

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

Valentin Burban<sup>1</sup>, Pavel Diev<sup>2</sup>, Gilles Dufrénot<sup>3</sup> & Nelson Mongeaud<sup>4</sup>

June 2026, WP #1049

### ABSTRACT

This paper proposes a new empirical taxonomy of safe assets based on their safe-haven behavior during periods of global risk aversion. Our multi-criteria framework captures the persistent performance of bond securities, currencies, and alternative assets during episodes of acute risk-off sentiment, allowing us to construct a cross-asset ranking of safe-haven behavior by asset characteristics: global safe assets, credit-sensitive assets, and emerging assets. We find that sovereign bonds issued by G10 economies, including U.S. Treasuries, consistently exhibit the strongest safe-haven behavior. A limited set of corporate bond markets displays partial safe-asset characteristics, while gold is the only alternative asset that consistently scores highly across our safe-haven criteria, particularly during periods of geopolitical risk. We further show that U.S. Treasuries have exhibited weaker safe-haven properties since the pandemic, although this reflects a broader reconfiguration of global safe-asset hedging properties rather than a uniquely U.S. decline. We find that weaker safe-haven properties are associated with higher inflation, debt levels and scarcity of available assets.

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

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

<sup>1</sup> Banque de France and Aix-Marseille University, CNRS, AMSE, [valentin.burban@banque-france.fr](mailto:valentin.burban@banque-france.fr)

<sup>2</sup> Banque de France, [pavel.diev@banque-france.fr](mailto:pavel.diev@banque-france.fr)

<sup>3</sup> Aix-Marseille University, AMSE, Sciences Po Aix, CNRS and CEPII, [gilles.dufrenot@sciencespo-aix.fr](mailto:gilles.dufrenot@sciencespo-aix.fr)

<sup>4</sup> Banque de France

We are grateful to Benoît Nguyen for useful discussion of our paper during Banque de France research seminar. We also thank Antoine Camous, Wenxin Du, Lorenzo Garlanda-Longueville, Karine Ishii, Margarita Lopez-Forero, Camille Macaire, Alain Naef, Giulia Sestieri, Christian Speck, Pierre-François Weber and the participants of Banque de France and Aix-Marseille School of Economics research seminars and the French/Japanese Conference on “International Economies: Challenges Ahead” for their comments and suggestions.

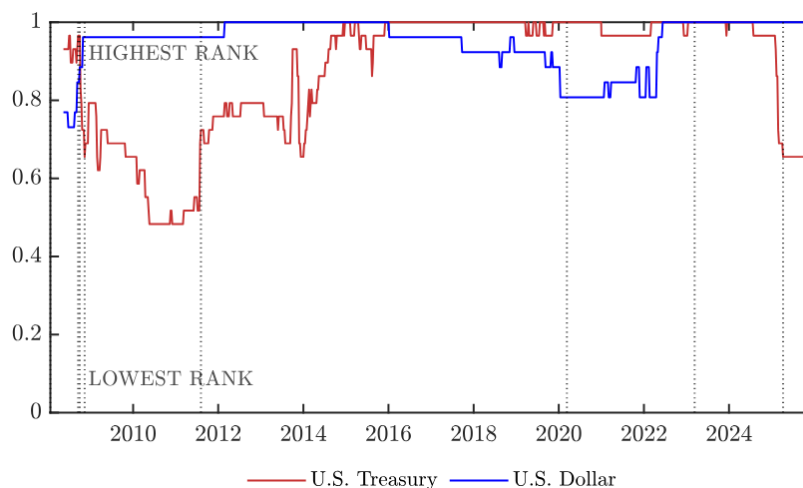
Working Papers reflect the opinions of the authors and do not necessarily express the views of the Banque de France. This document is available on [publications.banque-france.fr/en](https://publications.banque-france.fr/en)

## 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, U.S. 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 U.S. Treasuries still provide the same degree of protection during periods of heightened uncertainty. In this paper, we investigate whether these developments are specific to U.S. 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 U.S. 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 U.S. 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 U.S. Treasuries and the U.S. Dollar on a 5-Year Rolling Window**



Note: U.S. Treasuries (UST) are ranked relative to other global sovereign and corporate bonds; the U.S. 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 U.S. 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 U.S. 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 reduced asset availability associated with central bank purchases. Overall, our findings contribute to a better understanding of how safe assets are evolving in a changing global financial environment.

---

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

## RÉSUMÉ

Cet article propose une nouvelle taxonomie empirique des actifs refuges fondée sur leur comportement lors des périodes d'aversion mondiale au risque. Notre cadre d'analyse multicritère permet de saisir la performance persistante des titres obligataires, des devises et des actifs alternatifs durant les épisodes de forte aversion au risque (« risk-off »), et nous conduit à établir une classification transversale des comportements de valeur refuge selon les caractéristiques des actifs : actifs refuges mondiaux, actifs sensibles au risque de crédit et actifs des marchés émergents. Nos résultats montrent que les obligations souveraines libellées dans les devises du G10, et y compris les bons du Trésor américain, présentent les propriétés de valeur refuge les plus marquées. Un nombre limité de marchés obligataires d'entreprise manifeste certaines caractéristiques d'actifs refuges. Par ailleurs, l'or est le seul actif alternatif qui obtient systématiquement des scores élevés selon nos différents critères de valeur refuge, en particulier lors des périodes de risque géopolitique. Nous montrons également que les bons du Trésor américain ont vu leurs propriétés de valeur refuge s'atténuer depuis la pandémie. Toutefois, cette évolution reflète davantage une reconfiguration plus générale des propriétés de couverture offertes par les actifs refuges à l'échelle mondiale qu'un déclin spécifique aux États-Unis. Enfin, nous mettons en évidence qu'un niveau plus faible de propriétés de valeur refuge est associé à une inflation plus élevée, à un niveau d'endettement plus important et à une moindre rareté des actifs disponibles.

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

Les Documents de travail reflètent les idées personnelles de leurs auteurs et n'expriment pas nécessairement la position de la Banque de France. Ils sont disponibles sur [publications.banque-france.fr](https://publications.banque-france.fr)

# 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; Szóke et al., 2024). For decades, U.S. Treasury securities have been widely regarded as the benchmark safe asset in the international monetary system (Gourinchas and Rey, 2007). However, recent episodes have raised questions about the stability of this role, suggesting that the safe-haven status of U.S. Treasuries may be eroding. 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 U.S. Treasuries, or do they reflect broader changes in safe-asset markets?

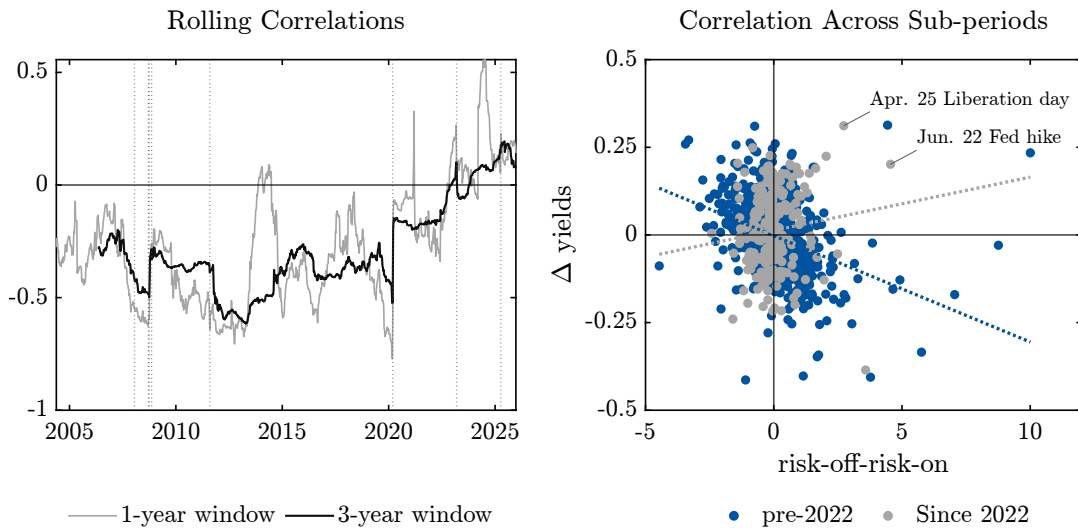


Figure 1: Correlation Between Risk Aversion and Changes in U.S. Treasury Yields

*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 U.S. 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–December 2025.

In this paper, we provide an empirical assessment of the relative safe-haven properties of a broad set of financial instruments, including sovereign and corporate bond securities, currencies, and alternative assets such as gold, silver, oil, and Bitcoin. First, we identify episodes of acute risk aversion based on large positive realizations of the risk-off–risk-on index proposed by Chari et al. (2023). Second, rather than assuming that safe assets are risk-free or mechanically counter cyclical, we evaluate, based on yields and returns, their behavior at weekly frequency using five

criteria that capture different dimensions of safe-haven characteristics. The paper is organized into two parts.

In the first part of the paper, we assess the safe-haven behavior of these assets over more than 20 years of data (i.e. from 2003 to 2025). Specifically for bond securities, we apply a k-means clustering methodology to group bonds according to their safe-haven behavior *and* economic fundamentals. We identify three groups of assets, which we label as "global safe assets", "credit-sensitive assets", and "emerging market assets". Within these groups, we provide a novel ranking of the relative safe-haven behavior based on a multidimensional set of criteria. We find that U.S. Treasuries rank among the assets with the most pounced safe-haven behavior, alongside Swedish and Norwegian sovereign bonds. A limited set of corporate bond markets (particularly in Norway, Australia and Sweden) rank high in global safe assets, reflecting a potential substitutability between sovereign and corporate bonds. Among currencies, the U.S. dollar, Japanese yen, and Swiss franc rank as the strongest safe-haven reserve currencies, while the Norwegian krone, Australian, Canadian, and New Zealand dollars rank relatively lower compared to their respective sovereign bond markets, 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 more moderate safe-haven properties during typical episodes of risk aversion.

In the second part of the paper, we reassess the relative safe-haven properties of U.S. Treasuries and the U.S. 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 procedure 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 U.S. Treasuries have exhibited weaker safe-haven characteristics relative to other global safe assets in recent years, the same is not true for the U.S. dollar, which continues to rank as the leading safe-haven currency. We further show that the deterioration in the absolute safe-haven performance of U.S. Treasuries is not unique to the United States. Rather, it reflects a broader pattern affecting other assets traditionally regarded as safe havens. We argue that weaker safe-haven behavior is partly associated with heightened inflationary pressures, rising public debt levels, and asset scarcity arising from central bank holdings.

This paper 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 U.S. 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 U.S. 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 U.S. Treasury yields to negative news about future government surpluses. More recently, the tariff announcements of 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 U.S. Treasuries (Jiang et al. (2025)). Du et al. (2026) document a decoupling between the convenience yield on the U.S. dollar and that on U.S. Treasuries. Our paper contributes to this strand of the literature by adopting a relative perspective: we assess the safe-haven properties of U.S. 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 exhibit a negative beta: they appreciate precisely when the aggregate market declines, making them valuable as portfolio insurance (Caballero et al., 2017). Historically, high-grade sovereign debt, such as US Treasuries, fulfill this role, commanding 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 foster a safe asset status (Habib et al., 2020).

A related concept is that of the *safe haven* asset, whose defining property operates along a shorter temporal dimension (Baur, 2023). The notion of a safe haven refers to an asset's ability to preserve value, and even appreciate, during episodes of severe financial distress (Baur and Lucey, 2010), such as systemic banking crises, stock market crashes, geopolitical shocks, or global pandemics. During such periods, 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 fulfilling 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 U.S. Treasuries and the U.S. 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 serves to identify episodes of heightened global financial stress, together with alternative measures. We then introduce the financial asset indices and the macroeconomic fundamentals and cyclical variables used to identify safe assets.

#### 3.1 Identifying Risk Aversion Episodes

To identify episodes of acute risk aversion, we rely on the risk-on risk-off (RORO) index developed by Chari et al. (2023). This index provides a multifaceted<sup>1</sup> measure of realized variation

---

<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., safe-haven currency appreciation, gold prices). Each underlying series is standardized prior to the

in global investor risk appetite, making it particularly well suited for the analysis of global safe assets. Its explicit global dimension is essential for capturing shifts in risk-bearing capacity that transcend national financial markets.

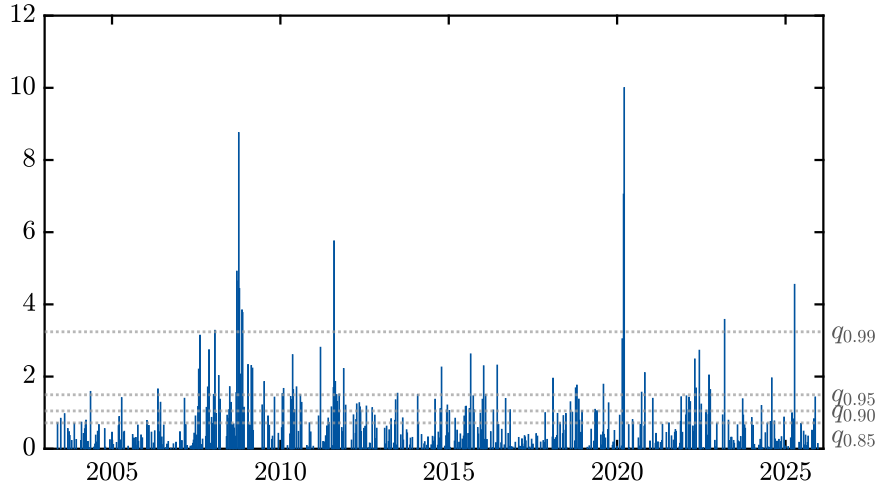


Figure 2: Identification of Risk Aversion Episodes

*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%, 15%, and 25% of the RORO distribution. The 99th, 95th, 90th, 85th, and 75th percentiles are 3.24, 1.49, 1.05, 0.71, and 0.35, respectively. The sample spans May 2003 to December 2025. The RORO index is constructed by [Chari et al. \(2023\)](#).

A higher value of the RORO index corresponds to a risk-off environment, that is, a deterioration in investors' willingness to bear risk, elevated perceived uncertainty, and a broad flight toward safe assets. Conversely, a lower value signals a risk-on environment characterized by strong risk appetite, compressed spreads, and buoyant capital flows toward risky 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 U.S. sovereign downgrade, the banking stress of March 2023, and the period of elevated volatility associated with the introduction of new U.S. tariff policies in April 2025.

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

---

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.

Russia’s invasion of Ukraine in February 2022. In Annex, Table 7 we detail the different key episodes of the 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 multifaced 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	34.3	31.8	0.3
2008–2013	51	41.7	47.4	11.6	-0.6
2014–2019	31	18.0	82.7	0.0	-0.7
2020–2025	25	42.8	49.3	5.6	2.3

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.

In the robustness analysis, we consider alternative measures of financial tensions. First, we construct an orthogonalized version of the RORO index controlling for monetary policy shocks provided by Acosta et al. (2025). This ensure that around results are not contaminated by monetary policy surprise in time of elevated risk aversion. Second, we purge the RORO index from the currency and gold component to ensure that potential endogeneity issue is avoided 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 become relatively more attractive. 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 9 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 10 in the Appendix).

### 3.2 Market Data

We construct a weekly panel dataset spanning 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 represent 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 also consider overnight index swaps (OIS), Treasury Inflation-Protected Securities (TIPS), 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 developed economies.

### 3.3 Economic Fundamentals and Cyclical

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 U.S. 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 political stability. These data are 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 and debt-to-GDP ratios. Unlike the fundamental variables

---

<sup>2</sup>The sample period and country coverage are determined by data availability. The exhaustive list of variables is reported in Tables 8 and 9.

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 10.

## 4 Empirical Strategy

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 one hand, agents holding assets for liquidity purposes may liquidate their positions to raise cash, exerting downward pressure on prices. On the other hand, investors seeking capital preservation may rotate into perceived safe assets, 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 potential momentum effects, that is, 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 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.

**Criteria.** Based on the definition of safe-haven assets (see Section 2), we define a set of 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 assets. 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 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: Relative Magnitude of Positive Performance Across Regimes.*

$$C_2^{(h)} = \mathbb{E} \left[ M_t^{(h)} \mid M_t^{(h)} > 0, \text{risk}_t = 1 \right] - \mathbb{E} \left[ M_t^{(h)} \mid M_t^{(h)} > 0, \text{risk}_t = 0 \right]. \quad (4)$$

Criterion 2 compares the magnitude of positive demand pressures of the asset, between risk-off and risk-on periods. Conditioning on positive realizations isolates the intensive margin of safe-haven demand. A positive value indicates that such favorable movements are amplified during periods of acute risk aversion relative to tranquil market conditions.

*Criterion 3: Difference in the Frequency of Positive Performances Across Regimes..*

$$C_3^{(h)} = \mathbb{P} \left( M_t^{(h)} > 0 \mid \text{risk}_t = 1 \right) - \mathbb{P} \left( M_t^{(h)} > 0 \mid \text{risk}_t = 0 \right)$$

We measure the change 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.

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

$$C_4^{(h)} = q_{0.95} \left( M_t^{(h)} \mid \text{risk}_t = 1 \right)$$

Criterion 4 characterizes the upper tail (95th 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.

*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.

**Ranking.** 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 11), we perform a dimensionality reduction via principal component analysis (PCA). Specifically, we aggregate the weighted scores across the five 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>3</sup>. Third, we rank assets according to  $\mathcal{P}_{1,a}$ . The rank of asset  $a$ ,  $x_a$ , is defined as the number of assets with a strictly lower score, plus one:

$$x_a = 1 + \#\{b \neq a : \mathcal{P}_{1,b} < \mathcal{P}_{1,a}\}. \quad (5)$$

**Clustering.** Specifically, for bond securities, we first apply 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, together with the first principal component of the normalized scores obtained from the five criteria. The  $k$ -means procedure partitions assets into a predetermined number of clusters<sup>4</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.

## 5 Benchmark Results

This section presents the results of our multidimensional taxonomy of safe assets across a broad set of financial indices over the period 2003-2025. 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 treat together sovereign and corporate bond securities. Sovereign bonds are commonly regarded as safe assets and serve as benchmark securities for pricing and hedging in global fi-

---

<sup>3</sup>The sample includes  $N$  observations covering  $N_b$  bond securities,  $N_{NEER}$  nominal effective exchange rates,  $N_{FX}$  bilateral exchange rates, and four alternative assets.

<sup>4</sup>The number of clusters is selected using the “elbow” method, which identifies the point at which adding an additional cluster no longer significantly improves the within-cluster fit.

nancial markets. A large literature emphasizes that government debt issued by stable sovereigns provides liquidity, collateral services, and a store of value during periods of financial stress. In particular, [Krishnamurthy and Vissing-Jorgensen \(2012\)](#) show that such securities command a convenience yield reflecting their role as safe and liquid assets. For this reason, sovereign bonds are typically treated as canonical safe assets in empirical macro-finance analyses. The expansion of local-currency debt markets in emerging economies has reshaped the landscape of sovereign borrowing. Recent evidence suggests that, under certain conditions, local-currency sovereign bonds in emerging markets may also exhibit convenience yields, particularly during episodes of country-specific stress ([Cuevas, 2024](#)). In addition, some private debt instruments can provide safety services. Highly rated corporate bonds, for instance, may display safe-asset characteristics when investors rebalance portfolios toward safer segments of credit markets.

	$\mathcal{P}_1$	OPEN	SIZE	LC	NIIP	RATG	POL
Global safe assets	0.79 (0.72)	0.62 (0.31)	0.34 (1.00)	0.55 (0.42)	0.61 (1.08)	0.74 (0.66)	0.68 (0.38)
Credit-sensitive assets	-0.45 (0.65)	0.44 (0.45)	-0.43 (0.91)	0.17 (0.85)	-0.75 (0.72)	-0.34 (0.70)	0.39 (0.44)
Emerging market assets	-0.68 (0.85)	-1.25 (0.84)	-0.09 (0.95)	-0.92 (1.06)	-0.16 (0.45)	-0.71 (0.95)	-1.29 (0.69)

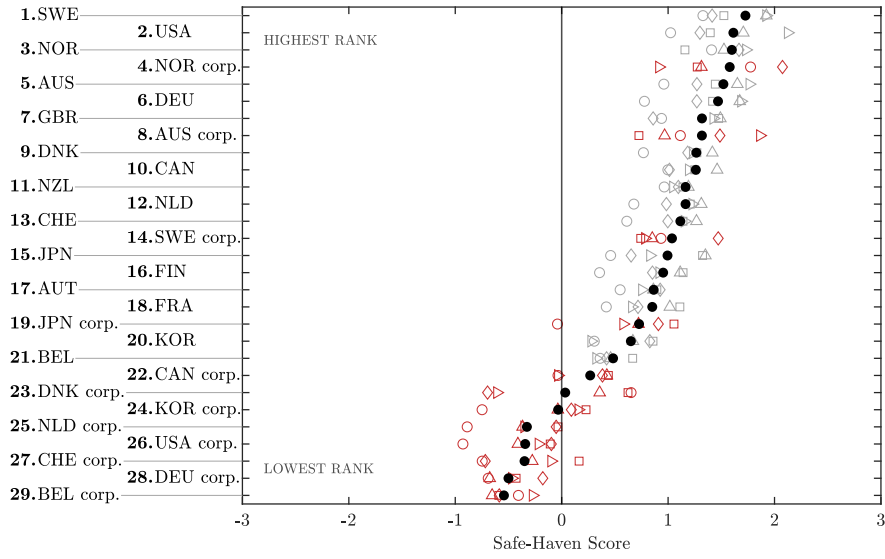
Table 2: Taxonomy of Bond Securities and Characteristics

*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 "POL" denotes political stability.

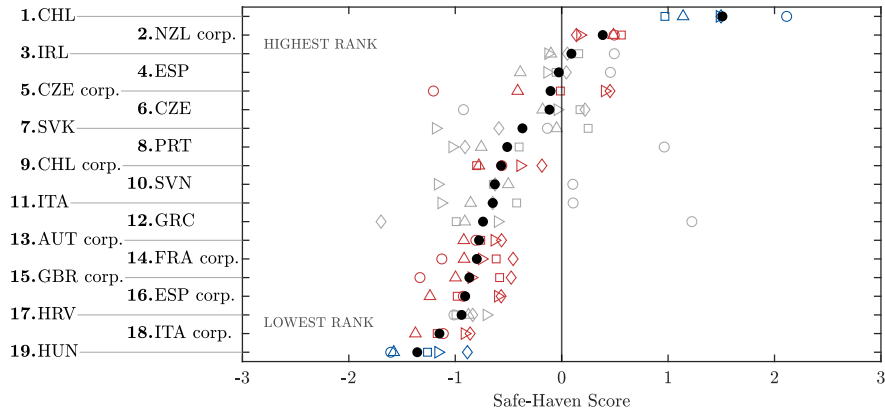
**Clustering.** Controlling for economic fundamentals, our clustering exercise identifies three distinct groups of debt securities, including both sovereign and corporate bonds. We label these categories as: (i) "global safe assets", (ii) "credit-sensitive assets", and (iii) "emerging market assets", each of which comprises both sovereign and corporate bond securities. [Table 2](#) summarizes the main characteristics of each group, which is robust to alternative definitions of acute risk-off episodes ([Table 15](#)).

The first cluster, including *global safe assets*, is characterized by high average safe-haven behavior, strong capital account openness, a large debt market size, a high share of debt issued in local currency, a positive NIIP, high credit ratings, and robust institutional quality. The second cluster, labeled *credit-sensitive assets*, exhibits weaker safe-haven behavior despite relatively high openness, institutional quality, and a significant share of debt issued in local currency. However, this group is also characterized by small market size, low NIIP, and lower credit ratings. The third cluster, including *emerging market assets*, is characterized by the lowest safe-haven behavior, relatively closed capital account, a large share of debt issued in foreign currency, poor credit ratings, and weak political stability.

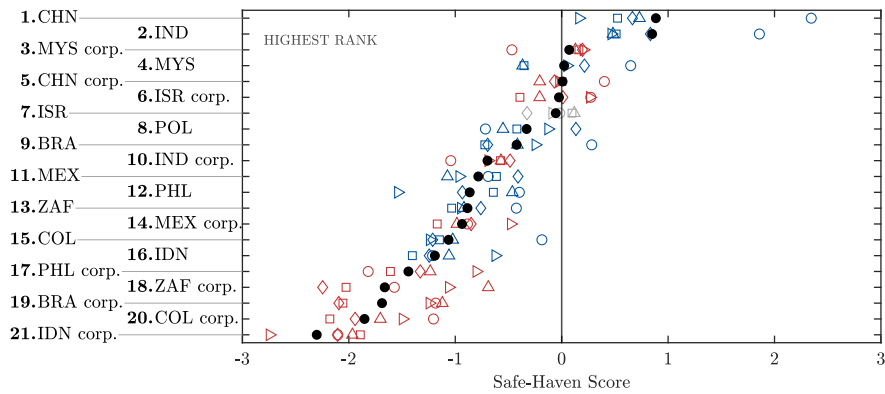
### Global Safe Assets



### Credit-Sensitive Assets



### Emerging and Segmented Markets



● Advanced economies ● Emerging markets ● Corporate △ C<sub>1</sub> ▷ C<sub>2</sub> □ C<sub>3</sub> ◇ C<sub>4</sub> ○ C<sub>5</sub> ● P<sub>1</sub>

Figure 3: Ranking Based on Safe Haven Behavior by Asset Groups

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.

**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 black. A detailed description of each clusters is provided in Tables 12, 13 and 14.

Within the global safe asset cluster, U.S. Treasuries rank among the top assets, alongside sovereign bonds from Sweden, Norway, and Australia. Only a few assets originate from the core euro area. Germany ranks sixth, while the Netherlands ranks eleventh. Finland, France, Austria, Belgium, and the Netherlands are all located in the lower half of the ranking.

Corporate bonds from advanced economies, such as Norway and Australia, also rank highly, indicating that highly rated corporate debt can provide safety characteristics similar to those of sovereign bonds, in line with the notion that corporations supply quasi-safe assets (Mota, 2023). Wang et al. (2025) find that investment-grade corporate bonds can exhibit safe-haven characteristics during periods of market stress, as their correlation with equity markets declines. This pattern is observed, for instance, for Norwegian corporate bonds, which score particularly well on tail-risk criterion  $C_4$  and on the hedging criterion  $C_5$ . Nonetheless, not all corporate bonds rank near the top of the cluster. Most are located in the lower part of the ranking, reflecting weaker safe-haven characteristics.

In the credit-sensitive cluster, Chile ranks first, followed by New Zealand corporate and Irish sovereign bonds. Other advanced economies are essentially from the peripheral euro area or neighboring to the euro area such as Spain, Greece, Portugal, Slovakia, Italia, Slovenia, Croatia, Hungary and Czechia. Interestingly, UK corporate features in this cluster despite large market size. The safe haven behavior of this asset is alike Spanish corporate bonds.

In the third cluster, Indonesian and Chinese sovereign bonds rank highest, driven by their hedging properties against risky assets during periods of market stress. By contrast, corporate bonds from Colombia and Indonesia are among the riskiest assets in the sample.

Although the criteria are correlated (see Table 11), Figure 3 shows that rankings remain sensitive to the criterion used. For example, U.S. corporate bonds rank relatively low overall because of their weak hedging performance against risky assets (see the circled observation). This result highlights the value of a multidimensional approach to evaluating safe-haven assets.

We assess the robustness of our results to alternative definitions of risk-off episodes. Specifically, we vary the threshold used to identify stress periods (85th to 95th percentiles), refine the risk-on-risk-off index by excluding traditional safe assets (e.g., U.S. dollar and gold), and consider alternative measures of global risk, including the VIX. We also rely on the orthogonalized version of the index controlling for monetary policy shocks provided by Acosta et al. (2025). We show in Table 15 that, across specifications, the clustering structure remains stable, with three groups of comparable size. While rankings exhibit some variation, the overall ordering of assets is largely preserved.

## 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 U.S. dollar. Our estimates clearly reaffirms the status of the U.S. dollar among safe-haven currencies over the 2003-2025 sample, in line with the established literature.

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 reversal 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 U.S. 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](#)).

---

<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.

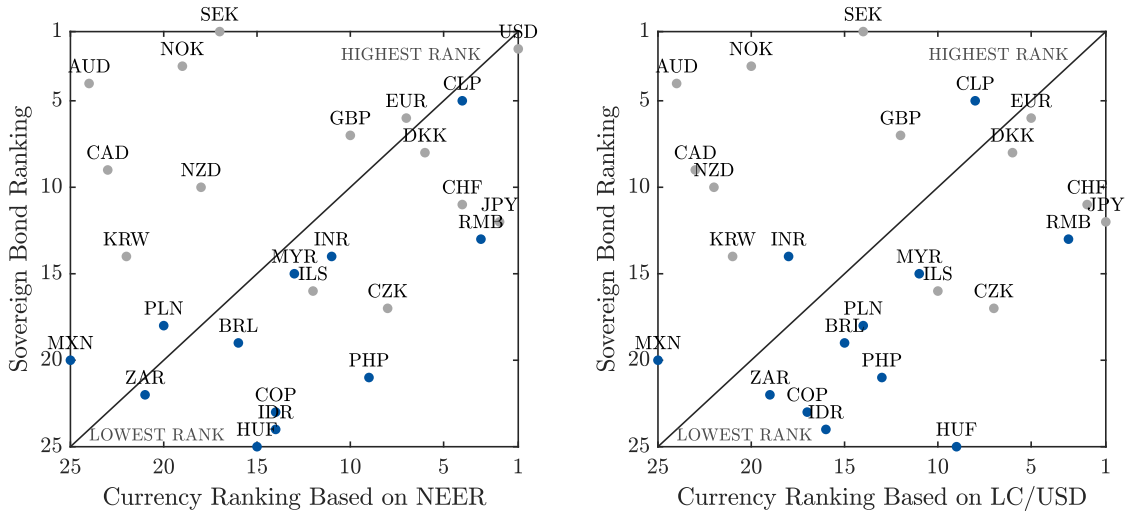


Figure 4: Comparison of Relative Safe Haven Behavior Between Currencies and Sovereign Bonds

*Notes:* The figure reports the correlation between the relative safe-haven behavior ranking of sovereign bond securities and the returns on national currencies. 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 U.S. dollar is used. Acute risk-off periods are identified using the 90th percentile of the risk-on–risk-off index.

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 the case of Chile, we argue that the peso may act as a regional safe haven assets in time of risk aversion episodes explaining its ranking. The remainder of emerging market currencies rank significantly lower, broadly consistent with the behavior observed in their corresponding sovereign bond markets.

### 5.3 Alternative assets

We next consider alternative assets commonly viewed as potential stores of value during periods of market stress. These include gold, silver, oil, and Bitcoin. Gold has long been viewed as a traditional safe-haven asset ([Gurdgiev and Petrovskiy, 2024](#)). More recently, the debate has expanded to include other commodities and digital assets, such as Bitcoin, whose role during episodes of financial turbulence remains actively discussed in the literature. To place these assets in perspective relative to sovereign and corporate bond securities, we include gold, silver, oil, and Bitcoin in our ranking exercise.

Figure 5 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.

When risk-off periods are defined using geopolitical risk measures, both gold and silver display stronger safe-haven behavior, while U.S. Treasuries remain broadly stable. Overall, these findings underscore the dominant role of fixed-income securities in providing safety services during periods of financial stress. They are also consistent with evidence that gold’s safe-haven properties can be weakened during episodes of acute market turmoil, when investors liquidate even highly liquid assets to meet funding and margin requirements. At the same time, 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).

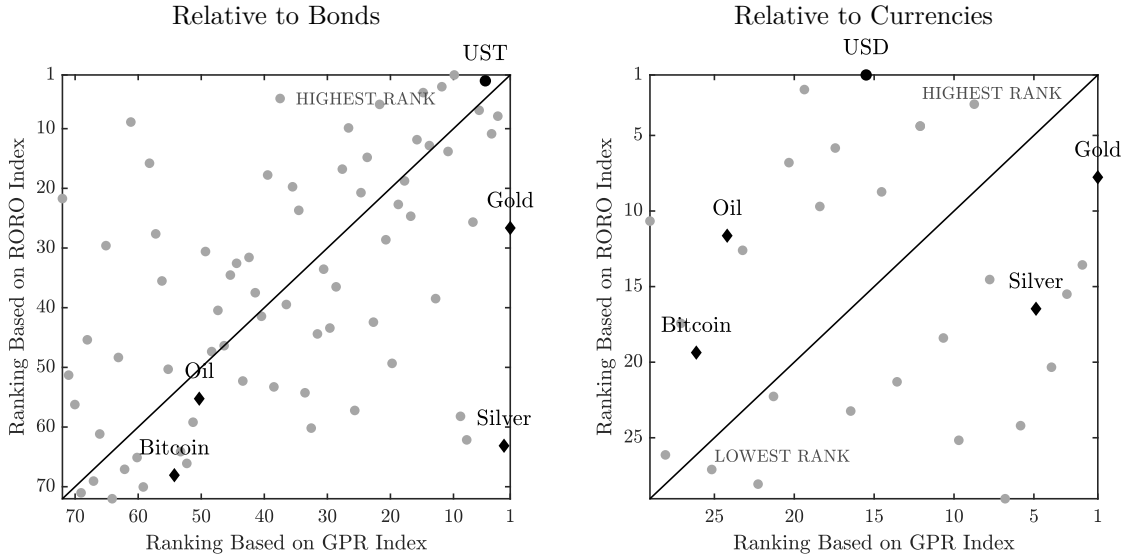


Figure 5: Risk-off vs. Geopolitical Risk for Alternative Assets

*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)

## 6 The Changing Landscape of Safe Asset Risk Properties

The COVID-19 episode has been a significant test for U.S. 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 U.S. Treasuries (see Duffie (2020) and He et al. (2022)). As a result, Treasury prices did not react in line with the behavior typically expected of safe assets. Gómez-Cram et al. (2024) provide high-frequency evidence from the COVID-19 episode linking increases in U.S. 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 U.S. Treasuries (Jiang et al. (2025)).

This section investigates whether these developments are unique to U.S. 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 convert our five criteria into testable equations.

For  $C_1$ ,  $C_2$  and  $C_3$ , we estimate the following OLS regression:

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

where  $\text{Risk}_t$  is a dummy variable equal to one during periods of elevated risk aversion, defined as observations above the 90th percentile of the RORO index. The dependent variable,  $Y_t$ , varies across specifications. For the  $C_1$  and  $C_2$  specifications,  $Y_t$  is the first principal component of  $M_t^{(h)}$ , computed over horizons ranging from one to five weeks. In the  $C_2$  specification, the sample is further restricted to observations with positive average momentum. For  $C_3$ ,  $Y_t$  is a dummy variable equal to one when average  $M_t$  is positive, thereby capturing the frequency of positive realizations. The coefficient  $\beta_1$  measures the average response of  $M_t$  prior to 2020, while the corresponding marginal effect in the post-2020 period is given by  $\beta_1 + \beta_2$ .

For  $C_4$ , we estimate the following quantile regression to capture tail demand pressure during risk-off episodes:

$$Q_{0.95}(Y_t | \cdot) = \alpha + \beta_1 \text{Risk}_t + \beta_2 (\text{Risk}_t \times D_{>2020}) + \delta D_{>2020}. \quad (7)$$

The model is estimated using quantile regression. Statistical inference is based on bootstrap standard errors obtained from repeated resampling of the data, which provides robust confidence intervals in the presence of heteroskedasticity and the nonstandard sampling distribution of quantile regression estimators.

Finally, for  $C_5$ , which reflect the hedging properties against risky asset during risk-off episodes, we estimate

$$Y_t = \alpha + \beta_1 S_t + \beta_2 (S_t \times D_{>2020}) + \delta D_{>2020} + \epsilon_t. \quad (8)$$

where  $S_t$  is the world equity index.

Table 3 reports estimates of Equations (6)–(8) for long-term U.S. Treasury yields and the U.S. nominal effective exchange rate (NEER). Prior to 2020, Treasury yields exhibit a strong and statistically significant response to risk-off episodes, with  $M_t$  increasing across most criteria. However, this sensitivity weakens or even reverses in the post-2020 period for  $C_1$  and  $C_3$ , indicating a deterioration in average performance and a lower frequency of safe-haven realizations during periods of market stress. Interestingly, the results point to an improvement in  $C_2$ . Conditional on moving in the safe-haven direction, the magnitude of yield adjustments during risk-off episodes increases relative to tranquil periods and exceeds that observed in the pre-pandemic period. This finding suggests that safe-haven episodes have become less frequent but more pronounced. The remaining criteria provide limited evidence of structural change. For  $C_5$ , the correlation with world equity index is not statistically significant and remains broadly stable over time, though this interpretation should be taken with caution given the small sample

size for  $C_5$  ( $N = 120$ ).

	U.S. Treasuries					U.S. Dollar				
	$C_1$	$C_2$	$C_3$	$C_4$	$C_5$	$C_1$	$C_2$	$C_3$	$C_4$	$C_5$
Constant	-0.10 (0.07)	1.35*** (0.06)	0.50*** (0.02)	2.66*** (0.11)	0.16 (0.10)	-0.20** (0.07)	1.45*** (0.07)	0.44*** (0.02)	2.70*** (0.16)	-0.01 (0.09)
Risk	1.66*** (0.21)	0.92*** (0.14)	0.33*** (0.05)	1.80*** (0.53)		1.85*** (0.21)	1.09*** (0.16)	0.34*** (0.05)	3.04*** (0.48)	
S					-0.08 (0.10)					-0.53*** (0.09)
Post2020	-0.12 (0.14)	0.21 (0.11)	-0.04 (0.03)	0.74* (0.32)	-0.79*** (0.23)	0.04 (0.13)	0.12 (0.13)	0.00 (0.03)	0.19 (0.34)	0.05 (0.20)
Risk $\times$ Post2020	-1.75*** (0.46)	0.85* (0.41)	-0.43*** (0.12)	0.28 (1.02)		0.50 (0.45)	0.04 (0.33)	0.06 (0.12)	0.04 (0.96)	
S $\times$ Post2020					-0.04 (0.22)					0.07 (0.20)
Adj. $R^2$	5.13	9.77	3.57		7.64	8.63	9.59	4.18		24.87
$N$	1174	599	1174	1174	119	1174	561	1174	1174	119

Table 3: Regression Coefficients: U.S. Treasuries and U.S. Dollar

*Note:* Results are based on individual OLS regressions. Quantile regressions for criterion  $C_4$  are estimated using a likelihood-based method, with bootstrapped p-values reported. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

Turning to the U.S. dollar, we find a robust positive response of USD momentum to risk-off periods, consistent with an appreciation of the currency during episodes of market stress. The correlation with the world equity index is significantly negative. In contrast to Treasuries, these relationships remain broadly unchanged after 2020.

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)<sup>6</sup>

The estimated coefficients are reported in Figure 6. Overall, the results corroborate the structural break analysis, pointing to a marked shift in the relationship between our indicators and risk-off periods. In particular, the average momentum factor exhibits a clear decline in statistical significance, alongside a reduction in its estimated beta, which turns negative over time. The evidence is more nuanced for  $C_2$  and  $C_4$ . While the baseline estimate converges toward zero toward the end of the sample, the results indicate a weakening and eventual loss of statistical significance in the tail-risk hedging properties of U.S. Treasuries. Notably, the correlation between U.S. Treasury yields and equity prices becomes significantly positive after 2022, signaling a reversal relative to earlier periods. Interestingly, the contrast with results reported in Table 3 point to the fact that the correlation between world equity index and U.S. Treasuries yields is not significant during acute risk aversion but show up significantly negative on average during risk-off and risk-on phases.

<sup>6</sup>Results are robust to alternative alternative window lengths with less pronounced change of sign for US Treasuries indicators as window increase (see Figures 11 and 12).

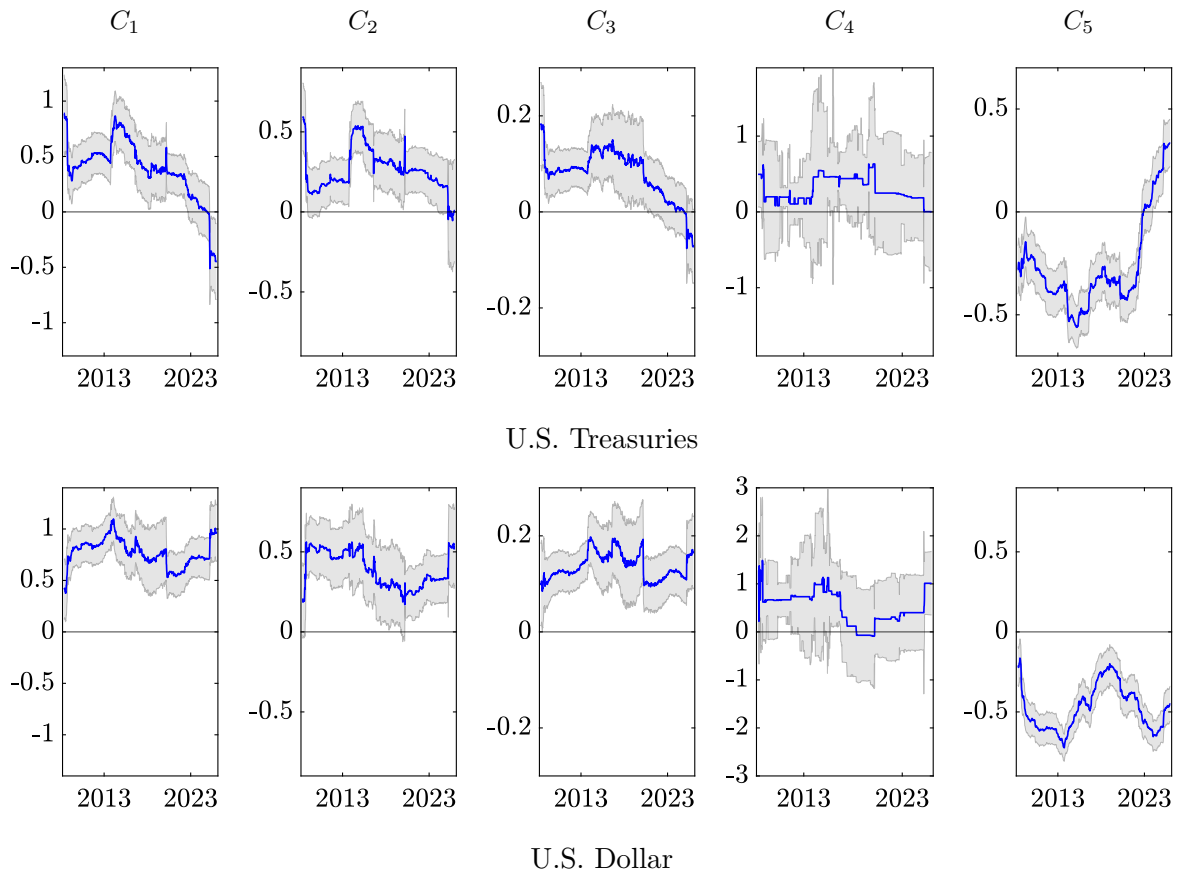


Figure 6: Rolling Coefficient for U.S. Treasuries and U.S. Dollar

*Notes:* OLS regressions on a 5-year windows. Quantile regressions for criterion  $C_4$  are estimated using a likelihood-based method, with bootstrapped standard errors reported.

By contrast, the results for the U.S. 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 U.S. dollar and equity prices remains significantly negative throughout, in sharp contrast with the evolving behavior of U.S. Treasuries.

**Robustness.** To assess whether the structural break identified above is pervasive across the U.S. 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 investigate whether the findings are specific to nominal yields by repeating the analysis using real yields derived from Treasury Inflation-Protected Securities (TIPS). Finally, 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, real yields, and OIS rates (see Table 18), suggesting that the decline in safe-haven properties reflects a broad-based shift in the U.S. fixed-income market. The evidence is particularly strong for the 10-year term premium, which exhibits the most pronounced deterioration in safe-haven characteristics.

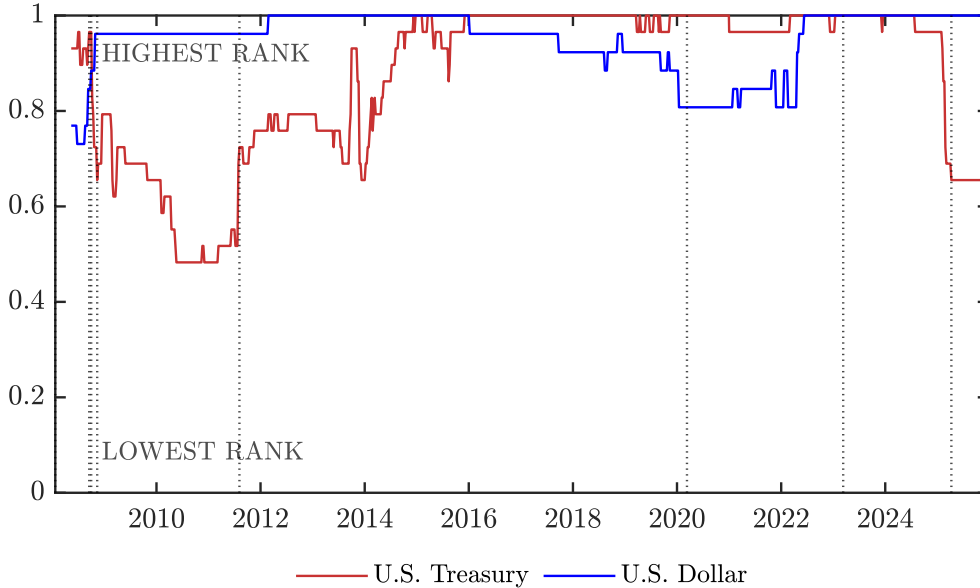


Figure 7: Safe-Haven Ranking of U.S. Treasuries and the U.S. Dollar on a 5-Year Rolling Window

*Notes:* U.S. Treasuries (UST) are ranked relative to global safe assets (cf. Table 12); the U.S. dollar (USD) is ranked 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.

## 6.2 Only a U.S. Phenomenon?

Figure 7 provides additional evidence on the evolution of the safe-haven properties of U.S. Treasuries during risk-off episodes. It reports five-year rolling rankings of U.S. Treasuries relative to other safe assets (as defined in Section 5.1) and of the U.S. 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 U.S. 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 U.S. dollar remains persistently high throughout the sample. These findings suggest, first, that the safe-haven properties of U.S. Treasuries are time-varying and, second, that the decoupling documented by Du et al. (2026) is also evident in high-frequency (weekly) momentum dynamics following risk-off episodes. Results are robust to alternative rolling windows (cf. Figure 13).

The novelty of the most recent phase lies in the presence of a structural break in the safe-haven properties of U.S. Treasuries in absolute terms, as documented in Section 6.1. By contrast, the decline in their relative ranking following the Global Financial Crisis was not associated with

such a break: during that earlier period, U.S. Treasuries continued to display strong safe-haven behavior.

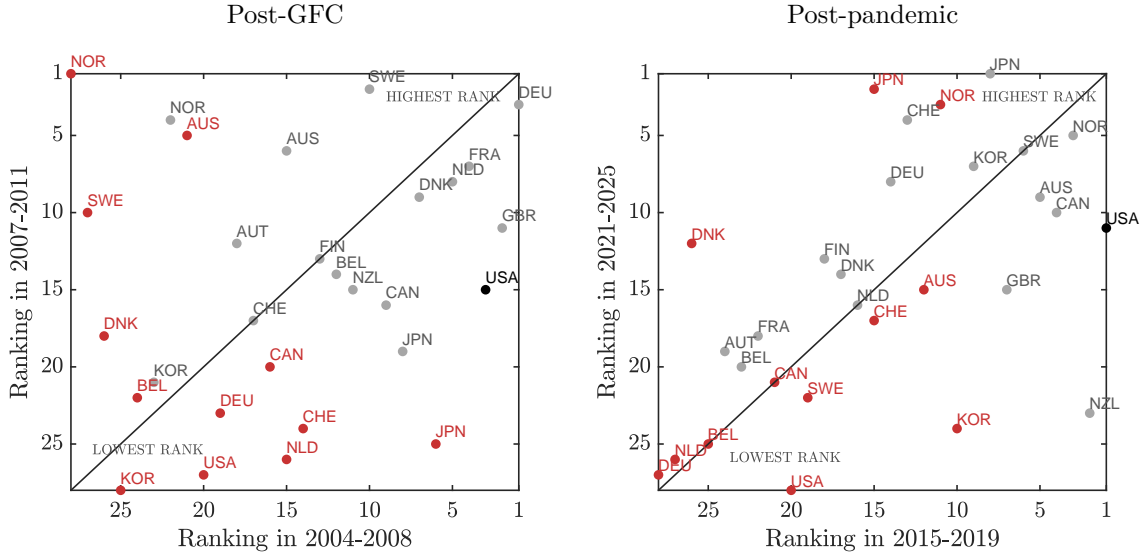


Figure 8: Safe-Haven Ranking of Selected Safe Assets

*Notes:* Each point corresponds to the ranking of a global safe asset listed in Table 12. Grey points denote advanced economy sovereign bonds and red points denote corporate bonds.

Figure 8 provides a detailed decomposition of changes in the relative rankings of U.S. Treasuries across different periods, compared with other global safe assets. We highlight two phases associated with the relative decline of U.S. Treasuries: the post-GFC period and the post-pandemic period. With the exception of Norwegian and Danish corporate bonds, which improve their rankings in both periods, the dynamics differ across other assets. First, Japanese assets record gains in the post-pandemic period, coinciding with the normalization of monetary policy. Second, several euro area assets, notably Germany, Finland, Belgium, and Austria, gain relative to U.S. Treasuries in the post-pandemic period. This contrasts with the post-GFC period, during which such improvements were not observed (with the exception of Austria). A similar pattern is observed for Switzerland. Interestingly, in the recent post-pandemic phase, assets from New Zealand, Canada, and the United Kingdom decline in the rankings, alongside U.S. Treasuries. Overall, the most recent period provides additional evidence of the distinct nature of current dynamics. The relative ranking of G10 sovereign bonds and their respective currencies are reported in annex (Table 14).

We extend the analysis beyond the United States by re-estimating Equations (6)–(8) for all assets in Cluster 1. Rather than including an interaction term, the regressions are estimated separately over the 2003–2019 and 2020–2025 subperiods. Table 4 reports the estimated coefficients associated with risk-off episodes across the five criteria for sovereign bonds issued by advanced economies (excluding the euro area). The results indicate a clear loss of significance of the coefficients in the post-pandemic period across all criteria. Some notable exceptions exist: Japan for the first, second, and fourth criteria; Norway for  $C_2$ ; and Sweden for  $C_2$  and  $C_4$ . Euro area sovereign bonds also exhibit a clear structural break. Interestingly, German bonds remain

ISO	$C_1$		$C_2$		$C_3$		$C_4$		$C_5$	
	Prior	Post	Prior	Post	Prior	Post	Prior	Post	Prior	Post
<b>Advanced Economies</b>										
USA	1.66*** (0.21)	-0.09 (0.46)	0.95*** (0.14)	1.77*** (0.41)	0.33*** (0.05)	-0.10 (0.10)	1.86*** (0.49)	2.08** (0.90)	-0.08 (0.09)	-0.11 (0.27)
GBR	1.60*** (0.20)	-0.40 (0.48)	0.95*** (0.14)	0.49 (0.41)	0.31*** (0.05)	-0.08 (0.10)	1.88*** (0.63)	0.19 (0.42)	-0.16* (0.09)	0.12 (0.25)
CAN	1.35*** (0.20)	-0.19 (0.50)	0.77*** (0.13)	1.48*** (0.50)	0.26*** (0.05)	-0.10 (0.10)	1.46*** (0.55)	1.23 (0.79)	-0.04 (0.09)	-0.15 (0.28)
SWE	1.78*** (0.21)	0.06 (0.44)	1.05*** (0.14)	1.61*** (0.41)	0.29*** (0.05)	-0.07 (0.10)	2.41*** (0.53)	1.17** (0.52)	-0.26*** (0.09)	0.13 (0.26)
KOR	0.63*** (0.22)	-0.53 (0.43)	0.30* (0.17)	0.50 (0.46)	0.18*** (0.06)	-0.03 (0.10)	1.30** (0.53)	-0.76 (0.60)	-0.04 (0.10)	0.13 (0.25)
JPN	1.34*** (0.22)	0.73** (0.37)	0.53*** (0.14)	1.48*** (0.37)	0.27*** (0.05)	-0.02 (0.10)	0.85* (0.44)	3.75*** (1.52)	0.07 (0.09)	-0.05 (0.28)
DNK	1.48*** (0.21)	-0.68 (0.46)	0.85*** (0.14)	0.74* (0.42)	0.27*** (0.05)	-0.03 (0.10)	2.49*** (0.38)	-0.10 (0.61)	-0.15* (0.09)	0.17 (0.26)
CHE	1.25*** (0.20)	-0.60 (0.47)	0.81*** (0.13)	1.05** (0.43)	0.24*** (0.05)	-0.13 (0.10)	1.90*** (0.68)	1.23 (0.94)	-0.11 (0.09)	0.35 (0.25)
AUS	1.72*** (0.21)	-0.57 (0.45)	0.97*** (0.13)	0.87** (0.38)	0.33*** (0.05)	-0.06 (0.10)	2.66*** (0.48)	0.41 (0.57)	-0.20** (0.09)	0.19 (0.24)
NOR	1.31*** (0.20)	0.47 (0.47)	0.95*** (0.15)	1.60*** (0.43)	0.22*** (0.06)	-0.01 (0.10)	2.11*** (0.56)	1.42* (0.78)	-0.13 (0.10)	-0.22 (0.26)
NZL	1.26*** (0.20)	-0.75 (0.47)	0.87*** (0.14)	0.83* (0.42)	0.24*** (0.06)	-0.14 (0.10)	1.70*** (0.45)	0.07 (0.53)	-0.19** (0.09)	0.10 (0.24)
<b>Euro area</b>										
DEU	1.69*** (0.20)	-0.29 (0.47)	1.03*** (0.12)	1.19*** (0.42)	0.28*** (0.05)	-0.03 (0.10)	2.56*** (0.62)	0.66 (0.40)	-0.12 (0.08)	0.13 (0.28)
FRA	1.21*** (0.20)	-0.98** (0.47)	0.75*** (0.13)	0.48 (0.44)	0.21*** (0.05)	-0.08 (0.10)	1.84*** (0.43)	0.02 (0.63)	-0.09 (0.08)	0.35 (0.26)
NLD	1.43*** (0.20)	-0.82* (0.47)	0.87*** (0.12)	0.61 (0.41)	0.25*** (0.05)	-0.04 (0.10)	2.71*** (0.59)	-0.25 (0.45)	-0.11 (0.08)	0.22 (0.26)
FIN	1.29*** (0.20)	-1.00** (0.48)	0.71*** (0.12)	0.50 (0.42)	0.26*** (0.05)	-0.06 (0.10)	1.87*** (0.39)	0.01 (0.59)	-0.09 (0.08)	0.29 (0.26)
AUT	1.00*** (0.20)	-1.08** (0.49)	0.73*** (0.13)	0.50 (0.45)	0.19*** (0.06)	-0.10 (0.10)	1.99*** (0.42)	-0.14 (0.68)	-0.09 (0.09)	0.33 (0.25)
BEL	0.71*** (0.21)	-1.19** (0.46)	0.42*** (0.13)	0.46 (0.42)	0.16*** (0.05)	-0.10 (0.10)	1.22*** (0.42)	-0.36 (0.56)	-0.08 (0.09)	0.34 (0.26)

Table 4: Time-Varying Betas of Risk-Off Episodes: Advanced Economies

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

resilient for one of the five criteria. For some euro area assets, such as Austria, Belgium, and France, the coefficient associated with the first criterion even turns negative, similarly to risky assets. Finally, corporate bonds display an even stronger structural break, with a change in the sign of the coefficient between the two periods (see Table 5). As for sovereign bonds, some notable exceptions remain, such as Norwegian and Japanese corporate bonds.

ISO	$C_1$		$C_2$		$C_3$		$C_4$		$C_5$	
	Prior	Post	Prior	Post	Prior	Post	Prior	Post	Prior	Post
USA	-0.09 (0.21)	-2.25*** (0.48)	0.42** (0.19)	1.00 (0.68)	0.02 (0.06)	-0.37*** (0.10)	0.80 (0.71)	-0.95 (1.37)	0.34*** (0.09)	0.35 (0.21)
DEU	-0.17 (0.19)	-3.07*** (0.53)	0.22 (0.16)	-0.53 (0.77)	0.04 (0.06)	-0.39*** (0.10)	0.50 (0.63)	-3.44*** (0.89)	0.22** (0.09)	0.57** (0.21)
CAN	0.59*** (0.19)	-1.61*** (0.55)	0.52*** (0.14)	0.47 (0.61)	0.10* (0.06)	-0.17* (0.10)	0.93* (0.53)	0.57 (1.40)	0.15* (0.08)	0.24 (0.28)
SWE	1.12*** (0.21)	-1.35*** (0.48)	0.74*** (0.18)	0.22 (0.43)	0.20*** (0.06)	-0.19* (0.10)	3.05*** (0.68)	-1.11 (1.18)	-0.33*** (0.08)	0.53** (0.22)
KOR	-0.14 (0.22)	-0.91** (0.44)	0.30 (0.19)	1.10*** (0.41)	0.06 (0.06)	-0.13 (0.10)	0.66 (0.45)	1.36 (0.88)	0.39*** (0.09)	0.06 (0.23)
NLD	0.14 (0.20)	-2.89*** (0.52)	0.34** (0.16)	-0.57 (0.63)	0.07 (0.06)	-0.30*** (0.10)	0.80** (0.38)	-2.86*** (0.99)	0.25*** (0.08)	0.52** (0.22)
JPN	0.76*** (0.24)	0.74** (0.32)	0.46*** (0.16)	1.02*** (0.26)	0.20*** (0.05)	0.11 (0.10)	1.68** (0.77)	2.44* (1.41)	0.28** (0.11)	-0.08 (0.19)
DNK	0.77*** (0.19)	-1.09** (0.50)	0.34* (0.17)	0.12 (0.50)	0.19*** (0.06)	-0.12 (0.10)	1.32** (0.66)	-0.22 (0.80)	-0.13 (0.08)	0.48 (0.28)
CHE	-0.14 (0.20)	-2.09*** (0.53)	0.61*** (0.19)	-0.36 (0.35)	0.03 (0.06)	-0.09 (0.10)	1.26 (1.59)	-0.48 (0.87)	0.23** (0.09)	0.45* (0.23)
AUS	1.19*** (0.21)	-0.94** (0.47)	1.16*** (0.18)	1.09*** (0.36)	0.16*** (0.06)	-0.12 (0.10)	2.75*** (0.47)	1.52 (1.10)	-0.25*** (0.09)	0.19 (0.25)
BEL	-0.31 (0.21)	-2.59*** (0.42)	0.42** (0.18)	-0.65 (0.52)	-0.01 (0.06)	-0.28*** (0.10)	1.17 (1.15)	-2.46*** (0.73)	0.17 (0.10)	0.53*** (0.18)
NOR	1.03*** (0.20)	0.68 (0.50)	0.48** (0.19)	1.31*** (0.46)	0.24*** (0.06)	0.09 (0.10)	2.37** (1.04)	2.81*** (0.86)	-0.24*** (0.09)	-0.39 (0.29)

Table 5: Time-Varying Betas on Risk-Off Episodes: Corporate bonds

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

### 6.3 The Role of Cyclical Macroeconomic Conditions

The regressions reported above establish whether the safe-haven properties of U.S. Treasuries have changed over time, but remain silent on the underlying macroeconomic conditions that may amplify or dampen these properties. We therefore investigate whether the safe-haven behavior of U.S. Treasuries (as measured by criteria  $C_1$  through  $C_5$ ) is systematically related to cyclical macroeconomic fundamentals. 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 the domestic central bank.

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, large-scale asset purchase programs by the central bank (captured here by the share of sovereign debt securities held on its balance sheet) have significantly altered the supply of safe assets available to private investors, potentially affecting market liquidity and the safe-haven dynamics of Treasuries during risk-off episodes. 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 U.S. Treasuries. The results are reported in Table 6.

**Main findings for the United States.** Inflation exerts a negative and statistically significant effect on the safe-haven properties of U.S. Treasuries, primarily through its interaction with the risk-off indicator. The coefficient on  $\text{Risk} \times \text{Inflation}$  is negative and significant at the 10 percent level for  $C_1$  and  $C_3$ , indicating that higher inflation dampens both the average performance and the frequency of positive safe-haven realizations during stress episodes. This result is consistent with the view that inflation erodes the real return on nominal bonds, reducing their attractiveness as a store of value precisely when investors seek refuge. Interestingly, the direct effect of inflation (the coefficient on  $Z$  alone) is not significant for  $C_1$  or  $C_3$ , suggesting that inflation matters for safe-haven behavior specifically during risk-off episodes rather than unconditionally. For  $C_5$ , the interaction coefficient is positive and significant (0.141), indicating that, conditionally on risk-off periods, higher inflation is associated with a stronger negative comovement between Treasury yields and world equity prices. This result may reflect a flight-to-safety demand for Treasuries even in inflationary environments, though this interpretation should be taken with caution given the small sample size for  $C_5$ .

The debt-to-GDP ratio displays a more nuanced pattern. Its interaction with the risk-off dummy is negative and highly significant for  $C_1$  and  $C_3$ , implying that a higher debt burden weakens the average safe-haven response and reduces the frequency of positive momentum realizations during stress episodes. This finding is consistent with the fiscal sustainability channel: as public indebtedness rises, investors may reassess the perceived safety of Treasury securities, reducing the premium they are willing to pay during episodes of global risk aversion. By contrast, the direct effect of debt on momentum (outside risk-off periods) is essentially zero across all criteria, confirming that the fiscal channel operates specifically through the interaction with stress conditions rather than through a permanent level effect.

The share of sovereign debt held by the Federal Reserve is the variable with the strongest and most consistent negative effect on safe-haven behavior. The interaction coefficient is negative and highly significant for  $C_1$  and  $C_3$ , and marginally significant for  $C_4$ , indicating that a larger Federal Reserve balance sheet is associated with a pronounced deterioration in the safe-haven properties of Treasuries during risk-off episodes across multiple criteria. The direct effect of CBH is also negative and significant for  $C_3$  ( $-0.836$ ) and  $C_5$  ( $-8.193$ ), suggesting that large-scale asset purchases reduce safe-haven momentum both unconditionally and during stress periods. By crowding out private investors from the Treasury market, quantitative easing programs may have structurally reduced the liquidity and price-discovery capacity that underpin the safe-haven

	$C_1$	$C_2$	$C_3$	$C_4$	$C_5$
<b>Inflation</b>					
Constant	-0.13 (0.11)	1.16*** (0.08)	0.48*** (0.03)	2.33*** (0.19)	0.24 (0.15)
Risk-off	1.92*** (0.39)	1.03*** (0.28)	0.36*** (0.08)	2.79*** (0.92)	-0.45** (0.18)
INF	-0.00 (0.04)	0.10*** (0.03)	0.00 (0.01)	0.17*** (0.05)	-0.07 (0.04)
Risk-off $\times$ INF	-0.23* (0.13)	-0.03 (0.09)	-0.04* (0.02)	-0.29 (0.30)	0.14*** (0.05)
Adj. $R^2$	4.50	10.20	2.50	—	12.30
$N$	1187	604	1187	1187	120
<b>Debt-to-GDP</b>					
Constant	-0.19 (0.30)	1.67*** (0.22)	0.57*** (0.08)	2.60*** (0.59)	1.42*** (0.43)
Risk-off	4.93*** (1.09)	1.70** (0.80)	0.74*** (0.20)	3.78* (2.21)	-0.03 (0.48)
DEBT	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.01)	-0.01*** (0.00)
Risk-off $\times$ DEBT	-0.03*** (0.01)	-0.01 (0.01)	-0.00** (0.00)	-0.02 (0.02)	0.00 (0.00)
Adj. $R^2$	5.20	9.00	3.00	—	8.80
$N$	1188	604	1188	1188	120
<b>Central Bank Holding</b>					
Constant	0.14 (0.22)	1.57*** (0.19)	0.58*** (0.05)	2.64*** (0.50)	0.88*** (0.21)
Risk-off	3.27*** (0.62)	1.34*** (0.48)	0.52*** (0.11)	3.32*** (0.95)	-0.16 (0.24)
CBH	-2.38 (1.73)	-1.35 (1.49)	-0.84** (0.41)	1.34 (4.32)	-8.19*** (2.02)
Risk-off $\times$ CBH	-18.25*** (5.52)	-4.04 (4.26)	-2.54** (1.03)	-12.97* (7.88)	2.01 (2.31)
Adj. $R^2$	6.20	9.10	3.60	—	13.30
$N$	1147	584	1147	1147	118

Table 6: Cyclical Drivers of Safe-Haven Behavior: U.S. Treasuries

*Notes:* OLS regressions for  $C_1$ ,  $C_2$ ,  $C_3$ ; quantile regression ( $\tau = 0.95$ ) for  $C_4$ ; OLS regression for  $C_5$ . The dependent variable is the momentum measure  $M_t$  throughout. For  $C_5$ , the sample is restricted to risk-off periods and the main regressor is the world equity return  $S_t$  rather than the risk-off dummy, so as to capture the hedging properties of the asset against risky asset prices during stress episodes. All cyclical variables are lagged one period. Heteroskedasticity-robust standard errors (HC1) in parentheses for OLS; bootstrapped standard errors for quantile regression. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

role of U.S. Treasuries.

These results therefore suggest that the cyclical macroeconomic environment meaningfully conditions the safe-haven properties of U.S. Treasuries. All three variables, inflation, sovereign indebtedness, and central bank holdings, tend to weaken rather than reinforce safe-haven behavior during risk-off episodes, primarily through their interaction with the stress indicator. This finding provides additional support for the structural break documented in the preceding section: the post-2020 deterioration in the safe-haven performance of U.S. Treasuries may partly reflect the simultaneous rise in inflation, the sharp increase in the debt-to-GDP ratio, and the unprecedented expansion of the Federal Reserve’s balance sheet that characterized the post-pandemic macroeconomic environment.

**Comparison with other global safe assets.** To assess whether the cyclical drivers identified for U.S. Treasuries reflect a broader pattern or a U.S.-specific phenomenon, we replicate the analysis for four other global safe assets: Germany, the United Kingdom, Sweden, and Japan. These countries are natural comparators for several reasons. First, all four issue sovereign debt that qualifies as a global safe asset in our taxonomy, providing a meaningful benchmark against which to evaluate the U.S. results. Second, they exhibit significant variation in their macroeconomic trajectories over the sample period, i.e. in terms of inflation dynamics, fiscal consolidation, and the scale of central bank asset purchase programs. This allows us to identify whether the cyclical channels documented for the United States are specific to its institutional and macroeconomic context or can be generalized across advanced economies. The results are reported in Appendix in Tables 19 and 20.

The most robust finding is that the share of sovereign debt held by the national central bank exerts a negative and significant effect on safe-haven behavior across all countries, mirroring the pattern documented for U.S. Treasuries. The interaction coefficient Risk-off  $\times$  CBH is negative and significant for Germany ( $C_1$ : -10.142;  $C_4$ : -11.306), the United Kingdom ( $C_1$ : -7.405;  $C_4$ : -8.037), Sweden ( $C_1$ : -8.826;  $C_3$ : -1.674), and Japan ( $C_3$ : -0.808). This cross-country consistency suggests that large-scale asset purchase programs structurally weaken the safe-haven properties of sovereign debt, irrespective of the issuer. By crowding out private investors, quantitative easing reduces the market depth and price-discovery capacity that underpin safe-haven demand during stress episodes (Duffie, 2020; He et al., 2022).

The debt channel is broadly consistent but more heterogeneous. The negative effect of sovereign indebtedness on safe-haven behavior is confirmed for most countries, though its magnitude and statistical significance vary. The interaction Risk-off  $\times$  Debt is negative and significant for the United Kingdom ( $C_1$ : -0.038;  $C_4$ : -0.046), Sweden ( $C_1$ : -0.125;  $C_2$ : -0.142;  $C_4$ : -0.217), and Japan ( $C_1$ : -0.016;  $C_3$ : -0.004), but less systematically so for Germany. The German exception is noteworthy: Germany’s debt-to-GDP ratio declined over much of the sample period, limiting the cross-sectional variation needed to identify the fiscal channel. Sweden’s result deserves a qualification: while the interaction is negative and significant across most criteria, it turns positive and significant under  $C_5$ , which restricts the sample to risk-off episodes and uses the world equity return as the main regressor. This sign reversal under  $C_5$  may reflect the particular behavior of Swedish sovereign bonds during the most severe stress episodes of the

sample, where their safe-haven properties appear relatively robust conditional on global equity market dynamics. Despite this exception, the dominant pattern remains negative, consistent with the fiscal sustainability channel identified for the United States (Gómez-Cram et al., 2024; Jiang et al., 2025).

By contrast with the two other cyclical variables, the effect of inflation on safe-haven behavior is less uniform across countries. While the interaction is negative and significant for Germany ( $C_1$ :  $-0.544$ ;  $C_3$ :  $-0.081$ ), the United Kingdom ( $C_1$ :  $-0.327$ ), and the United States, it is not significant for Sweden or Japan. For Sweden, the absence of a significant inflation interaction is consistent with the Riksbank’s credible inflation-targeting framework over most of the sample period, which kept inflation expectations well anchored and largely decoupled real bond returns from inflation fluctuations during stress episodes; the sharp inflationary episode of 2022–2023 falls near the end of the sample and may not yet generate sufficient variation to identify the channel. For Japan, the coefficient on inflation alone (outside risk-off episodes) is negative and highly significant across all criteria ( $C_1$ :  $-0.145$ ;  $C_3$ :  $-0.043$ ), suggesting that deflationary pressures (rather than inflationary ones) have historically reinforced the safe-haven properties of Japanese government bonds by sustaining their real return. This asymmetry between Japan and the other economies reflects the distinctive macroeconomic environment of Japan over the sample period, marked by persistently low inflation and a structurally different monetary policy regime. Overall, the inflation channel appears to be most relevant for countries where inflation has been both volatile and elevated, reducing the predictability of real returns on nominal bonds precisely when investors most need reliable stores of value.

## 7 Conclusion

This paper provides a novel empirical assessment of safe-haven behavior across a broad range of financial assets, including sovereign and corporate bonds, currencies, and alternative assets. We develop a multi-criteria framework to evaluate how assets perform during episodes of acute global risk aversion. This approach allows us to propose a new taxonomy of safe assets and to rank their relative safe-haven properties within economically meaningful groups.

Our results confirm the central role of sovereign bonds issued by advanced economies, particularly U.S. Treasuries, as the primary providers of global safety services. At the same time, we document meaningful heterogeneity across asset classes. While a limited set of corporate bond markets displays partial safe-asset characteristics, currencies such as the U.S. dollar, Japanese yen, and Swiss franc continue to dominate as safe-haven currencies. Alternative assets play a more nuanced role: gold provides protection mainly during episodes of acute geopolitical stress, whereas other assets such as Bitcoin or oil do not exhibit consistent safe-haven properties.

A separate contribution of the paper is to reassess the role of U.S. Treasuries in a relative and dynamic perspective. We show that their safe-haven performance has weakened in recent years, particularly after the onset of the pandemic, when compared to other global safe assets. However, this decline should not be interpreted as an isolated U.S. phenomenon. Rather, it reflects a broader reconfiguration of safe-asset markets, affecting other advanced-economy sovereign bonds as well. We show that reduction in safe-haven behavior is associated with

higher inflation, debt level and central bank holding of debt securities. In contrast, the U.S. dollar retains its dominant role as a safe-haven currency, highlighting an increasing divergence between currency-based and bond-based safety. Overall, our findings suggest that the notion of a single, dominant safe asset is becoming less clear-cut. Instead, safety appears increasingly fragmented across asset classes. This has important implications for investors, policymakers, and the functioning of the international monetary system.

Beyond documenting these trends, our framework opens several promising avenues for future research. First, understanding how changes in safe-haven rankings translate into debt-servicing costs and fiscal space would provide valuable insights into the economic benefits of issuing safe assets. Second, our results raise important questions for monetary policy. If credible and responsive monetary frameworks contribute to preserving safe-asset status, then central banks may indirectly influence the safety premium attached to domestic sovereign debt. Conversely, if sovereign bonds become less effective as safe havens, policymakers may need to reassess the scale and nature of policy interventions required to stabilize financial markets during periods of stress. Exploring these links between safe-asset status, fiscal capacity, and monetary policy effectiveness constitutes a fruitful agenda for future work.

## References

- Acosta, M., A. Ajello, M. Bauer, F. Loria, and S. Miranda-Agrippino. (2025). Financial Market Effects of FOMC Communication: Evidence from a New Event-Study Database. *Federal Reserve Bank of San Francisco Working Paper*, 2025–30.
- Adrian, T., M. J. Fleming, and K. Nikolaou (2025). U.S. Treasury Market Functioning from the Global Financial Crisis to the Pandemic. *Federal Reserve Bank of New York Staff Reports*, 1146.
- Arslanalp, S. and T. Tsuda (2014a). Tracking Global Demand for Advanced Economy Sovereign Debt. *IMF Economic Review* 62, 430–464.
- Arslanalp, S. and T. Tsuda (2014b). Tracking Global Demand for Emerging Market Sovereign Debt. *IMF Working Paper*, WP/14/39.
- Arvai, K., N. Coimbra, and M. Pinchetti (2026). Fool’s Gold? How the US Dollar Lost its Shine. *CEPR Discussion Paper* 21575.
- Avdjiev, S., L. Gambacorta, L. Goldberg, and S. Schiaffi (2020). The Shifting Drivers of Global Liquidity. *Journal of International Economics* 125, 103324.
- Baur, D. (2023). Gold and the Safe Asset Shortage Conundrum. *Working Paper*.
- Baur, D. G. and B. M. Lucey (2010). Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold. *The Financial Review* 45(2), 217–229.
- Brunnermeier, M., S. Nagel, and L. Pedersen (2008). Carry Trades and Currency Crashes. *NBER Macroeconomics Annual* 23, 313–348.
- Bruno, V. and H. S. Shin (2015). Capital Flows and the Risk-Taking Channel of Monetary Policy. *Journal of Monetary Economics* 71, 119–132.
- Caballero, R., E. Farhi, and P.-O. Gourinchas (2017). The Safe Assets Shortage Conundrum. *Journal of Economic Perspectives* 31(3).
- Caldara, D. and M. Iacoviello (2022). Measuring Geopolitical Risk. *American Economic Review* 112(4), 1194–1225.
- Cashin, P., L. F. Céspedes, and R. Sahay (2004). Commodity Currencies and the Real Exchange Rate. *Journal of Development Economics* 75(1), 239–268.
- Chari, A., K. D. Stedman, and C. Lundblad (2023). Risk-on Risk-off: A Multifaceted Approach to Measuring Global Investor Risk Aversion. *NBER Working Paper*, 31907.
- Chen, Y.-c. and K. Rogoff (2003). Commodity Currencies. *Journal of International Economics* 60(1), 133–160.
- Cheng, X., H. Chen, and Y. Zhou (2021). Is the Renminbi a Safe-Haven Currency? Evidence from Conditional Coskewness and Cokurtosis. *Journal of International Money and Finance* 113, 102359.

- Chinn, M. D. and H. Ito (2006). What matters for financial development? Capital controls, institutions and interactions. *Journal of Development Economics* 81(1), 163–192.
- Cuevas, C. (2024). Safe Assets in Emerging Market Economies. *Working Paper*.
- De Bock, R. and I. de Carvalho Filho (2015). "The Behavior of Currencies During Risk-off Episodes". *Journal of International Money and Finance* 53, 218 – 234.
- Du, W., R. Keerati, and J. Schreger (2026). "Decoupling Dollar and Treasury Privilege". *NBER Working Paper*, 35000.
- Duffie, D. (2020). Still the World's Safe Haven? Redesigning the U.S. Treasury Market After the COVID-19 Crisis. (62).
- Eisenbach, T. M. and G. Phelan (2026). Fragility of Safe Asset Markets. *The Review of Financial Studies* 39(5), 1310–1361.
- Fatum, R. and Y. Yamamoto (2016). Intra-safe Haven Currency Behavior During the Global Financial Crisis. *Journal of International Money and Finance* 66, 49–64.
- Fatum, R., Y. Yamamoto, and G. Zhu (2017). Is the Renminbi a Safe Haven? *Journal of International Money and Finance* 79, 189–202.
- Ferreira, T. and S. Shousha (2023). Determinants of Global Neutral Interest Rates. *Journal of International Economics* 145, 103833.
- Gómez-Cram, R., H. Kung, and H. Lustig (2024). Government Debt in Mature Economies: Safe or Risky? *Working Paper*.
- Gorton, G. (2017). The History and Economics of Safe Assets. *Annual Review of Economics* 9, 547–586.
- Gourinchas, P.-O. and H. Rey (2007). From World Banker to World Venture Capitalist: U.S. External Adjustment and the Exorbitant Privilege. In R. Clarida (Ed.), *G7 Current Account Imbalances: Sustainability and Adjustment*, pp. 11–55. University of Chicago Press.
- Grise, C. and T. Nitschka (2015). On Financial Risk and the Safe Haven Characteristics of Swiss Franc Exchange Rates. *Journal of Empirical Finance* 32, 153–164.
- Gurdgiev, C. and A. Petrovskiy (2024). Hedging and Safe Haven Assets Dynamics in Developed and Developing Markets: Are Different Markets that Much Different? *International Review of Financial Analysis* 92.
- Habib, M. M. and L. Stracca (2012). Getting Beyond Carry Trade: What Makes a Safe Haven Currency? *Journal of International Economics* 5, 50–64.
- Habib, M. M., L. Stracca, and F. Venditti (2020). The Fundamentals of Safe Assets. *Journal of International Money and Finance* 102, 102119.

- He, Z., S. Nagel, and Z. Song (2022). Treasury Inconvenience Yields During the COVID-19 Crisis. *Journal of Financial Economics* 143(1), 57–79.
- Hossfeld, O. and R. MacDonald (2015). Carry Funding and Safe Haven Currencies: A Threshold Regression Approach. *Journal of International Money and Finance* 59, 185–202.
- Jiang, Z., A. Krishnamurthy, H. N. Lustig, R. Richmond, and C. Xu (2025). Dollar Upheaval: This Time is Different. *Working Paper*.
- Kahn, G. A. and A. K. Nguyen (2022). Treasury Market Stress: Lessons from 1958 and Today. *OFR Brief Series*, 22–01.
- Kose, A., S. Kurlat, F. Ohnsorge, and N. Sugawara (2022). A Cross-country Database of Fiscal Space. *Journal of International Money and Finance* 128, 102682.
- Krishnamurthy, A. and A. Vissing-Jorgensen (2012). The Aggregate Demand for Treasury Debt. *Journal of Political Economy* 120(2), 233–267.
- Lane, P. R. and G. M. Milesi-Ferretti (2018). The external wealth of nations revisited: International financial integration in the aftermath of the global financial crisis. *IMF Economic Review* 66, 189–222.
- Longstaff, F. A. (2004). The Flight-to-Liquidity Premium in U.S. Treasury Bond Prices. *Journal of Business* 77(3).
- Lustig, H., N. Roussanov, and A. Verdelhan (2011). Common Risk Factors in Currency Markets. *The Review of Financial Studies* 24(11), 3731–3777.
- Mota, L. (2023). The Corporate Supply of (Quasi) Safe Assets. *Working Paper*.
- Obstfeld, M., J. D. Ostry, and M. Qureshi (2018). Global Financial Cycles and the Exchange Rate Regime: a Perspective from Emerging Markets. *AEA Papers and Proceedings* 108, 499–504.
- Ready, R., N. Roussanov, and C. Ward (2017). Commodity Trade and the Carry Trade: A Tale of Two Countries. *The Journal of Finance* 72(6), 2629–2684.
- Szöke, B., F. Vazquez-Grande, and I. Xavier (2024). The Drivers of  $r^*$ : Accounting for Treasuries' Convenience Yield. *Working paper*.
- Vissing-Jorgensen, A. (2021). The Treasury Market in Spring 2020 and the Response of the Federal Reserve. *Journal of Monetary Economics* 124, 19–47.
- Wang, Q., J. Yang, and T. T.-L. Chong (2025). Creditable Bonds' Multifunctional Roles During the COVID-19 Pandemic. *The North American Journal of Economics and Finance* 76, 102348.
- Wang, W. and Y.-W. Cheung (2023). Commodity Price Effects on Currencies. *Journal of International Money and Finance* 130, 102745.

## Appendix

Year	Month	Week	Days	$z_{\text{RORO}}$	Event Description
<b>Largest 1%</b>					
2008	Jan.	4	21–25	3.26	Early Global Financial Crisis tensions
2008	Sep.	38	15–19	4.88	Lehman Brothers bankruptcy shock
2008	Sep.	40	29–03	4.61	Escalation of global financial panic
2008	Oct.	41	06–10	8.69	Peak of Global Financial Crisis
2008	Oct.	42	13–17	4.40	Persistent post-Lehman market stress
2008	Nov.	46	10–14	3.83	Financial system stabilization phase
2008	Nov.	47	17–21	3.75	Continued deleveraging and risk aversion
2011	Aug.	32	08–12	5.72	U.S. sovereign downgrade and Euro-area debt crisis
2020	Mar.	11	09–13	7.00	COVID-19 global market sell-off begins
2020	Mar.	12	16–20	9.92	Peak COVID-19 panic and flight to safety
2023	Mar.	11	13–17	3.56	Global banking stress episode
2025	Apr.	15	07–11	4.52	Heightened volatility following U.S. tariff announcements
<b>Selected largest 2-5%</b>					
2007	Aug.	33	13–17	3.12	Onset of subprime mortgage crisis and global liquidity stress
2020	Feb.	09	24–28	3.03	Initial global market reaction to COVID-19 outbreak
2011	Mar.	11	14–18	2.80	Japan earthquake and escalation of euro-area sovereign debt concerns
2022	Jun.	24	13–17	2.71	Peak inflation fears and tightening-driven market stress
<b>Selected largest 6-10%</b>					
2010	Aug.	32	09–13	1.49	Elevated sovereign risk concerns amid fragile post-crisis recovery
2022	Jan.	04	24–28	1.46	Monetary policy tightening repricing and early geopolitical tensions
2015	Sep.	39	21–25	1.46	Persistent global risk aversion following China slowdown and market turmoil
2010	Apr.	17	26–30	1.44	Escalation of Greek sovereign debt crisis and euro-area financial stress

Table 7: Identified Risk-Off Episodes Based on the RORO Index

Country	ISO	Long-rate		FX	NEER
		Mnemonic	Start date		
<b>Advanced economies</b>					
United States	USA	TRUS10T	May 2003	—	BISBUSN Index
Euro area	EUR	—	—	TEUSDSP	BISBEUN Index
Germany	DEU	TRBD10T	May 2003	—	—
United Kingdom	GBR	TRUK10T	May 2003	TSUSDSP	BISBGBN Index
Canada	CAN	TRCN10T	May 2003	TDCADSP	BISBCAN Index
France	FRA	TRFR10T	May 2003	—	—
Italy	ITA	TRIT10T	May 2003	—	—
Spain	ESP	TRES10T	May 2003	—	—
Greece	GRC	TRGR10T	May 2003	—	—
Sweden	SWE	TRSD10T	May 2003	TDSEKSP	BISBSEN Index
Korea	KOR	TRKR10T	May 2003	TDKRWSP	BISBKRN Index
Netherlands	NLD	TRNL10T	May 2003	—	BISBEUN Index
Ireland	IRL	TRIE10T	May 2003	—	—
Portugal	PRT	TRPT10T	May 2003	—	—
Czechia	CZE	TRCZ10T	May 2003	TDCZKSP	BISBCZN Index
Slovakia	SVK	TRSK10T	Jan. 2004	—	—
Japan	JPN	TRJP10T	May 2003	TDJPYSP	BISBJPN Index
Croatia	HRV	TRHR10T	Jan. 2008	—	—
Israel	ISR	TRIL10T	May 2003	ISUSDSP	BISBILN Index
Finland	FIN	TRFN10T	May 2003	—	—
Austria	AUT	TROE10T	May 2003	—	—
Denmark	DNK	TRDK10T	May 2003	TDDKKSP	BISBDKN Index
Switzerland	CHE	TRSW10T	May 2003	TDCHFSP	BISBCHN Index
Australia	AUS	TRAU10T	May 2003	TDAUDSP	BISBAUN Index
Slovenia	SVN	TRSI10T	Apr. 2007	—	—
Belgium	BEL	TRBG10T	May 2003	—	—
Norway	NOR	TRNW10T	May 2003	TDNOKSP	BISBNON Index
New Zealand	NZL	TRNZ10T	May 2003	TDNZDSP	BISBNZN Index
<b>Emerging market economies</b>					
Brazil	BRA	TRBR10T	May 2003	TDBRLSP	BISBBRN Index
Mexico	MEX	TRMX10T	May 2003	TDMXNSP	BISBMXN Index
South Africa	ZAF	TRSA10T	May 2003	TDZARSP	BISBZAN Index
Colombia	COL	TRCO10T	May 2003	TDCOPSP	BISBCON Index
Chile	CHL	TRCL10T	Mar. 2007	TDCLPSP	BISBCHN Index
India	IND	TRIN10T	May 2003	TDINRSP	BISBINN Index
China	CHN	TRCH10T	May 2003	TDCNYSP	BISBCNN Index
Hungary	HUN	TRHN10T	May 2003	TDHUFSP	BISBHUN Index
Poland	POL	TRPO10T	May 2003	TDPLNSP	BISBPLN Index
Indonesia	IDN	TRID10T	May 2003	TDIDRSP	BISBIDN Index
Malaysia	MYS	TRMY10T	May 2003	TDMYRSP	BISBMYN Index
Philippines	PHL	TRPH10T	May 2003	TDPHPSP	BISBPHN Index

Table 8: 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.

Table 9: Panel data of corporate bond yields and alternative assets

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

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

Variables	Acronym	Source	Description
<b>Fundamental</b>			
Capital Account Openness	OPEN	<a href="#">Chinn and Ito (2006)</a>	Degree of capital account openness
Market Debt Size	SIZE	Bank of International Settlement	Total outstanding debt (sovereign or corporate) in Q4 2024 (total debt securities) expressed in billion USD. Corporate includes financial. Sovereign corresponds to the general government
Sovereign Credit Rating	RATG	<a href="#">Kose et al. (2022)</a>	2003-2025 average foreign currency long-term sovereign debt ratings
Political Stability	POL	World Bank	World Governance Indicator measuring political stability and absence of violence
Local Currency Market	LC	<a href="#">Arslanalp and Tsuda (2014a,b)</a>	Share of local currency in total sovereign debt (total debt for emerging market; debt securities for advanced economies). 2000-2024 average. For Croatia, we apply the average sample
Net International Inv. Position	NIIP	<a href="#">Lane and Milesi-Ferretti (2018)</a>	Net International Investment Position (NIIP) as % of GDP in domestic currency
<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
Central Bank Holdings	CBH	<a href="#">Arslanalp and Tsuda (2014a,b)</a>	Share of total sovereign debt held by the domestic central bank

Table 10: Panel Data of Macroeconomic Cyclical Variables and Fundamentals

Variables	Mean	SD	Correlation													
			$C_1$	$C_2$	$C_3$	$C_4$	$C_5$	$\mathcal{P}_1$	OPEN	SIZE	LC	NIIP	RATG	POL		
$C_1$	0.04	0.13	1.00													
$C_2$	0.06	0.10	0.67	1.00												
$C_3$	0.03	0.07	0.88	0.52	1.00											
$C_4$	1.52	0.35	0.77	0.72	0.68	1.00										
$C_5$	-0.07	0.22	0.80	0.45	0.76	0.65	1.00									
$\mathcal{P}_1$	0.00	1.00	0.95	0.76	0.89	0.88	0.85	1.00								
OPEN	0.79	0.29	0.30	0.05	0.44	0.27	0.39	0.34	1.00							
SIZE	6.30	1.54	0.32	0.28	0.32	0.26	0.19	0.31	0.03	1.00						
LC	0.90	0.12	0.40	0.11	0.58	0.21	0.48	0.42	0.43	0.40	1.00					
NIIP	-0.09	0.48	0.48	0.37	0.44	0.37	0.31	0.46	0.15	0.13	0.25	1.00				
RATG	16.85	2.75	0.63	0.33	0.62	0.43	0.46	0.58	0.50	0.13	0.42	0.37	1.00			
POL	72.74	13.14	0.43	0.13	0.61	0.33	0.55	0.48	0.71	-0.04	0.57	0.23	0.51	1.00		

Table 11: Correlation Matrix of Hedging Criteria and Economic Fundamentals

*Notes:* "SD" denotes sample standard deviation.  $\mathcal{P}_1$  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 "POL" denotes political stability.

ISO	Group	$\mathcal{P}_1$	OPEN	RATG	SIZE	LC	NIIP	POL	Ranking		
									(1)	(2)	(3)
<b>Sovereign</b>											
SWE	Advanced	1.73	0.74	1.45	-0.98	-0.54	0.17	0.88	1	2	1
USA	Advanced	1.61	0.74	1.44	2.63	0.86	-0.59	-0.09	2	4	2
NOR	Advanced	1.60	0.74	1.51	-1.25	0.86	3.10	1.05	3	3	3
AUS	Advanced	1.52	0.14	1.39	0.01	0.78	-0.88	0.73	5	5	4
DEU	Euro area	1.47	0.74	1.51	0.97	0.70	0.83	0.57	6	6	5
GBR	Advanced	1.32	0.74	1.19	1.15	0.86	0.01	0.13	7	10	7
DNK	Advanced	1.27	0.74	1.48	-1.23	0.53	0.69	0.86	9	8	9
CAN	Advanced	1.26	0.74	1.43	0.79	-0.21	0.37	0.76	10	9	8
NZL	Advanced	1.16	0.74	1.13	-0.93	0.53	-1.15	1.23	11	11	11
NLD	Euro area	1.16	0.74	1.50	-0.16	0.78	0.54	0.68	12	13	11
CHE	Advanced	1.12	0.74	1.51	-0.90	0.86	2.37	1.08	13	14	13
JPN	Advanced	0.99	0.74	0.46	1.74	0.86	1.31	0.96	15	16	14
FIN	Euro area	0.95	0.74	1.36	-0.72	0.04	-0.04	1.16	16	15	16
AUT	Euro area	0.86	0.74	1.36	-0.23	0.28	0.14	0.82	17	17	17
FRA	Euro area	0.85	0.74	1.17	1.14	0.61	-0.12	-0.05	18	18	18
KOR	Advanced	0.65	-0.34	0.03	0.27	0.70	0.34	0.31	20	20	20
BEL	Euro area	0.48	0.69	0.81	0.06	0.70	1.13	0.36	21	21	21
<b>Corporate</b>											
NOR	Advanced	1.58	0.74	0.05	-0.19	0.86	3.10	1.05	4	1	6
AUS	Advanced	1.32	0.14	0.05	0.77	0.78	-0.88	0.73	8	7	10
SWE	Advanced	1.04	0.74	0.05	0.16	-0.54	0.17	0.88	14	12	14
JPN	Advanced	0.73	0.74	0.05	1.04	0.86	1.31	0.96	19	19	19
CAN	Advanced	0.27	0.74	0.05	0.97	-0.21	0.37	0.76	22	22	22
DNK	Advanced	0.03	0.74	0.05	0.09	0.53	0.69	0.86	23	24	23
KOR	Advanced	-0.03	-0.34	0.05	0.71	0.70	0.34	0.31	24	23	24
NLD	Euro area	-0.33	0.74	0.05	0.83	0.78	0.54	0.68	25	25	26
USA	Advanced	-0.34	0.74	0.05	2.52	0.86	-0.59	-0.09	26	26	27
CHE	Advanced	-0.35	0.74	0.05	0.15	0.86	2.37	1.08	27	28	25
DEU	Euro area	-0.50	0.74	0.05	0.85	0.70	0.83	0.57	28	27	29
BEL	Euro area	-0.54	0.69	0.05	-0.31	0.70	1.13	0.36	29	29	28

Table 12: Clustering: Global Safe Assets

*Notes:* (1) Rank based on the first principal component of the safe haven scores; (2) is based on the arithmetic average; (3) mean of the ranks.

ISO	Group	$\mathcal{P}_1$	OPEN	RATG	SIZE	LC	NIIP	POL	Ranking		
									(1)	(2)	(3)
<b>Sovereign</b>											
CHL	Emerging	1.51	-0.07	-0.22	-0.98	-1.52	-0.17	0.22	1	1	1
IRL	Advanced	0.09	0.74	0.40	-0.83	0.86	-1.86	0.85	3	3	3
ESP	Advanced	-0.03	0.74	0.11	0.67	0.78	-1.31	-0.26	4	6	5
CZE	Advanced	-0.11	0.61	-0.04	-0.91	-0.21	-0.36	0.80	6	5	4
SVK	Advanced	-0.37	-0.65	-0.44	-1.31	0.61	-0.97	0.59	7	7	7
PRT	Advanced	-0.51	0.74	-0.69	-0.69	0.70	-1.71	0.74	8	10	9
SVN	Advanced	-0.63	-0.08	-0.14	-1.66	0.28	-0.24	0.79	10	9	11
ITA	Advanced	-0.65	0.74	-0.48	1.04	0.70	-0.04	0.10	11	11	10
GRC	Advanced	-0.74	0.52	-2.17	-1.01	0.78	-2.11	-0.21	12	17	11
HRV	Advanced	-0.94	-0.41	-1.84	-1.73	-0.04	-1.10	0.33	17	16	17
HUN	Emerging	-1.36	0.57	-1.35	-0.95	-1.69	-1.30	0.51	19	19	19
<b>Corporate</b>											
NZL	Advanced	0.39	0.74	0.05	-0.93	0.53	-1.15	1.23	2	2	2
CZE	Advanced	-0.10	0.61	0.05	-0.57	-0.21	-0.36	0.80	5	4	6
CHL	Emerging	-0.57	-0.07	0.05	-0.67	-1.52	-0.17	0.22	9	8	8
AUT	Advanced	-0.78	0.74	0.05	-0.41	0.28	0.14	0.82	13	13	11
FRA	Advanced	-0.80	0.74	0.05	1.11	0.61	-0.12	-0.05	14	12	14
GBR	Advanced	-0.87	0.74	0.05	1.08	0.86	0.01	0.13	15	14	16
ESP	Advanced	-0.91	0.74	0.05	0.24	0.78	-1.31	-0.26	16	15	15
ITA	Advanced	-1.15	0.74	0.05	0.34	0.70	-0.04	0.10	18	18	18

Table 13: Clustering: Credit-sensitive

*Notes:* (1) Rank based on the first principal component of the safe haven scores; (2) is based on the arithmetic average; (3) mean of the ranks.

ISO	Group	$\mathcal{P}_1$	OPEN	RATG	SIZE	LC	NIIP	POL	Ranking		
									(1)	(2)	(3)
<b>Sovereign</b>											
CHN	Emerging	0.89	-2.15	-0.12	1.98	0.53	0.55	-1.06	1	1	2
IND	Emerging	0.85	-2.15	-1.89	0.84	0.28	-0.08	-1.67	2	2	1
MYS	Emerging	0.02	-1.37	-0.80	-0.43	-0.70	0.10	-0.32	4	4	3
ISR	Advanced	-0.06	0.59	-0.19	-0.51	-0.78	0.47	-1.55	7	7	7
POL	Emerging	-0.33	-0.92	-0.67	-0.31	-2.51	-0.83	0.41	8	8	8
BRA	Emerging	-0.42	-1.58	-2.43	0.69	0.04	-0.57	-0.87	9	9	9
MEX	Emerging	-0.78	-0.36	-1.32	0.25	-1.11	-0.61	-1.37	11	11	12
PHL	Emerging	-0.86	-1.33	-2.01	-0.54	-1.94	-0.24	-2.10	12	12	12
ZAF	Emerging	-0.89	-2.15	-1.66	-0.40	-0.21	0.16	-0.86	13	13	11
COL	Emerging	-1.06	-1.37	-1.96	-0.72	-1.85	-0.54	-2.26	15	15	15
IDN	Emerging	-1.19	-0.82	-2.41	-0.09	-2.68	-0.56	-1.67	16	16	16
<b>Corporate</b>											
MYS	Emerging	0.07	-1.37	0.05	-0.55	-0.70	0.10	-0.32	3	3	3
CHN	Emerging	0.01	-2.15	0.05	2.08	0.53	0.55	-1.06	5	6	5
ISR	Advanced	-0.03	0.59	0.05	-0.89	-0.78	0.47	-1.55	6	5	5
IND	Emerging	-0.70	-2.15	0.05	0.84	0.28	-0.08	-1.67	10	10	10
MEX	Emerging	-0.94	-0.36	0.05	-0.34	-1.11	-0.61	-1.37	14	14	14
PHL	Emerging	-1.44	-1.33	0.05	-1.66	-1.94	-0.24	-2.10	17	17	17
ZAF	Emerging	-1.66	-2.15	0.05	-0.97	-0.21	0.16	-0.86	18	18	18
BRA	Emerging	-1.69	-1.58	0.05	0.50	0.04	-0.57	-0.87	19	19	19
COL	Emerging	-1.85	-1.37	0.05	-0.72	-1.85	-0.54	-2.26	20	20	20
IDN	Emerging	-2.30	-0.82	0.05	-0.86	-2.68	-0.56	-1.67	21	21	21

Table 14: Clustering: Emerging Markets

*Notes:* (1) Rank based on the first principal component of the safe haven scores; (2) is based on the arithmetic average; (3) mean of the ranks.

Risk	# clusters	Within U.S. Treasury Cluster							
		$N$	$\mathcal{P}_1$	OPEN	SIZE	LC	NIIP	RATG	POL
Risk <sup>90th</sup>	3	29	0.79 (0.72)	0.62 (0.31)	0.34 (1.00)	0.55 (0.42)	0.61 (1.08)	0.74 (0.66)	0.68 (0.38)
Risk <sup>85th</sup>	3	31	0.64 (0.82)	0.63 (0.30)	0.46 (0.96)	0.57 (0.41)	0.60 (1.02)	0.64 (0.69)	0.60 (0.39)
Risk <sup>95th</sup>	3	31	0.57 (0.81)	0.63 (0.30)	0.46 (0.96)	0.57 (0.41)	0.60 (1.02)	0.64 (0.69)	0.60 (0.39)
Risk <sub>G</sub> <sup>90th</sup>	3	25	1.03 (0.53)	0.61 (0.30)	0.17 (0.99)	0.43 (0.61)	0.61 (1.15)	0.84 (0.67)	0.72 (0.37)
Risk <sub>M</sub> <sup>90th</sup>	3	31	0.63 (0.83)	0.63 (0.30)	0.46 (0.96)	0.57 (0.41)	0.60 (1.02)	0.64 (0.69)	0.60 (0.39)
VIX <sup>90th</sup>	3	31	0.67 (0.88)	0.63 (0.30)	0.46 (0.96)	0.57 (0.41)	0.60 (1.02)	0.64 (0.69)	0.60 (0.39)
VIX <sub>E</sub> <sup>90th</sup>	3	30	0.71 (0.68)	0.62 (0.30)	0.44 (0.97)	0.57 (0.42)	0.62 (1.03)	0.68 (0.67)	0.61 (0.39)

Table 15: Robustness of Clustering Based on Alternative Risk-Off Measurement

*Notes:* The table reports means and standard deviations (in parentheses), together with the total number of clusters and the number of assets included in the U.S. Treasury cluster ( $N$ ).  $\mathcal{P}_1$  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 "POL" denotes political stability. Risk<sub>M</sub><sup>90th</sup> denotes a risk-off dummy 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 dummy constructed from a version of the RORO index purged of its currency and gold components. VIX<sub>E</sub><sup>90th</sup> is a dummy based on a sample starting in 1990.

	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>
<i>C</i> <sub>1</sub>						
Constant	-0.101 (0.071)	-0.108 (0.073)	-0.017 (0.069)	-0.102 (0.070)	-0.086 (0.071)	-0.062 (0.070)
Risk	1.662*** (0.213)	1.229*** (0.186)	1.824*** (0.299)	1.670*** (0.213)	1.561*** (0.216)	1.575*** (0.233)
Post2020	-0.119 (0.135)	-0.088 (0.140)	-0.237 (0.133)	-0.110 (0.135)	-0.137 (0.136)	-0.134 (0.138)
Risk × Post2020	-1.754*** (0.460)	-1.449*** (0.367)	-1.237* (0.616)	-1.865*** (0.460)	-1.609*** (0.444)	-1.817*** (0.403)
<i>C</i> <sub>2</sub>						
Constant	1.348*** (0.057)	1.332*** (0.060)	1.397*** (0.054)	1.348*** (0.057)	1.355*** (0.057)	1.399*** (0.058)
Risk	0.922*** (0.139)	0.820*** (0.130)	1.306*** (0.188)	0.922*** (0.139)	0.928*** (0.142)	0.761*** (0.155)
Post2020	0.209 (0.113)	0.245* (0.119)	0.170 (0.111)	0.227* (0.114)	0.201 (0.114)	0.199 (0.118)
Risk × Post2020	0.851* (0.409)	-0.156 (0.303)	0.782 (0.470)	0.568 (0.411)	0.532 (0.380)	-0.122 (0.342)
<i>C</i> <sub>3</sub>						
Constant	0.497*** (0.018)	0.497*** (0.018)	0.517*** (0.017)	0.497*** (0.018)	0.501*** (0.018)	0.504*** (0.018)
Risk	0.333*** (0.054)	0.238*** (0.047)	0.310*** (0.075)	0.333*** (0.054)	0.304*** (0.054)	0.316*** (0.059)
Post2020	-0.042 (0.034)	-0.049 (0.035)	-0.072* (0.034)	-0.042 (0.034)	-0.048 (0.034)	-0.049 (0.035)
Risk × Post2020	-0.428*** (0.116)	-0.242** (0.092)	-0.254 (0.155)	-0.428*** (0.116)	-0.363** (0.112)	-0.382*** (0.101)
<i>C</i> <sub>4</sub>						
Constant	2.660*** (0.106)	2.634*** (0.118)	2.824*** (0.110)	2.660*** (0.111)	2.667*** (0.131)	2.782*** (0.167)
Risk	1.797*** (0.514)	1.635*** (0.366)	2.150*** (0.509)	1.797*** (0.481)	1.789*** (0.508)	2.359*** (0.584)
Post2020	0.742* (0.306)	0.779* (0.333)	0.578 (0.320)	0.754* (0.359)	0.734* (0.292)	0.861* (0.346)
Risk × Post2020	0.279 (1.026)	-0.788 (0.983)	0.208 (0.826)	-0.949 (0.961)	0.286 (0.979)	-1.930 (1.050)
<i>C</i> <sub>5</sub>						
Constant	0.166 (0.100)	0.165* (0.083)	0.120 (0.149)	0.175 (0.099)	0.169 (0.101)	0.255* (0.103)
Risk	-0.091 (0.102)	-0.221* (0.087)	-0.024 (0.150)	-0.096 (0.101)	-0.098 (0.104)	-0.286** (0.108)
Post2020	-0.782*** (0.230)	-0.619*** (0.165)	-0.525 (0.333)	-0.774*** (0.223)	-0.721** (0.218)	-0.775*** (0.176)
Risk × Post2020	0.016 (0.220)	0.269 (0.154)	-0.025 (0.337)	0.182 (0.213)	0.013 (0.210)	0.214 (0.172)

Table 16: UST robustness

*Notes:* Results are based on individual OLS regressions. For criterion *C*<sub>4</sub>, quantile regressions are estimated using a likelihood-based method, and bootstrapped p-values are reported. Risk<sub>M</sub><sup>90th</sup> denotes a risk-off dummy 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 dummy constructed from a version of the RORO index purged of its currency and gold components. \**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>
<i>C</i> <sub>1</sub>						
Constant	-0.200** (0.069)	-0.261*** (0.070)	-0.107 (0.068)	-0.198** (0.069)	-0.189** (0.069)	-0.069 (0.071)
Risk	1.852*** (0.208)	1.712*** (0.180)	2.029*** (0.294)	1.833*** (0.209)	1.787*** (0.211)	0.786*** (0.236)
Post2020	0.043 (0.132)	0.029 (0.136)	0.018 (0.131)	0.037 (0.132)	0.025 (0.133)	-0.008 (0.140)
Risk × Post2020	0.497 (0.449)	0.107 (0.355)	0.620 (0.606)	0.564 (0.449)	0.387 (0.434)	0.038 (0.407)
<i>C</i> <sub>2</sub>						
Constant	1.453*** (0.067)	1.416*** (0.070)	1.514*** (0.063)	1.452*** (0.067)	1.459*** (0.067)	1.548*** (0.067)
Risk	1.094*** (0.160)	0.980*** (0.144)	1.606*** (0.220)	1.115*** (0.160)	1.119*** (0.164)	0.906*** (0.203)
Post2020	0.117 (0.129)	0.105 (0.135)	0.082 (0.122)	0.109 (0.128)	0.102 (0.129)	0.125 (0.134)
Risk × Post2020	0.041 (0.333)	-0.037 (0.284)	0.206 (0.443)	0.082 (0.332)	-0.030 (0.325)	-0.594 (0.340)
<i>C</i> <sub>3</sub>						
Constant	0.442*** (0.018)	0.432*** (0.018)	0.464*** (0.017)	0.443*** (0.018)	0.446*** (0.018)	0.469*** (0.018)
Risk	0.335*** (0.053)	0.303*** (0.046)	0.275*** (0.075)	0.323*** (0.054)	0.304*** (0.054)	0.108 (0.059)
Post2020	0.002 (0.034)	0.001 (0.035)	-0.002 (0.034)	0.001 (0.034)	-0.004 (0.034)	-0.020 (0.035)
Risk × Post2020	0.061 (0.115)	-0.002 (0.091)	0.049 (0.155)	0.073 (0.115)	0.075 (0.111)	0.102 (0.102)
<i>C</i> <sub>4</sub>						
Constant	2.703*** (0.189)	2.592*** (0.151)	3.078*** (0.191)	2.703*** (0.181)	2.773*** (0.196)	3.079*** (0.199)
Risk	3.041*** (0.538)	2.703*** (0.374)	2.827*** (0.419)	3.041*** (0.521)	2.592*** (0.366)	2.685** (0.986)
Post2020	0.190 (0.366)	0.222 (0.357)	-0.022 (0.293)	0.190 (0.361)	0.079 (0.368)	0.053 (0.327)
Risk × Post2020	0.040 (0.957)	-0.182 (0.991)	0.483 (0.758)	0.040 (0.894)	0.529 (0.954)	-2.117 (1.555)
<i>C</i> <sub>5</sub>						
Constant	-0.012 (0.097)	-0.004 (0.083)	0.006 (0.132)	-0.024 (0.096)	-0.007 (0.100)	-0.053 (0.096)
Risk	-0.369*** (0.099)	-0.328*** (0.087)	-0.483*** (0.132)	-0.377*** (0.098)	-0.326** (0.103)	-0.574*** (0.100)
Post2020	0.036 (0.223)	0.013 (0.165)	-0.081 (0.294)	0.089 (0.217)	0.034 (0.216)	0.148 (0.164)
Equity × Post2020	-0.052 (0.214)	-0.019 (0.154)	-0.129 (0.297)	-0.070 (0.207)	0.008 (0.208)	0.035 (0.160)

Table 17: USD robustness

*Notes:* Results are based on individual OLS regressions. For criterion *C*<sub>4</sub>, quantile regressions are estimated using a likelihood-based method, and bootstrapped p-values are reported. Risk<sub>M</sub><sup>90th</sup> denotes a risk-off dummy 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 dummy constructed from a version of the RORO index purged of its currency and gold components. \**p* < 0.10, \*\**p* < 0.05, \*\*\**p* < 0.01.

	10y	5y	2y	3m	OIS	TP	Real
<i>C</i> <sub>1</sub>							
Constant	-0.098 (0.071)	-0.125 (0.070)	-0.117 (0.071)	-0.083 (0.072)	-0.012 (0.100)	-0.001 (0.072)	0.009 (0.071)
Risk	1.663*** (0.213)	1.762*** (0.213)	1.684*** (0.215)	1.339*** (0.218)	1.423*** (0.315)	0.728*** (0.218)	0.578** (0.215)
Post2020	-0.119 (0.135)	-0.052 (0.135)	-0.051 (0.136)	-0.129 (0.138)	-0.176 (0.154)	-0.200 (0.138)	-0.095 (0.136)
Risk × Post2020	-1.754*** (0.460)	-1.784*** (0.460)	-1.708*** (0.463)	-0.914 (0.470)	-1.429** (0.519)	-0.985* (0.470)	-2.017*** (0.464)
<i>C</i> <sub>2</sub>							
Constant	1.352*** (0.057)	1.310*** (0.061)	1.158*** (0.073)	0.782*** (0.089)	1.219*** (0.081)	1.286*** (0.057)	1.306*** (0.054)
Risk	0.922*** (0.139)	1.005*** (0.146)	1.134*** (0.179)	1.552*** (0.249)	0.858*** (0.206)	0.863*** (0.155)	0.702*** (0.151)
Post2020	0.209 (0.113)	0.114 (0.116)	0.232 (0.135)	0.013 (0.163)	0.516*** (0.129)	0.203 (0.115)	0.206* (0.104)
Risk × Post2020	0.850* (0.409)	0.785 (0.411)	1.120* (0.471)	1.627** (0.616)	0.716 (0.430)	-0.818* (0.383)	0.326 (0.445)
<i>C</i> <sub>3</sub>							
Constant	0.497*** (0.018)	0.489*** (0.018)	0.476*** (0.018)	0.536*** (0.018)	0.519*** (0.025)	0.542*** (0.018)	0.532*** (0.018)
Risk	0.333*** (0.054)	0.341*** (0.054)	0.301*** (0.054)	0.113* (0.054)	0.322*** (0.078)	0.149** (0.054)	0.096 (0.054)
Post2020	-0.042 (0.034)	0.004 (0.034)	0.041 (0.034)	0.079* (0.034)	-0.064 (0.038)	-0.077* (0.034)	-0.025 (0.034)
Risk × Post2020	-0.428*** (0.116)	-0.434*** (0.116)	-0.378** (0.116)	-0.288* (0.116)	-0.376** (0.129)	-0.134 (0.117)	-0.323** (0.117)
<i>C</i> <sub>4</sub>							
Constant	2.663*** (0.113)	2.642*** (0.137)	2.687*** (0.253)	2.002*** (0.233)	2.597*** (0.132)	2.650*** (0.091)	2.782*** (0.229)
Risk	1.795*** (0.475)	2.837*** (0.676)	3.139*** (0.621)	8.219*** (1.413)	1.897** (0.718)	2.533*** (0.484)	1.782*** (0.495)
Post2020	0.743* (0.309)	0.690* (0.301)	0.931 (0.479)	0.359 (0.406)	1.187** (0.365)	0.485* (0.241)	0.139 (0.348)
Risk × Post2020	0.275 (1.065)	-0.866 (0.945)	0.166 (1.076)	1.234 (3.403)	-0.027 (1.008)	-2.946*** (0.795)	0.038 (1.377)
<i>C</i> <sub>5</sub>							
Constant	0.163 (0.099)	0.164 (0.099)	0.145 (0.098)	0.075 (0.100)	0.309 (0.169)	0.080 (0.102)	0.138 (0.096)
Equity	-0.079 (0.101)	-0.174 (0.100)	-0.204* (0.100)	-0.185 (0.101)	-0.216 (0.198)	0.144 (0.104)	0.236* (0.098)
Post2020	-0.786*** (0.225)	-0.782*** (0.223)	-0.737** (0.223)	-0.467* (0.225)	-0.751** (0.264)	-0.417 (0.231)	-0.634** (0.218)
Equity × Post2020	-0.035 (0.220)	-0.010 (0.218)	-0.145 (0.217)	-0.350 (0.220)	0.013 (0.278)	-0.108 (0.226)	0.079 (0.213)

Table 18: Regression Coefficients for Selected Assets

*Notes:* Results are based on individual OLS regressions. For criterion  $C_4$ , quantile regressions are estimated using a likelihood-based method, and bootstrapped p-values are reported. "10y", "5y", "2y", and "3m" denote U.S. Treasury securities with maturities of 10 years, 5 years, 2 years, and 3 months, respectively. "OIS" refers to the 10-year U.S. overnight index swap rate; "TP" denotes the 10-year U.S. term premium; and "Real" refers to the yield on 10-year U.S. Treasury Inflation-Protected Securities (TIPS).  $p < 0.10$ ,  $p < 0.05$ ,  $p < 0.01$ .

	$C_1$			$C_2$			$C_3$			$C_4$			$C_5$		
	Infl.	Debt	CBH	Infl.	Debt	CBH	Infl.	Debt	CBH	Infl.	Debt	CBH	Infl.	Debt	CBH
<b>Germany</b>															
Constant	0.01 (0.10)	-1.25** (0.56)	-0.04 (0.07)	1.02*** (0.07)	2.48*** (0.40)	1.32*** (0.05)	0.54*** (0.02)	0.07 (0.16)	0.54*** (0.02)	1.76*** (0.16)	4.76*** (1.13)	2.51*** (0.10)	0.56*** (0.15)	-1.82 (1.41)	0.24*** (0.09)
Risk	2.36*** (0.39)	0.04 (2.94)	1.76*** (0.23)	0.96*** (0.24)	2.86** (1.33)	1.03*** (0.16)	0.38*** (0.07)	0.05 (0.57)	0.30*** (0.05)	2.98*** (0.81)	5.14 (4.49)	2.64*** (0.58)	-0.52*** (0.15)	2.70 (1.65)	-0.12 (0.09)
$Z$	-0.07 (0.05)	0.02** (0.01)	-1.55* (0.81)	0.18*** (0.04)	-0.02*** (0.01)	0.89 (0.67)	-0.02 (0.01)	0.01*** (0.00)	-0.45** (0.20)	0.44*** (0.10)	-0.04** (0.02)	2.93 (1.81)	-0.24*** (0.07)	0.03 (0.02)	-4.54*** (1.46)
Risk $\times$ $Z$	-0.54*** (0.21)	0.02 (0.05)	-10.14*** (3.88)	0.05 (0.11)	-0.03 (0.02)	-0.35 (2.01)	-0.08*** (0.03)	0.00 (0.01)	-1.61** (0.65)	-0.60 (0.39)	-0.06 (0.07)	-11.31*** (4.06)	0.22*** (0.07)	-0.05* (0.03)	1.61 (1.57)
$R^2$	6.20	4.10	6.10	16.20	12.10	10.60	2.70	2.50	3.30	—	—	—	22.00	4.30	13.50
$N$	1187	1188	1147	628	628	612	1187	1188	1147	1187	1188	1147	120	120	118
<b>United Kingdom</b>															
Constant	0.01 (0.12)	-0.10 (0.16)	-0.11 (0.09)	0.84*** (0.09)	1.55*** (0.14)	1.46*** (0.08)	0.54*** (0.03)	0.45*** (0.05)	0.47*** (0.02)	1.85*** (0.24)	3.15*** (0.34)	2.98*** (0.19)	0.48** (0.18)	1.01*** (0.22)	0.37*** (0.10)
Risk	2.09*** (0.48)	3.62*** (0.56)	2.09*** (0.26)	1.32*** (0.29)	1.05** (0.44)	0.88*** (0.22)	0.29*** (0.09)	0.74*** (0.11)	0.42*** (0.05)	2.01*** (0.76)	4.49*** (1.26)	2.53*** (0.66)	-0.48** (0.20)	-0.35 (0.24)	-0.11 (0.11)
$Z$	-0.05 (0.05)	-0.00 (0.00)	-0.18 (0.52)	0.20*** (0.04)	-0.00 (0.00)	-0.69 (0.43)	-0.01 (0.01)	0.00 (0.00)	0.25* (0.14)	0.37*** (0.08)	-0.01 (0.00)	-1.28 (1.03)	-0.16** (0.07)	-0.02*** (0.00)	-3.14*** (0.79)
Risk $\times$ $Z$	-0.33* (0.19)	-0.04*** (0.01)	-7.41*** (1.95)	-0.18* (0.11)	-0.00 (0.01)	-0.69 (1.27)	-0.02 (0.03)	-0.01*** (0.00)	-1.53*** (0.37)	-0.02 (0.35)	-0.05*** (0.02)	-8.04** (3.47)	0.13** (0.07)	0.01 (0.00)	1.20 (0.85)
$R^2$	4.50	5.20	5.40	14.60	7.10	7.00	2.20	3.10	3.30	—	—	—	11.70	14.70	14.40
$N$	1187	1188	1147	627	627	609	1187	1188	1147	1187	1188	1147	120	120	118

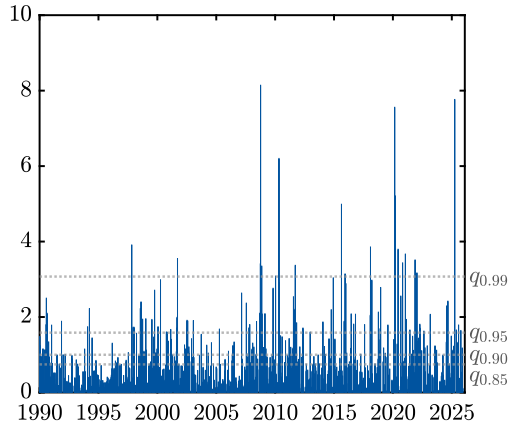
Table 19: Cyclical Drivers of Safe-Haven Behavior: Germany and United Kingdom

*Notes:* OLS regressions for  $C_1$ ,  $C_2$ ,  $C_3$ ; quantile regression ( $\tau = 0.95$ ) for  $C_4$ ; OLS regression for  $C_5$ . The dependent variable is  $M_t$  throughout. For  $C_1$ – $C_4$ , the main regressor is the risk-off dummy that equals 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 cyclical variable  $Z$  corresponds to the year-on-year inflation rate (Infl.), the government gross debt-to-GDP ratio (Debt), or the share of sovereign debt held by the national central bank (CBH), all lagged one period. Heteroskedasticity-robust standard errors (HC1) in parentheses for OLS; bootstrapped standard errors for quantile regression. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

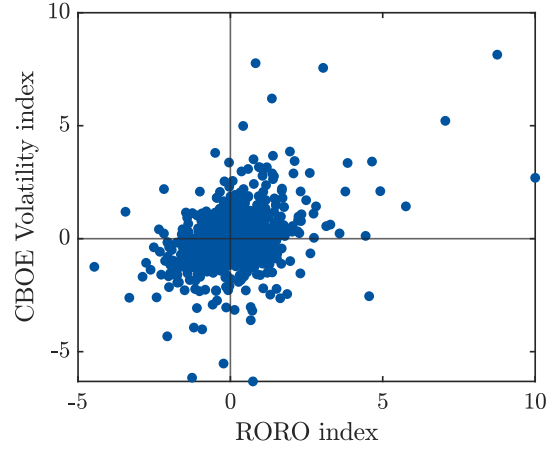
	$C_1$			$C_2$			$C_3$			$C_4$			$C_5$		
	Infl.	Debt	CBH	Infl.	Debt	CBH	Infl.	Debt	CBH	Infl.	Debt	CBH	Infl.	Debt	CBH
<b>Sweden</b>															
Constant	-0.10 (0.07)	-1.13* (0.64)	-0.09 (0.07)	1.18*** (0.06)	1.58*** (0.47)	1.38*** (0.05)	0.51*** (0.02)	0.13 (0.18)	0.51*** (0.02)	2.40*** (0.12)	4.62*** (1.14)	2.73*** (0.14)	0.21 (0.14)	2.72** (1.33)	0.23** (0.09)
Risk	1.70*** (0.32)	7.76** (3.21)	1.89*** (0.23)	0.93*** (0.21)	8.23*** (2.49)	1.05*** (0.18)	0.27*** (0.06)	0.88 (0.74)	0.32*** (0.05)	1.58*** (0.57)	12.76*** (4.75)	2.41*** (0.53)	-0.36** (0.17)	-4.62*** (1.60)	-0.26*** (0.08)
$Z$	-0.03 (0.03)	0.02 (0.01)	-0.98 (0.74)	0.11*** (0.03)	-0.00 (0.01)	0.05 (0.62)	-0.01** (0.01)	0.01** (0.00)	-0.29 (0.19)	0.19*** (0.06)	-0.04* (0.02)	-0.04 (1.92)	-0.08 (0.06)	-0.06** (0.03)	-3.94*** (1.24)
Risk $\times Z$	-0.12 (0.15)	-0.13** (0.06)	-8.83*** (3.17)	0.07 (0.09)	-0.14*** (0.05)	0.37 (2.04)	-0.02 (0.02)	-0.01 (0.02)	-1.67*** (0.57)	0.15 (0.22)	-0.22** (0.09)	-6.15 (3.89)	0.09 (0.07)	0.09*** (0.03)	2.63* (1.34)
$R^2$	5.20	5.20	6.60	15.60	12.10	10.30	2.50	2.40	3.30	—	—	—	6.10	6.20	17.60
$N$	1175	1188	1147	602	610	594	1175	1188	1147	1175	1188	1147	119	120	118
<b>Japan</b>															
Constant	-0.01 (0.07)	0.02 (0.41)	0.16 (0.13)	1.22*** (0.05)	3.14*** (0.29)	1.67*** (0.10)	0.56*** (0.02)	0.60*** (0.09)	0.62*** (0.03)	2.82*** (0.16)	6.71*** (0.86)	3.80*** (0.31)	0.06 (0.10)	1.71*** (0.53)	0.38** (0.16)
Risk	1.23*** (0.19)	4.19*** (1.07)	1.64*** (0.33)	0.62*** (0.16)	-0.24 (0.96)	0.20 (0.29)	0.22*** (0.05)	1.01*** (0.23)	0.38*** (0.07)	1.37*** (0.45)	-6.66* (3.82)	-0.36 (0.67)	0.01 (0.10)	0.60 (0.56)	0.19 (0.15)
$Z$	-0.15*** (0.05)	-0.00 (0.00)	-0.96** (0.42)	-0.03 (0.04)	-0.01*** (0.00)	-2.07*** (0.34)	-0.04*** (0.01)	-0.00 (0.00)	-0.34*** (0.11)	-0.16 (0.14)	-0.02*** (0.01)	-4.71*** (1.02)	-0.05 (0.11)	-0.01*** (0.00)	-1.76** (0.72)
Risk $\times Z$	0.02 (0.20)	-0.02*** (0.01)	-2.15 (1.48)	0.10 (0.19)	0.01 (0.01)	2.10 (1.61)	-0.01 (0.04)	-0.00*** (0.00)	-0.81** (0.32)	0.64 (0.40)	0.05** (0.02)	9.44** (4.36)	0.08 (0.10)	-0.00 (0.00)	-0.58 (0.79)
$R^2$	4.60	4.40	4.60	4.30	11.40	8.70	2.90	2.70	3.60	—	—	—	1.70	9.50	6.60
$N$	1170	1188	1147	649	653	641	1170	1188	1147	1170	1188	1147	118	120	118

Table 20: Cyclical Drivers of Safe-Haven Behavior: Sweden and Japan

*Notes:* OLS regressions for  $C_1$ ,  $C_2$ ,  $C_3$ ; quantile regression ( $\tau = 0.95$ ) for  $C_4$ ; OLS regression for  $C_5$ . The dependent variable is  $M_t$  throughout. For  $C_1$ – $C_4$ , the main regressor is the risk-off dummy that equals one when the 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 cyclical variable  $Z$  corresponds to the year-on-year inflation rate (Infl.), the government gross debt-to-GDP ratio (Debt), or the share of sovereign debt held by the national central bank (CBH), all lagged one period. Heteroskedasticity-robust standard errors (HC1) in parentheses for OLS; bootstrapped standard errors for quantile regression. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .



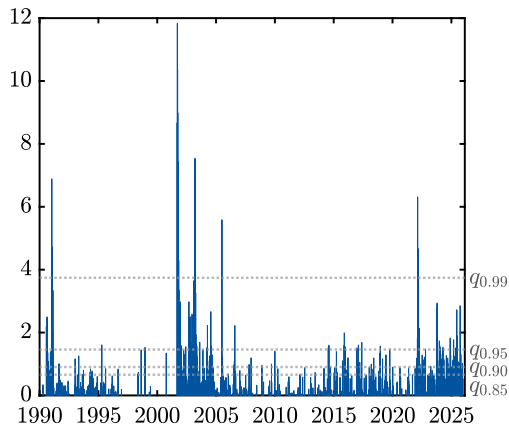
Identification of Acute Risk-off Periods



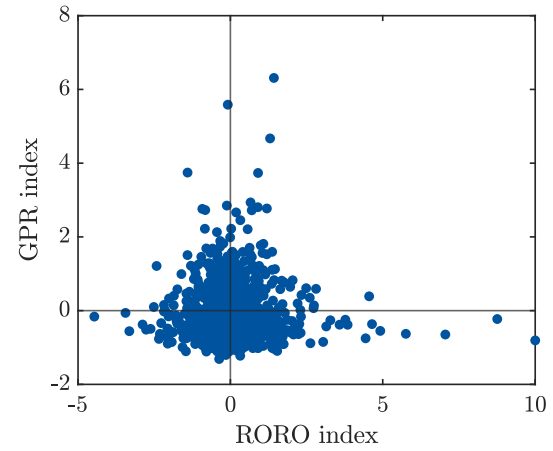
Correlation with RORO Index

Figure 9: 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 3.37, 1.67, 1.05 and 0.78, 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 10: 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, 0.89 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.

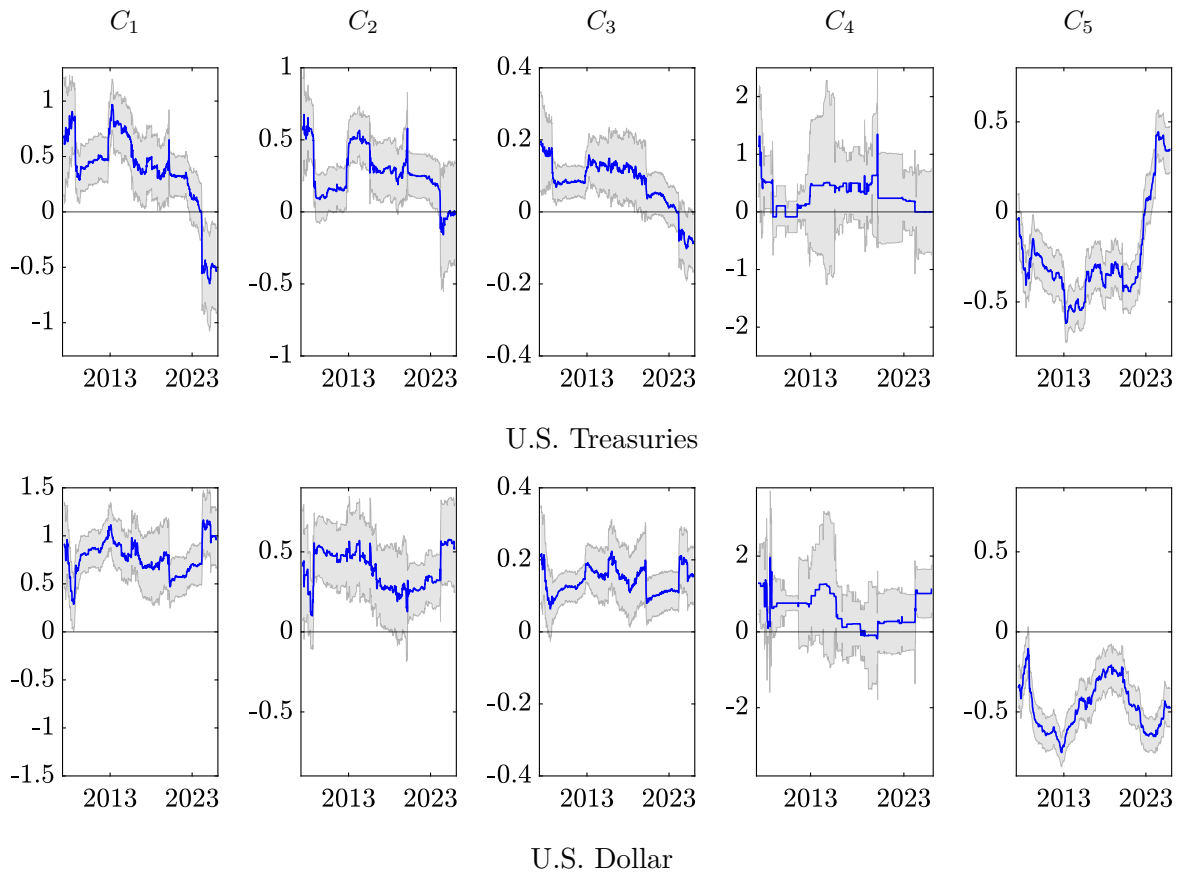


Figure 11: Rolling Coefficient for U.S. Treasuries and U.S. Dollar on a 4-Year Rolling Window

*Notes:* OLS regressions on a 4-year windows. 95% confidence interval reported. Quantile regressions for criterion  $C_4$  are estimated using a likelihood-based method, with bootstrapped standard errors reported.

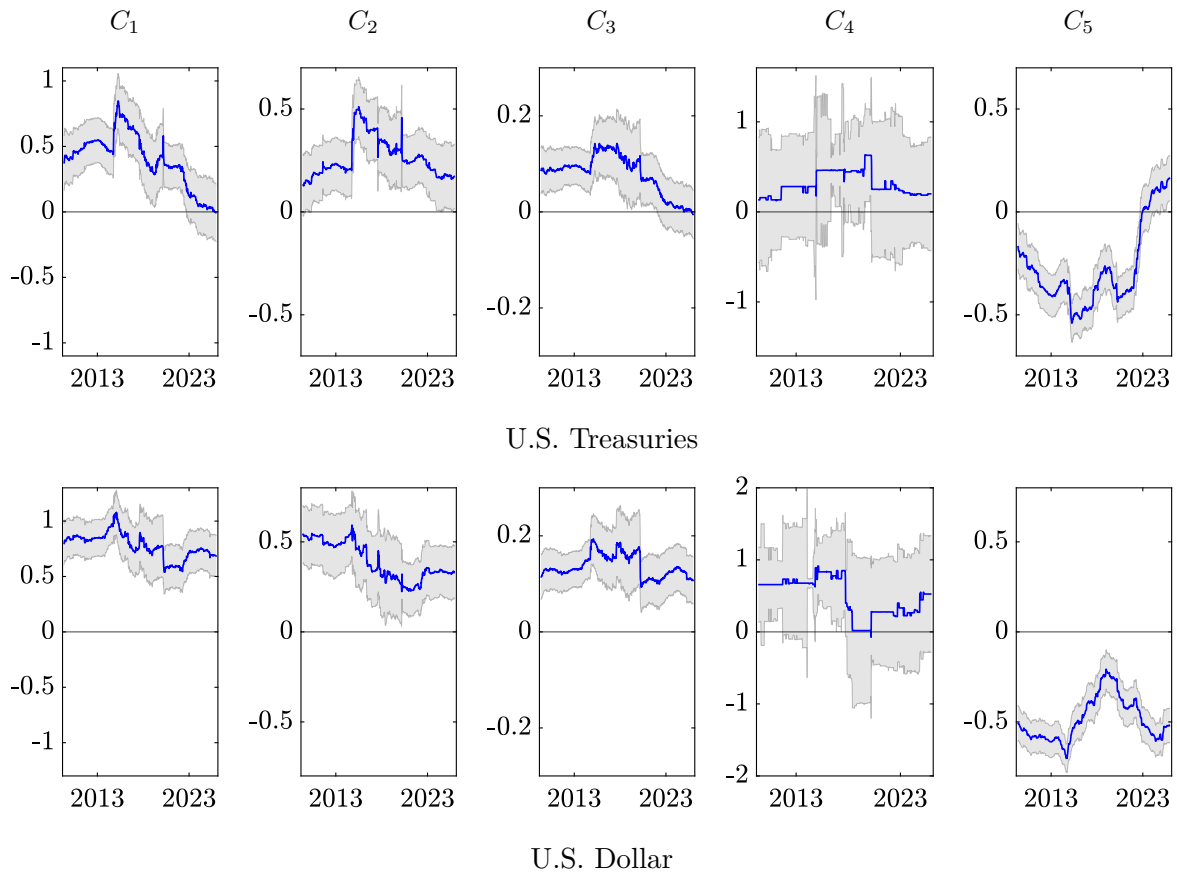


Figure 12: Rolling Coefficient for U.S. Treasuries and U.S. Dollar on a 6-Year Rolling Window

*Notes:* OLS regressions on a 6-year windows. 95% confidence interval reported. Quantile regressions for criterion  $C_4$  are estimated using a likelihood-based method, with bootstrapped standard errors reported.

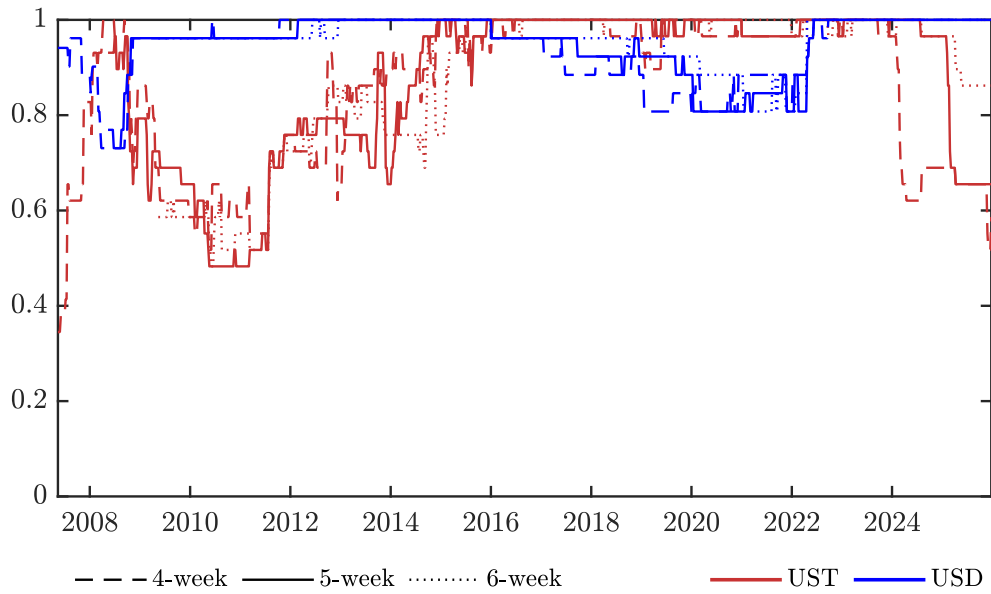


Figure 13: Relative Safe-Haven Behavior of U.S. Treasuries and the U.S. Dollar at Various Windows

*Notes:* U.S. Treasuries (UST) are ranked relative to global safe assets detailed in 12; the U.S. dollar (USD) is ranked relative to other currencies. Higher values correspond to higher rankings; the index is bounded between 0 and 1.



Figure 14: 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 12; 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.