | -1.15 | 1.13  | 1.05  | 2       | 1   | 2   |
| SVK       | Advanced  | 0.09            | -0.65 | -1.12 | 0.60  | -0.97 | -0.44 | -0.62 | 4       | 4   | 4   |
| ISR       | Advanced  | 0.05            | 0.59  | -0.37 | -0.79 | 0.47  | -0.19 | -0.04 | 5       | 6   | 5   |
| IRL       | Euro Area | -0.02           | 0.74  | -0.74 | 0.84  | -1.86 | 0.40  | 0.77  | 6       | 5   | 6   |
| CZE       | Advanced  | -0.19           | 0.61  | -0.73 | -0.22 | -0.36 | -0.04 | 0.02  | 7       | 7   | 7   |
| ESP       | Euro Area | -0.20           | 0.74  | 0.67  | 0.76  | -1.31 | 0.11  | 0.15  | 9       | 9   | 9   |
| PRT       | Euro Area | -0.37           | 0.74  | -0.57 | 0.68  | -1.71 | -0.69 | 0.21  | 10      | 10  | 12  |
| SVN       | Euro Area | -0.48           | -0.08 | -1.49 | 0.27  | -0.24 | -0.14 | -0.08 | 12      | 12  | 11  |
| GRC       | Euro Area | -0.55           | 0.52  | -0.88 | 0.76  | -2.11 | -2.17 | -0.43 | 13      | 13  | 13  |
| HRV       | Euro Area | -0.95           | -0.41 | -1.50 | 0.76  | -1.10 | -1.84 | -0.79 | 15      | 15  | 15  |
| HUN       | Emerging  | -1.54           | 0.57  | -0.75 | -1.69 | -1.30 | -1.35 | -0.42 | 17      | 17  | 17  |
| Corporate |           |                 |       |       |       |       |       |       |         |     |     |
| NZL       | Advanced  | 0.49            | 0.74  | -0.91 | 0.52  | -1.15 | 0.05  | 1.05  | 3       | 3   | 3   |
| ISR       | Advanced  | -0.19           | 0.59  | -0.66 | -0.79 | 0.47  | 0.05  | -0.04 | 8       | 8   | 8   |
| CZE       | Advanced  | -0.44           | 0.61  | -0.46 | -0.22 | -0.36 | 0.05  | 0.02  | 11      | 10  | 10  |
| CHL       | Emerging  | -0.76           | -0.07 | -0.58 | -1.53 | -0.17 | 0.05  | 0.19  | 14      | 14  | 14  |
| ESP       | Euro Area | -1.18           | 0.74  | 0.23  | 0.76  | -1.31 | 0.05  | 0.15  | 16      | 16  | 16  |

**Table B7: Clustering: credit-sensitive assets**

*Notes:* (1) ranks assets based on the first principal component of the safe-haven scores; (2) ranks assets based on the arithmetic average of the safe-haven scores; and (3) reports the mean rank across the individual safe-haven criteria.

| ISO       | Group    | $\mathcal{P}_1$ | OPEN  | SIZE  | LC    | NIIP  | RATG  | ROL   | Ranking |     |     |
|-----------|----------|-----------------|-------|-------|-------|-------|-------|-------|---------|-----|-----|
|           |          |                 |       |       |       |       |       |       | (1)     | (2) | (3) |
| Sovereign |          |                 |       |       |       |       |       |       |         |     |     |
| CHN       | Emerging | 0.94            | -2.15 | 1.88  | 0.52  | 0.55  | -0.12 | -1.83 | 1       | 1   | 1   |
| IND       | Emerging | 0.66            | -2.15 | 0.79  | 0.27  | -0.08 | -1.89 | -1.06 | 2       | 2   | 2   |
| MYS       | Emerging | -0.12           | -1.37 | -0.35 | -0.71 | 0.10  | -0.80 | -0.78 | 5       | 4   | 5   |
| BRA       | Emerging | -0.47           | -1.58 | 0.75  | 0.03  | -0.57 | -2.43 | -1.40 | 6       | 6   | 6   |
| PHL       | Emerging | -0.58           | -1.33 | -0.49 | -1.94 | -0.24 | -2.01 | -1.69 | 7       | 7   | 7   |
| POL       | Emerging | -0.60           | -0.92 | -0.12 | -2.51 | -0.83 | -0.67 | -0.39 | 8       | 7   | 8   |
| COL       | Emerging | -0.91           | -1.37 | -0.64 | -1.86 | -0.54 | -1.96 | -1.66 | 10      | 11  | 10  |
| ZAF       | Emerging | -0.93           | -2.15 | -0.30 | -0.22 | 0.16  | -1.66 | -1.00 | 11      | 10  | 11  |
| MEX       | Emerging | -0.94           | -0.36 | 0.32  | -1.12 | -0.61 | -1.32 | -1.80 | 12      | 12  | 12  |
| IDN       | Emerging | -1.24           | -0.82 | -0.09 | -2.68 | -0.56 | -2.41 | -1.61 | 14      | 15  | 15  |
| Corporate |          |                 |       |       |       |       |       |       |         |     |     |
| MYS       | Emerging | 0.12            | -1.37 | -0.45 | -0.71 | 0.10  | 0.05  | -0.78 | 3       | 3   | 3   |
| CHN       | Emerging | -0.04           | -2.15 | 1.91  | 0.52  | 0.55  | 0.05  | -1.83 | 4       | 4   | 4   |
| IND       | Emerging | -0.68           | -2.15 | 0.79  | 0.27  | -0.08 | 0.05  | -1.06 | 9       | 9   | 9   |
| MEX       | Emerging | -1.08           | -0.36 | -0.32 | -1.12 | -0.61 | 0.05  | -1.80 | 13      | 13  | 13  |
| ZAF       | Emerging | -1.29           | -2.15 | -0.83 | -0.22 | 0.16  | 0.05  | -1.00 | 15      | 14  | 14  |
| PHL       | Emerging | -1.54           | -1.33 | -1.64 | -1.94 | -0.24 | 0.05  | -1.69 | 16      | 16  | 16  |
| BRA       | Emerging | -1.73           | -1.58 | 0.57  | 0.03  | -0.57 | 0.05  | -1.40 | 17      | 18  | 18  |
| COL       | Emerging | -1.75           | -1.37 | -3.57 | -1.86 | -0.54 | 0.05  | -1.66 | 18      | 17  | 17  |
| IDN       | Emerging | -1.94           | -0.82 | -0.86 | -2.68 | -0.56 | 0.05  | -1.61 | 19      | 19  | 19  |

**Table B8: Clustering: emerging-market assets**

*Notes:* (1) ranks assets based on the first principal component of the safe-haven scores; (2) ranks assets based on the arithmetic average of the safe-haven scores; and (3) reports the mean rank across the individual safe-haven criteria.

|                       | 10y                 | 5y                  | 2y                  | 3m                  | OIS                 | TP                 | Real                |
|-----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|--------------------|---------------------|
| <i>C</i> <sub>1</sub> |                     |                     |                     |                     |                     |                    |                     |
| Risk                  | 0.794***<br>(0.100) | 0.844***<br>(0.106) | 0.754***<br>(0.114) | 0.485***<br>(0.130) | 0.750***<br>(0.122) | 0.338*<br>(0.160)  | 0.257<br>(0.138)    |
| $\beta_1 + \beta_2$   | 0.029<br>(0.326)    | 0.075<br>(0.352)    | 0.081<br>(0.425)    | 0.206<br>(0.490)    | 0.103<br>(0.361)    | -0.094<br>(0.198)  | -0.498<br>(0.268)   |
| <i>R</i> <sup>2</sup> | 6.480               | 7.067               | 6.266               | 3.564               | 4.581               | 1.345              | 1.692               |
| <i>C</i> <sub>2</sub> |                     |                     |                     |                     |                     |                    |                     |
| Risk                  | 0.362***<br>(0.041) | 0.349***<br>(0.043) | 0.348***<br>(0.048) | 0.116<br>(0.059)    | 0.362***<br>(0.053) | 0.166**<br>(0.055) | 0.122*<br>(0.059)   |
| $\beta_1 + \beta_2$   | -0.097<br>(0.108)   | -0.001<br>(0.121)   | -0.011<br>(0.117)   | -0.040<br>(0.126)   | 0.002<br>(0.125)    | 0.101<br>(0.106)   | -0.152<br>(0.094)   |
| <i>R</i> <sup>2</sup> | 4.221               | 3.440               | 3.185               | 0.485               | 3.563               | 1.050              | 0.940               |
| <i>C</i> <sub>3</sub> |                     |                     |                     |                     |                     |                    |                     |
| Risk                  | 0.881***<br>(0.125) | 1.085***<br>(0.142) | 0.825**<br>(0.258)  | 0.235<br>(0.280)    | 0.851***<br>(0.171) | 0.573**<br>(0.181) | 0.509*<br>(0.231)   |
| $\beta_1 + \beta_2$   | 0.815<br>(0.762)    | 0.588<br>(0.699)    | 0.241<br>(0.904)    | 0.004<br>(1.082)    | 0.793<br>(0.775)    | 0.086<br>(0.231)   | -0.345<br>(0.397)   |
| <i>C</i> <sub>4</sub> |                     |                     |                     |                     |                     |                    |                     |
| Risk                  | 0.927***<br>(0.127) | 0.865***<br>(0.121) | 0.492***<br>(0.084) | 0.180***<br>(0.047) | 0.926***<br>(0.181) | -0.006<br>(0.295)  | 0.275*<br>(0.131)   |
| $\beta_1 + \beta_2$   | -0.369<br>(0.515)   | -0.413<br>(0.458)   | -0.774<br>(0.455)   | -0.467<br>(0.497)   | -0.185<br>(0.630)   | -0.333<br>(0.316)  | -1.108**<br>(0.390) |
| <i>C</i> <sub>5</sub> |                     |                     |                     |                     |                     |                    |                     |
| S                     | -0.060<br>(0.097)   | -0.163<br>(0.089)   | -0.161<br>(0.095)   | -0.109<br>(0.082)   | -0.227<br>(0.118)   | 0.151<br>(0.176)   | 0.181<br>(0.164)    |
| $\beta_1 + \beta_2$   | 0.130<br>(0.319)    | 0.041<br>(0.353)    | -0.165<br>(0.359)   | -0.356<br>(0.336)   | 0.019<br>(0.348)    | 0.144<br>(0.140)   | 0.465***<br>(0.124) |
| <i>R</i> <sup>2</sup> | 8.480               | 8.909               | 6.961               | 2.700               | 8.023               | 3.092              | 14.011              |

**Table B9: Regression coefficients for selected US fixed-income assets**

*Notes:* Columns report estimates for US fixed-income securities across maturities and components of Treasury yields. Criteria *C*<sub>1</sub>, *C*<sub>2</sub>, and *C*<sub>5</sub> are estimated using linear regressions with Newey–West standard errors using five lags. Criteria *C*<sub>3</sub> and *C*<sub>4</sub> are estimated using quantile regressions at the 75th and 25th percentiles, respectively, with inference based on a five-week moving-block bootstrap. "10y", "5y", "2y", and "3m" denote US Treasury securities with maturities of 10 years, 5 years, 2 years, and 3 months, respectively. "OIS" refers to the 10-year US overnight index swap rate; "TP" denotes the 10-year US term premium; and "Real" refers to the yield on 10-year US Treasury Inflation-Protected Securities (TIPS). The row  $\beta_1 + \beta_2$  reports the post-2020 marginal effect. Standard errors are reported in parentheses. \**p* < 0.10, \*\**p* < 0.05, \*\*\**p* < 0.01.

|                       | Risk <sup>90th</sup> | Risk <sup>85th</sup> | Risk <sup>95th</sup> | Risk <sub>M</sub> <sup>90th</sup> | Risk <sub>G</sub> <sup>90th</sup> | VIX <sup>90th</sup> | SPRD <sup>90th</sup> | EQTI <sup>90th</sup> | LIQY <sup>90th</sup> | GOLD <sup>90th</sup> |
|-----------------------|----------------------|----------------------|----------------------|-----------------------------------|-----------------------------------|---------------------|----------------------|----------------------|----------------------|----------------------|
| <i>C</i> <sub>1</sub> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| Risk                  | 0.794***<br>(0.100)  | 0.591***<br>(0.087)  | 0.830***<br>(0.162)  | 0.811***<br>(0.100)               | 0.719***<br>(0.108)               | 0.754***<br>(0.109) | 0.868***<br>(0.117)  | 0.639***<br>(0.104)  | 0.249<br>(0.131)     | -0.260*<br>(0.119)   |
| $\beta_1 + \beta_2$   | 0.029<br>(0.326)     | -0.140<br>(0.229)    | 0.229<br>(0.515)     | -0.082<br>(0.273)                 | 0.083<br>(0.312)                  | -0.154<br>(0.180)   | 0.256<br>(0.310)     | -0.247<br>(0.332)    | 0.151<br>(0.271)     | -0.744***<br>(0.146) |
| <i>R</i> <sup>2</sup> | 6.480                | 4.993                | 3.877                | 6.828                             | 5.261                             | 5.142               | 7.798                | 4.330                | 0.971                | 2.892                |
| <i>C</i> <sub>2</sub> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| Risk                  | 0.362***<br>(0.041)  | 0.265***<br>(0.041)  | 0.336***<br>(0.050)  | 0.376***<br>(0.040)               | 0.319***<br>(0.044)               | 0.294***<br>(0.050) | 0.360***<br>(0.045)  | 0.289***<br>(0.045)  | 0.065<br>(0.061)     | -0.090<br>(0.057)    |
| $\beta_1 + \beta_2$   | -0.097<br>(0.108)    | -0.086<br>(0.081)    | -0.038<br>(0.145)    | -0.125<br>(0.099)                 | -0.008<br>(0.097)                 | -0.073<br>(0.080)   | 0.130<br>(0.099)     | -0.160<br>(0.100)    | 0.024<br>(0.096)     | -0.289***<br>(0.074) |
| <i>R</i> <sup>2</sup> | 4.221                | 3.193                | 2.096                | 4.590                             | 3.240                             | 2.591               | 4.206                | 2.934                | 0.572                | 1.517                |
| <i>C</i> <sub>3</sub> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| Risk                  | 0.881***<br>(0.115)  | 0.747***<br>(0.141)  | 1.024***<br>(0.127)  | 0.882***<br>(0.116)               | 0.853***<br>(0.134)               | 0.765***<br>(0.127) | 0.909***<br>(0.112)  | 0.757***<br>(0.166)  | 0.344<br>(0.195)     | -0.021<br>(0.161)    |
| $\beta_1 + \beta_2$   | 0.815<br>(0.795)     | -0.036<br>(0.415)    | 1.713<br>(0.937)     | -0.183<br>(0.700)                 | 0.815<br>(0.641)                  | -0.100<br>(0.287)   | 0.904<br>(0.496)     | -0.195<br>(0.741)    | 0.605<br>(0.499)     | -0.635*<br>(0.259)   |
| <i>C</i> <sub>4</sub> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| Risk                  | 0.927***<br>(0.122)  | 0.607***<br>(0.143)  | 0.851***<br>(0.241)  | 0.927***<br>(0.106)               | 0.785***<br>(0.154)               | 0.752***<br>(0.149) | 0.883***<br>(0.130)  | 0.649***<br>(0.155)  | 0.060<br>(0.209)     | -0.481**<br>(0.166)  |
| $\beta_1 + \beta_2$   | -0.369<br>(0.511)    | -0.875*<br>(0.412)   | -0.368<br>(0.699)    | -0.369<br>(0.502)                 | -0.125<br>(0.573)                 | -0.533<br>(0.273)   | -0.125<br>(0.540)    | -0.902*<br>(0.444)   | 0.155<br>(0.498)     | -0.731***<br>(0.202) |
| <i>C</i> <sub>5</sub> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| <i>S</i>              | -0.060<br>(0.097)    | -0.202*<br>(0.096)   | -0.027<br>(0.108)    | -0.048<br>(0.098)                 | -0.093<br>(0.102)                 | -0.254*<br>(0.101)  | -0.042<br>(0.146)    | -0.176<br>(0.091)    | -0.294*<br>(0.116)   | -0.358***<br>(0.097) |
| $\beta_1 + \beta_2$   | 0.129<br>(0.319)     | 0.048<br>(0.239)     | 0.262<br>(0.354)     | 0.138<br>(0.340)                  | 0.112<br>(0.303)                  | -0.041<br>(0.271)   | 0.154<br>(0.255)     | -0.094<br>(0.220)    | 0.085<br>(0.226)     | 0.179<br>(0.170)     |
| <i>R</i> <sup>2</sup> | 8.481                | 11.091               | 2.771                | 11.525                            | 6.248                             | 21.819              | 5.573                | 13.135               | 4.267                | 14.078               |

**Table B10: Robustness of US Treasury safe haven behavior to alternative risk measures**

*Notes:* The table reports estimates obtained using alternative measures and thresholds to identify risk-off episodes. Risk<sup>90th</sup>, Risk<sup>85th</sup>, and Risk<sup>95th</sup> denote risk-off episodes identified using the 90th, 85th, and 95th percentiles of the RORO index, respectively. Risk<sub>M</sub><sup>90th</sup> denotes a risk-off indicator constructed from the residual component of the RORO index after orthogonalization with respect to monetary policy shocks. Risk<sub>G</sub><sup>90th</sup> denotes a risk-off indicator constructed from a version of the RORO index purged of its currency and gold components. VIX<sup>90th</sup>, SPRD<sup>90th</sup>, EQTI<sup>90th</sup>, LIQY<sup>90th</sup>, and GOLD<sup>90th</sup> identify risk-off episodes using the corresponding alternative risk measures. The row  $\beta_1 + \beta_2$  reports the post-2020 marginal effect. Standard errors are reported in parentheses. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

|                      | Risk <sup>90th</sup> | Risk <sup>85th</sup> | Risk <sup>95th</sup> | Risk <sub>M</sub> <sup>90th</sup> | Risk <sub>G</sub> <sup>90th</sup> | VIX <sup>90th</sup> | SPRD <sup>90th</sup> | EQTI <sup>90th</sup> | LIQY <sup>90th</sup> | GOLD <sup>90th</sup> |
|----------------------|----------------------|----------------------|----------------------|-----------------------------------|-----------------------------------|---------------------|----------------------|----------------------|----------------------|----------------------|
| <i>C<sub>1</sub></i> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| Risk                 | 0.257<br>(0.138)     | 0.118<br>(0.117)     | 0.187<br>(0.250)     | 0.273*<br>(0.137)                 | 0.174<br>(0.152)                  | 0.495***<br>(0.127) | 0.319<br>(0.165)     | 0.143<br>(0.140)     | -0.088<br>(0.173)    | -0.512***<br>(0.111) |
| $\beta_1 + \beta_2$  | -0.498<br>(0.268)    | -0.498*<br>(0.228)   | -0.627<br>(0.379)    | -0.621*<br>(0.265)                | -0.424<br>(0.314)                 | -0.412*<br>(0.175)  | -0.365<br>(0.294)    | -0.797**<br>(0.247)  | -0.052<br>(0.230)    | -0.888***<br>(0.134) |
| $R^2$                | 1.692                | 1.700                | 1.140                | 2.166                             | 1.133                             | 3.263               | 1.733                | 2.699                | 0.324                | 5.861                |
| <i>C<sub>2</sub></i> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| Risk                 | 0.122*<br>(0.059)    | 0.067<br>(0.051)     | 0.057<br>(0.087)     | 0.138*<br>(0.059)                 | 0.097<br>(0.061)                  | 0.179**<br>(0.060)  | 0.154*<br>(0.062)    | 0.037<br>(0.060)     | -0.056<br>(0.068)    | -0.247***<br>(0.054) |
| $\beta_1 + \beta_2$  | -0.152<br>(0.094)    | -0.174*<br>(0.079)   | -0.190<br>(0.118)    | -0.181<br>(0.093)                 | -0.138<br>(0.105)                 | -0.167*<br>(0.076)  | -0.084<br>(0.106)    | -0.209*<br>(0.083)   | -0.021<br>(0.090)    | -0.466***<br>(0.048) |
| $R^2$                | 0.940                | 0.912                | 0.555                | 1.132                             | 0.754                             | 1.449               | 1.052                | 0.783                | 0.423                | 4.127                |
| <i>C<sub>3</sub></i> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| Risk                 | 0.509*<br>(0.227)    | 0.164<br>(0.180)     | 0.779*<br>(0.309)    | 0.415*<br>(0.211)                 | 0.196<br>(0.246)                  | 0.644***<br>(0.117) | 0.676***<br>(0.182)  | 0.156<br>(0.263)     | 0.034<br>(0.254)     | -0.386**<br>(0.130)  |
| $\beta_1 + \beta_2$  | -0.345<br>(0.394)    | -0.320<br>(0.325)    | 0.215<br>(0.789)     | -0.419<br>(0.346)                 | -0.094<br>(0.547)                 | -0.278<br>(0.214)   | 0.206<br>(0.519)     | -0.419<br>(0.351)    | 0.307<br>(0.391)     | -0.902***<br>(0.143) |
| <i>C<sub>4</sub></i> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| Risk                 | 0.275*<br>(0.133)    | 0.104<br>(0.159)     | 0.076<br>(0.354)     | 0.293*<br>(0.123)                 | 0.211<br>(0.200)                  | 0.326**<br>(0.102)  | 0.233<br>(0.180)     | 0.149<br>(0.168)     | -0.255<br>(0.235)    | -0.685***<br>(0.130) |
| $\beta_1 + \beta_2$  | -1.108**<br>(0.418)  | -1.024**<br>(0.327)  | -1.289*<br>(0.549)   | -1.108**<br>(0.384)               | -0.972*<br>(0.420)                | -0.695*<br>(0.312)  | -1.108*<br>(0.484)   | -1.353***<br>(0.324) | -0.447<br>(0.285)    | -0.675**<br>(0.232)  |
| <i>C<sub>5</sub></i> |                      |                      |                      |                                   |                                   |                     |                      |                      |                      |                      |
| $S$                  | 0.181<br>(0.164)     | 0.048<br>(0.148)     | 0.236<br>(0.208)     | 0.195<br>(0.164)                  | 0.184<br>(0.177)                  | 0.160<br>(0.180)    | 0.193<br>(0.165)     | 0.070<br>(0.163)     | 0.095<br>(0.190)     | -0.101<br>(0.127)    |
| $\beta_1 + \beta_2$  | 0.465***<br>(0.124)  | 0.364*<br>(0.143)    | 0.670***<br>(0.155)  | 0.483***<br>(0.128)               | 0.430**<br>(0.141)                | 0.376*<br>(0.144)   | 0.378***<br>(0.110)  | 0.272<br>(0.161)     | 0.373*<br>(0.144)    | 0.500***<br>(0.083)  |
| $R^2$                | 14.011               | 9.194                | 18.043               | 17.601                            | 11.004                            | 21.752              | 10.767               | 13.126               | 3.174                | 11.701               |

**Table B11: Robustness of US TIPS safe haven behavior to alternative risk measures**

*Notes:* The table reports estimates obtained using alternative measures and thresholds to identify risk-off episodes. Risk<sup>90th</sup>, Risk<sup>85th</sup>, and Risk<sup>95th</sup> denote risk-off episodes identified using the 90th, 85th, and 95th percentiles of the RORO index, respectively. Risk<sub>M</sub><sup>90th</sup> denotes a risk-off indicator constructed from the residual component of the RORO index after orthogonalization with respect to monetary policy shocks. Risk<sub>G</sub><sup>90th</sup> denotes a risk-off indicator constructed from a version of the RORO index purged of its currency and gold components. VIX<sup>90th</sup>, SPRD<sup>90th</sup>, EQTI<sup>90th</sup>, LIQY<sup>90th</sup>, and GOLD<sup>90th</sup> identify risk-off episodes using the corresponding alternative risk measures. The row  $\beta_1 + \beta_2$  reports the post-2020 marginal effect. Standard errors are reported in parentheses. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

|                       | Risk <sup>90th</sup> | Risk <sup>85th</sup> | Risk <sup>95th</sup> | Risk <sub>M</sub> <sup>90th</sup> | Risk <sub>G</sub> <sup>90th</sup> | VIX <sup>90th</sup>  | SPRD <sup>90th</sup> | EQTI <sup>90th</sup> | LIQY <sup>90th</sup> | GOLD <sup>90th</sup> |
|-----------------------|----------------------|----------------------|----------------------|-----------------------------------|-----------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| <i>C</i> <sub>1</sub> |                      |                      |                      |                                   |                                   |                      |                      |                      |                      |                      |
| Risk                  | 0.877***<br>(0.129)  | 0.794***<br>(0.112)  | 0.979***<br>(0.192)  | 0.868***<br>(0.129)               | 0.791***<br>(0.132)               | 0.425**<br>(0.146)   | 0.661***<br>(0.151)  | 0.735***<br>(0.129)  | 0.339*<br>(0.142)    | 1.111***<br>(0.090)  |
| $\beta_1 + \beta_2$   | 1.085***<br>(0.181)  | 0.909***<br>(0.144)  | 1.164***<br>(0.253)  | 1.142***<br>(0.196)               | 0.982***<br>(0.185)               | 0.460**<br>(0.156)   | 0.947***<br>(0.212)  | 0.933***<br>(0.169)  | 0.443<br>(0.247)     | 1.077***<br>(0.124)  |
| <i>R</i> <sup>2</sup> | 10.937               | 12.330               | 7.076                | 11.068                            | 8.880                             | 2.255                | 6.806                | 7.904                | 1.545                | 15.586               |
| <i>C</i> <sub>2</sub> |                      |                      |                      |                                   |                                   |                      |                      |                      |                      |                      |
| Risk                  | 0.337***<br>(0.051)  | 0.300***<br>(0.049)  | 0.344***<br>(0.059)  | 0.328***<br>(0.051)               | 0.304***<br>(0.055)               | 0.160*<br>(0.063)    | 0.274***<br>(0.061)  | 0.297***<br>(0.053)  | 0.163**<br>(0.063)   | 0.428***<br>(0.041)  |
| $\beta_1 + \beta_2$   | 0.357***<br>(0.070)  | 0.365***<br>(0.070)  | 0.297**<br>(0.099)   | 0.393***<br>(0.071)               | 0.333***<br>(0.075)               | 0.208**<br>(0.080)   | 0.284***<br>(0.084)  | 0.391***<br>(0.065)  | 0.125<br>(0.088)     | 0.375***<br>(0.064)  |
| <i>R</i> <sup>2</sup> | 3.971                | 4.933                | 1.904                | 4.000                             | 3.234                             | 0.921                | 2.530                | 3.564                | 0.611                | 5.946                |
| <i>C</i> <sub>3</sub> |                      |                      |                      |                                   |                                   |                      |                      |                      |                      |                      |
| Risk                  | 1.029***<br>(0.170)  | 0.896***<br>(0.153)  | 1.337***<br>(0.288)  | 0.972***<br>(0.165)               | 0.868***<br>(0.157)               | 0.701*<br>(0.275)    | 0.781***<br>(0.189)  | 0.812***<br>(0.149)  | 0.316<br>(0.228)     | 1.124***<br>(0.175)  |
| $\beta_1 + \beta_2$   | 1.097***<br>(0.263)  | 0.955***<br>(0.201)  | 1.609***<br>(0.459)  | 1.097***<br>(0.276)               | 1.097***<br>(0.269)               | 0.480*<br>(0.214)    | 1.106***<br>(0.294)  | 0.885**<br>(0.274)   | 1.053**<br>(0.337)   | 0.901***<br>(0.220)  |
| <i>C</i> <sub>4</sub> |                      |                      |                      |                                   |                                   |                      |                      |                      |                      |                      |
| Risk                  | 0.832***<br>(0.190)  | 0.632***<br>(0.182)  | 0.883***<br>(0.176)  | 0.832***<br>(0.207)               | 0.709***<br>(0.202)               | 0.322<br>(0.175)     | 0.549**<br>(0.190)   | 0.705***<br>(0.206)  | 0.342<br>(0.209)     | 1.092***<br>(0.120)  |
| $\beta_1 + \beta_2$   | 0.891***<br>(0.243)  | 0.747***<br>(0.165)  | 0.686<br>(0.405)     | 0.910***<br>(0.275)               | 0.731**<br>(0.227)                | 0.290<br>(0.270)     | 0.816**<br>(0.278)   | 0.717***<br>(0.173)  | 0.238<br>(0.290)     | 1.245***<br>(0.233)  |
| <i>C</i> <sub>5</sub> |                      |                      |                      |                                   |                                   |                      |                      |                      |                      |                      |
| <i>S</i>              | -0.457**<br>(0.141)  | -0.452***<br>(0.113) | -0.537**<br>(0.173)  | -0.470***<br>(0.135)              | -0.440**<br>(0.135)               | -0.660***<br>(0.086) | -0.542***<br>(0.113) | -0.540***<br>(0.143) | -0.643***<br>(0.104) | -0.492***<br>(0.109) |
| $\beta_1 + \beta_2$   | -0.363*<br>(0.140)   | -0.338*<br>(0.141)   | -0.539***<br>(0.105) | -0.371**<br>(0.139)               | -0.347**<br>(0.119)               | -0.645***<br>(0.092) | -0.458**<br>(0.164)  | -0.440**<br>(0.153)  | -0.749***<br>(0.120) | -0.653***<br>(0.103) |
| <i>R</i> <sup>2</sup> | 17.395               | 16.462               | 24.559               | 19.081                            | 15.669                            | 41.026               | 26.300               | 24.842               | 44.802               | 28.493               |

**Table B12: Robustness of US Dollar safe haven behavior to alternative risk measures**

*Notes:* The table reports estimates obtained using alternative measures and thresholds to identify risk-off episodes. Risk<sup>90th</sup>, Risk<sup>85th</sup>, and Risk<sup>95th</sup> denote risk-off episodes identified using the 90th, 85th, and 95th percentiles of the RORO index, respectively. Risk<sub>M</sub><sup>90th</sup> denotes a risk-off indicator constructed from the residual component of the RORO index after orthogonalization with respect to monetary policy shocks. Risk<sub>G</sub><sup>90th</sup> denotes a risk-off indicator constructed from a version of the RORO index purged of its currency and gold components. VIX<sup>90th</sup>, SPRD<sup>90th</sup>, EQTI<sup>90th</sup>, LIQY<sup>90th</sup>, and GOLD<sup>90th</sup> identify risk-off episodes using the corresponding alternative risk measures. The row  $\beta_1 + \beta_2$  reports the post-2020 marginal effect. Standard errors are reported in parentheses. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

|                       | $C_1$               |                      |                    | $C_2$               |                      |                     | $C_3$               |                     |                   | $C_4$                |                      |                      | $C_5$              |                      |                     |
|-----------------------|---------------------|----------------------|--------------------|---------------------|----------------------|---------------------|---------------------|---------------------|-------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|
|                       | Infl.               | Debt                 | Inv.               | Infl.               | Debt                 | Inv.                | Infl.               | Debt                | Inv.              | Infl.                | Debt                 | Inv.                 | Infl.              | Debt                 | Inv.                |
| <i>United Kingdom</i> |                     |                      |                    |                     |                      |                     |                     |                     |                   |                      |                      |                      |                    |                      |                     |
| Constant              | 0.115<br>(0.223)    | 0.034<br>(0.259)     | -0.570<br>(0.489)  | 0.549***<br>(0.041) | 0.471***<br>(0.070)  | 0.528***<br>(0.111) | 0.847***<br>(0.233) | 1.362***<br>(0.304) | 0.736*<br>(0.437) | -0.699***<br>(0.250) | -1.277***<br>(0.298) | -1.938***<br>(0.579) | 0.631**<br>(0.308) | 0.961***<br>(0.281)  | -1.333**<br>(0.658) |
| Risk-off              | 2.438***<br>(0.831) | 3.556***<br>(0.682)  | -2.170<br>(1.612)  | 0.279***<br>(0.087) | 0.709***<br>(0.112)  | -0.400**<br>(0.201) | 1.690***<br>(0.592) | 1.713**<br>(0.796)  | 1.056<br>(1.427)  | 1.996**<br>(0.865)   | 3.288***<br>(0.808)  | -0.880<br>(1.521)    |                    |                      |                     |
| $S$                   |                     |                      |                    |                     |                      |                     |                     |                     |                   |                      |                      |                      | -0.440<br>(0.421)  | -0.204<br>(0.273)    | 0.153<br>(0.484)    |
| $Z$                   | -0.289<br>(0.320)   | -0.133<br>(0.226)    | 0.518<br>(0.480)   | -0.048<br>(0.044)   | 0.036<br>(0.059)     | -0.006<br>(0.114)   | 0.356<br>(0.330)    | -0.248<br>(0.253)   | 0.427<br>(0.443)  | -0.890***<br>(0.325) | -0.049<br>(0.292)    | 0.626<br>(0.537)     | -0.727*<br>(0.384) | -0.939***<br>(0.326) | 1.350**<br>(0.563)  |
| Risk-off $\times Z$   | -1.772<br>(1.200)   | -2.482***<br>(0.745) | 3.161**<br>(1.461) | -0.066<br>(0.103)   | -0.466***<br>(0.115) | 0.631***<br>(0.185) | -0.533<br>(0.800)   | -0.419<br>(0.706)   | 0.219<br>(1.480)  | -1.236<br>(1.406)    | -2.074**<br>(0.940)  | 2.038<br>(1.313)     |                    |                      |                     |
| $S \times Z$          |                     |                      |                    |                     |                      |                     |                     |                     |                   |                      |                      |                      | 0.469<br>(0.442)   | 0.275<br>(0.295)     | -0.052<br>(0.408)   |
| Adj. $R^2$            | 5.4                 | 4.6                  | 4.3                | 2.2                 | 2.9                  | 2.9                 | —                   | —                   | —                 | —                    | —                    | —                    | 16.5               | 12.7                 | 8.9                 |
| $N$                   | 1212                | 1202                 | 1116               | 1212                | 1202                 | 1116                | 1212                | 1202                | 1116              | 1212                 | 1202                 | 1116                 | 121                | 121                  | 118                 |

**Table B13: Cyclical drivers of safe haven behavior: Germany and United Kingdom**

*Notes:* OLS regressions for  $C_1$  and  $C_2$ ; quantile regressions ( $\tau = 0.75$  and  $\tau = 0.25$ ) for  $C_3$  and  $C_4$ , respectively; OLS regression for  $C_5$ . The dependent variable for  $C_1$ – $C_4$  is the momentum measure  $M_t$ . For  $C_1$ – $C_4$ , the main regressor is the risk-off dummy **ROR090**, equal to one when the RORO index exceeds its 90th percentile. For  $C_5$ , the sample is restricted to risk-off periods and the main regressor is the world equity return  $S_t$ , capturing hedging properties against risky asset prices during stress episodes. The interaction  $S_t \times Z_{t-1}$  captures how these hedging properties vary with the cyclical variable. The cyclical variable  $Z$  corresponds to the inflation rate (Infl.), the government gross debt-to-GDP ratio (Debt), or price-sensitive investors (Inv.), all lagged one period. Newey-West standard errors with five lags are reported in parentheses for OLS; five-week fixed moving-block bootstrap standard errors are reported for quantile regressions.

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

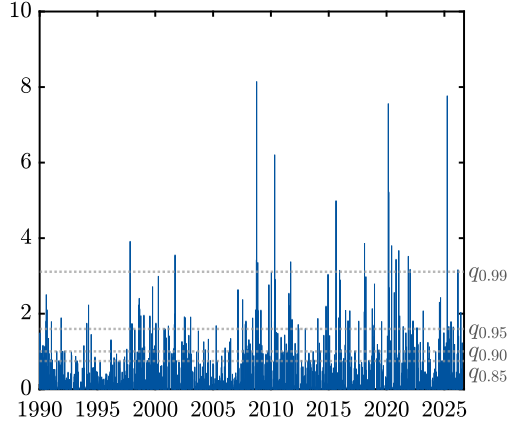
|                     | $C_1$               |                   |                     | $C_2$                |                   |                     | $C_3$               |                     |                    | $C_4$                |                      |                      | $C_5$                |                    |                      |
|---------------------|---------------------|-------------------|---------------------|----------------------|-------------------|---------------------|---------------------|---------------------|--------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|
|                     | Infl.               | Debt              | Inv.                | Infl.                | Debt              | Inv.                | Infl.               | Debt                | Inv.               | Infl.                | Debt                 | Inv.                 | Infl.                | Debt               | Inv.                 |
| <i>Germany</i>      |                     |                   |                     |                      |                   |                     |                     |                     |                    |                      |                      |                      |                      |                    |                      |
| Constant            | 0.087<br>(0.172)    | -1.487<br>(0.977) | -1.299**<br>(0.621) | 0.540***<br>(0.037)  | 0.055<br>(0.249)  | 0.207*<br>(0.121)   | 1.043***<br>(0.172) | 0.361<br>(0.775)    | -0.031<br>(0.486)  | -0.912***<br>(0.222) | -3.534***<br>(1.319) | -2.405***<br>(0.738) | 0.571***<br>(0.216)  | -2.259<br>(1.966)  | -2.842***<br>(0.749) |
| Risk-off            | 2.346***<br>(0.477) | -0.272<br>(3.317) | -5.049**<br>(1.973) | 0.380***<br>(0.069)  | 0.102<br>(0.593)  | -0.648**<br>(0.261) | 1.917***<br>(0.673) | 6.466**<br>(2.571)  | -1.809<br>(3.278)  | 2.458***<br>(0.593)  | -2.471<br>(4.999)    | -7.212**<br>(3.321)  |                      |                    |                      |
| $S$                 |                     |                   |                     |                      |                   |                     |                     |                     |                    |                      |                      |                      | -0.454<br>(0.334)    | 3.799*<br>(1.969)  | 1.930*<br>(0.978)    |
| $Z$                 | -0.300<br>(0.249)   | 1.264<br>(0.891)  | 1.226**<br>(0.606)  | -0.046<br>(0.036)    | 0.423*<br>(0.234) | 0.319**<br>(0.125)  | 0.108<br>(0.279)    | 0.693<br>(0.702)    | 1.223**<br>(0.493) | -0.659*<br>(0.347)   | 2.035*<br>(1.205)    | 1.185<br>(0.761)     | -0.681***<br>(0.246) | 2.198<br>(1.813)   | 2.819***<br>(0.714)  |
| Risk-off $\times Z$ | -1.429**<br>(0.673) | 1.432<br>(3.024)  | 6.110***<br>(1.858) | -0.203***<br>(0.077) | 0.115<br>(0.554)  | 0.841***<br>(0.249) | -0.550<br>(0.825)   | -4.568**<br>(2.301) | 2.843<br>(3.076)   | -1.504*<br>(0.810)   | 3.667<br>(4.560)     | 8.246***<br>(2.932)  |                      |                    |                      |
| $S \times Z$        |                     |                   |                     |                      |                   |                     |                     |                     |                    |                      |                      |                      | 0.506<br>(0.411)     | -3.724*<br>(1.915) | -1.892**<br>(0.928)  |
| Adj. $R^2$          | 6.5                 | 4.0               | 8.8                 | 2.8                  | 2.6               | 5.0                 | —                   | —                   | —                  | —                    | —                    | —                    | 17.5                 | 5.8                | 28.2                 |
| $N$                 | 1212                | 1202              | 1116                | 1212                 | 1202              | 1116                | 1212                | 1202                | 1116               | 1212                 | 1202                 | 1116                 | 121                  | 121                | 118                  |

**Table B14: Cyclical drivers of safe haven behavior: Germany and United Kingdom**

*Notes:* OLS regressions for  $C_1$  and  $C_2$ ; quantile regressions ( $\tau = 0.75$  and  $\tau = 0.25$ ) for  $C_3$  and  $C_4$ , respectively; OLS regression for  $C_5$ . The dependent variable for  $C_1$ – $C_4$  is the momentum measure  $M_t$ . For  $C_1$ – $C_4$ , the main regressor is the risk-off dummy **ROR090**, equal to one when the RORO index exceeds its 90th percentile. For  $C_5$ , the sample is restricted to risk-off periods and the main regressor is the world equity return  $S_t$ , capturing hedging properties against risky asset prices during stress episodes. The interaction  $S_t \times Z_{t-1}$  captures how these hedging properties vary with the cyclical variable. The cyclical variable  $Z$  corresponds to the inflation rate (Infl.), the government gross debt-to-GDP ratio (Debt), or price-sensitive investors (Inv.), all lagged one period. Newey-West standard errors with five lags are reported in parentheses for OLS; five-week fixed moving-block bootstrap standard errors are reported for quantile regressions.

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

Identification of Acute Risk-off Periods



Correlation with RORO Index

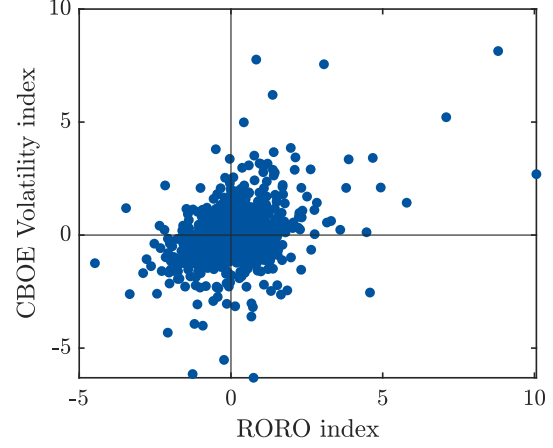
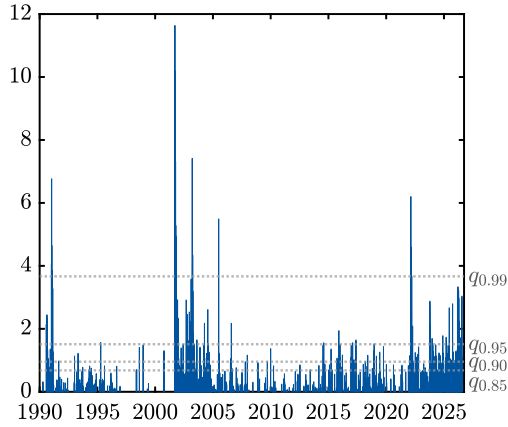


**Figure B1: Correlation between VIX and RORO indices**

*Notes left panel:* The figure reports positive realizations of the scaled CBOE VIX index, which correspond to a proxy of periods of acute risk aversion tensions. Horizontal dotted lines denote thresholds associated with the upper 1%, 5%, 10% and 15% of the VIX distribution. The corresponding percentiles (99th, 95th, 90th and 85th) are 2.67, 1.22, 0.87 and 0.68, respectively. The sample spans January 1990 to December 2025. *Notes right panel:* Correlation coefficient of 0.38 based on sample spanning May 2003 to December 2025.

Identification of Acute Geopolitical Tensions



Correlation with Risk-off Episodes

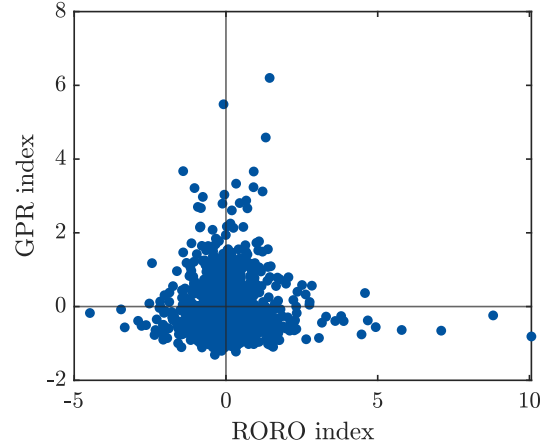


**Figure B2: Correlation between GPR and RORO indices**

*Notes left panel:* The figure reports positive realizations of the scaled geopolitical risk (GPR) index, which correspond to periods of elevated geopolitical tensions. Horizontal dotted lines denote thresholds associated with the upper 1%, 5%, 10% and 15% of the GPR distribution. The corresponding percentiles (99th, 95th, 90th and 85th) are 2.67, 1.22, 0.87 and 0.68, respectively. The sample spans January 1990 to December 2025. The GPR index is constructed following [Caldara and Iacoviello \(2022\)](#). *Notes right panel:* Correlation coefficient of -0.01 based on sample spanning May 2003 to December 2025.

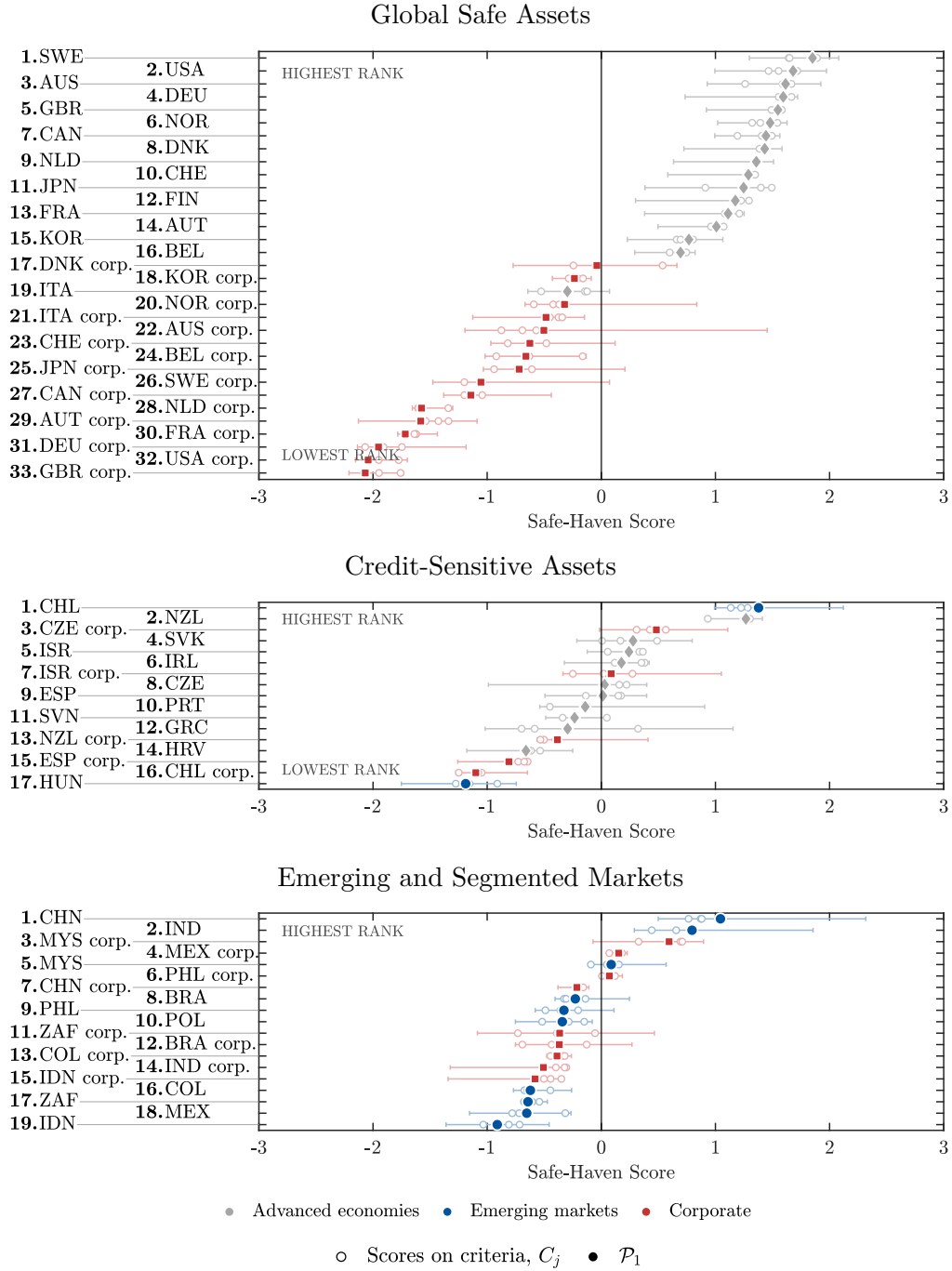


**Figure B3: Ranking based on safe haven behavior by asset groups using corporate spreads**

*Notes:* Each point corresponds to the scoring of the asset to a different criterion. Acute risk-off periods are identified using the 90th percentile of the risk-on-risk-off index.

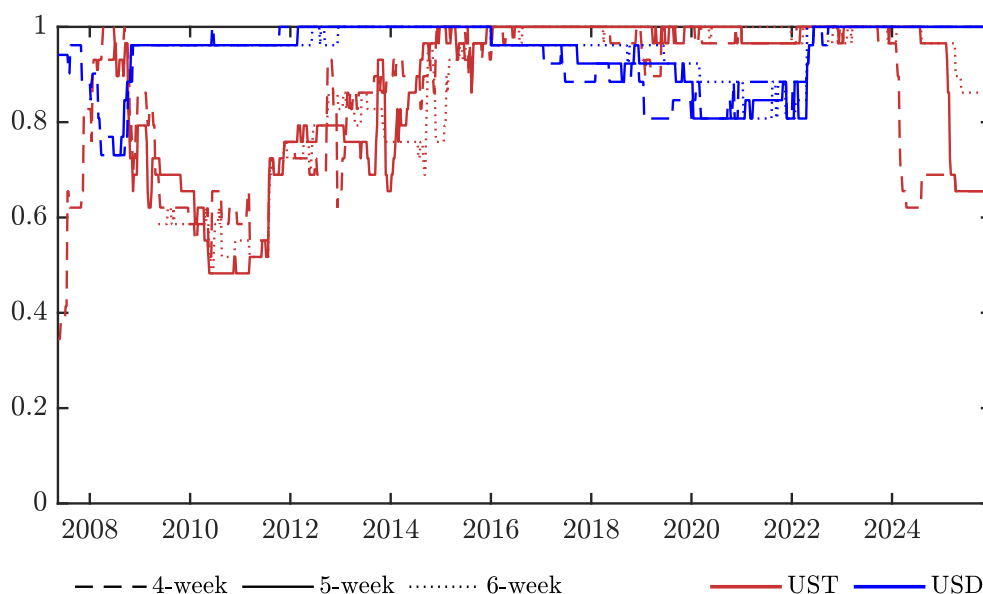


**Figure B4: Relative Safe-Haven Behavior of US Treasuries and the US Dollar at various windows**

*Notes:* US Treasuries (UST) are measured relative to global safe assets (cf. Table B6); the US dollar (USD) is measured relative to other currencies. Higher values correspond to higher rankings; the index is bounded between 0 and 1. Vertical dotted lines highlight episodes corresponding to the 99<sup>th</sup> percentile of risk-off realizations of the index. Rankings are computed using a 5-year rolling window.

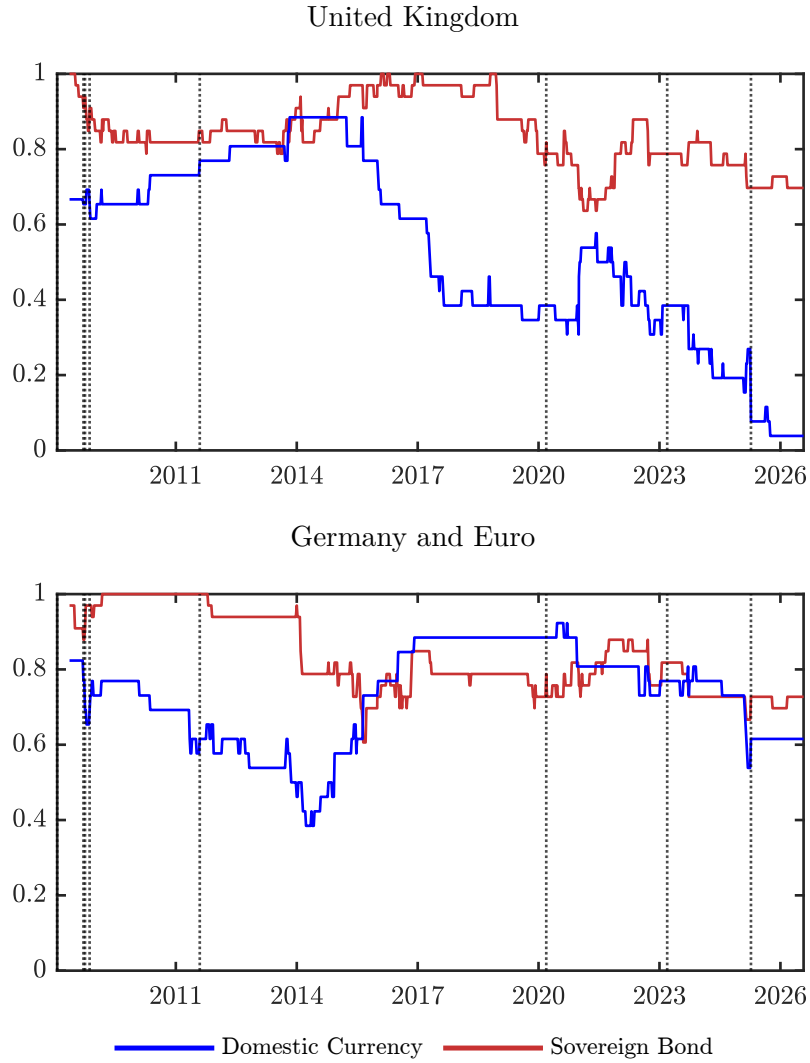


**Figure B5: Relative safe haven behavior of bonds and currencies on a 5-year rolling window**

*Notes:* Bonds are ranked relative to global safe assets detailed in Table B6; currencies are ranked relative to other currencies. Higher value corresponds to higher ranking; index bonded to 0-1. For Euro, the german sovereign bond is used. Vertical dotted lines highlight episodes corresponding to the 99<sup>th</sup> percentile of risk-off realizations of the index.