How do Global Portfolio Investors Hedge Currency Risk?*

Alex Cheema-Fox & Robin Greenwood

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Abstract

We study how institutional investors hedge foreign exchange risk using more than 25 years of monthly portfolio data from a global custodian, matching asset holdings with FX forward positions for U.S.- and non-U.S.-based investors. Fixed-income investors hedge more than equity investors, non-USD investors hedge more than USD investors, and hedging has risen markedly since 2008. Many investors appear to target and rebalance toward stable hedge ratios. Hedge ratios are related to carry, volatility, and FX momentum, but they are far from risk-minimizing benchmarks. Overall, hedging has increased across domiciles and asset classes, with important implications for currency demand and portfolio management.

* Cheema-Fox is at State Street Associates; Greenwood is at Harvard Business School and an academic affiliate of State Street Associates. Additional disclosures are here: https://www.hbs.edu/ris/Profile%20Files/Outside%20Activities%20RG_ed358270-4d82-4c9e-8b46-f1f847ab381a.pdf. . The views expressed in this material are the views of Author(s) are provided "as-is" at the time of first publication, are not intended for distribution to any person or entity in any jurisdiction where such distribution or use would be contrary to applicable law, and are not an offer or solicitation to buy or sell securities or any product. The views expressed do not necessarily represent the views of State Street Global Markets® and/or State Street Corporation® and its affiliates. We are grateful to Paige Frasier and Uli Fernald for editorial assistance.

A substantial body of research in finance suggests that investors holding foreign assets should hedge or partially hedge their currency risk. Beginning with Solnik (1974) and Black (1990), many authors have sought to determine optimal currency positions within a mean-variance framework. More recently, Glen and Jorion (1993), Campbell, Serfaty-de Medeiros, and Viceira (2010), and Campbell, Viceira, and White (2003) have empirically measured the benefits of foreign currency hedging based on historical return and risk patterns. Campbell, Serfaty-de Medeiros, and Viceira (2010) show that for global bond investors, a near 100% currency hedge minimizes risk, whereas for equity investors, the optimal risk-minimizing strategy typically involves long positions in the US dollar, Swiss franc, and Euro, while shorting other currencies. Statman (2005) and Michenaud and Solnik (2008) extend this literature by analyzing optimal currency hedging choices when investors aim to avoid regret.

Despite extensive theoretical work, until recently there has been little evidence on what institutional investors actually do. Notable exceptions to this include recent papers by Sialm and Zhu (2024), Du and Huber (2024), and Opie and Riddiough (2024). Sialm and Zhu (2024) document widespread use currency forward contracts by US mutual funds. They also show that mutual funds that hedge currency risk do not generate differential abnormal returns. Du and Huber (2024) analyze industry- and company filings of global institutional investors, with a focus on their hedging of US dollar exposures. They show that foreign mutual funds and other investors have raised their US-dollar hedge ratio over the past two decades, notwithstanding higher hedging costs. Opie and Riddiough (2024) also study US mutual funds, additionally finding that funds trade in currencies not in the underlying equity portfolio. However, most data on institutional investors remain sparse, indirect, and limited in scope, covering only a few years or currencies. This leaves several important empirical questions unanswered. Are USD-domiciled investors different in their hedging behavior? How has currency hedging evolved over time? How does hedging activity vary across asset types? Do investors maintain target hedge ratios? If hedging costs rise, do investors maintain these targets or adjust their hedging strategies? And lastly, how closely do hedge ratios conform with theory? Addressing these questions requires substantially better data.

This paper leverages granular new data to analyze the hedging behavior of USD- and foreign currency-domiciled equity and fixed-income investors worldwide over a 28-year period. Our objective is to document the key patterns in how investors across different domiciles and asset classes hedge their currency exposure and how these patterns have evolved over time. We utilize historical monthly position data from a large group of institutional investors worldwide, based on anonymized custodial records provided by State Street Corporation. As one of the world's largest global custodians, State Street oversees over US$51 trillion in assets under custody or administration as of 2025, representing investors from a wide range of domiciles. These anonymized data offer a comprehensive view of fiduciary accounts, capturing all transactions and positions, including foreign exchange and underlying securities. The key advantage of our dataset over previous studies is its ability to match investors' asset positions in equities and fixed income with their forward foreign exchange positions. This enables us to analyze hedging behavior across a broad universe of investors from 1998 to 2025.

We present five main findings. First, we construct hedge ratios for both US-dollar and foreign-domiciled investors, defining the hedge ratio as the ratio of the foreign exchange short position to the value of the underlying assets (e.g., Australian equities or German bonds). We find that USD-based fixed-income investors hedge significantly more than their equity-investing counterparts. Fixed-income managers are more likely to hedge, and when they do, they tend to hedge at higher ratios. On average (across foreign currencies), only 27% of USD-based equity investors hedge their currency exposure, compared to 51% of USD-based fixed-income managers. These estimates may even be biased upwards due to data limitations. Among investors who hedge, the average hedge ratio is 33% for equity investors and 60% for fixed-income investors. However, there is considerable heterogeneity. For instance, while 85% of US-domiciled fixed-income managers hedge their Euro exposure, 15% do not, including investors who take FX positions without holding underlying Euro-denominated assets. Many fixed-income investors have hedge ratios close to one, suggesting complete hedging, yet others exhibit varying hedge ratios across currencies and over time. Compared to previous findings by Sialm and Zhu (2024), USD-based investors in our dataset hedge more frequently and at higher ratios.

Second, we compare USD-domiciled investors with those domiciled in other currencies. Across both fixed-income and equity managers, non-USD domiciled investors hedge more frequently and at higher intensities than their US counterparts. For example, on average, 39% of Euro-based equity investors hedge currency risk compared with 28% of USD-based investors. 85% of Euro-based fixed-income investors hedge currency risk compared with 78% of USD-based investors. These patterns are repeated on the intensive margin: of the fixed income investors that hedge, USD-domiciled fixed income investors have an average hedge ratio of 60%, compared with 92% for Euro-based investors. Conditional on hedging, most non-US domiciled fixed income investors hedge their dollar exposure with a ratio of about one, significantly more than USD-based investors hedge their non-dollar exposure. These findings are surprising from the perspective of theory and have obvious implications for demand for the US dollar: because non-USD investors hedge currency more than US investors, foreign asset purchases by USD investors have greater implications for USD demand than do USD asset purchases by non-USD investors.[1]

Third, currency hedging activity has increased steadily over time, both for USD-domiciled and non-USD-domiciled investors, and on both the intensive and extensive margins. For example, on average between 1998 and 2025, 85% of USD-based fixed income investors hedged their Euro exposure, a number that rose to 91% for the 2021–2025 period. Hedge ratios have risen too: the average hedge ratio for USD-based fixed income investors hedging Euro risk rose from a sample average of 65% to 88% for the 2021–2025 period. These findings are consistent with Du and Huber (2024), who document increases in USD hedge ratios by an average of 15 percentage points post-GFC, as well as Lilley et.al. (2022), who see a weaker relation between US investors' foreign bond purchases and the USD in recent years. Greater hedging by USD investors would dampen net currency demand coming from their foreign bond purchases.

[1] Lilley et. al. (2022) find a relationship between US investor purchases of foreign bonds and the USD: a lower degree of hedging by US based investors implies greater net demand for currency from their bond purchases than an equivalent purchase of US Treasuries by a foreign investor.

Fourth, we compare hedge ratios adopted in practice with those suggested by theory for a risk-minimizing investor. Risk minimizing fixed income investors would hedge most of their foreign exchange exposure in all currencies. A risk minimizing equity investors would do similarly, but have lower hedge ratios for the Euro, Yen, and dollar (for Euro-based investors). In the cross-section, there is zero or negative correlation between what theory prescribes and actual behavior, whether we measure hedging at the extensive or intensive margin.

Fifth, we measure how currency hedges change in response to fluctuations in the underlying assets, by measuring what we term "dynamic hedge ratios". For example, consider a Euro-domiciled equity investor who appears to have hedged their dollar assets with a ratio of 50%, meaning they have a negative forward position in US dollars equivalent to half of their dollar-denominated assets. What happens when the dollar assets go up in value by 10 percent? If the investor adheres to the target hedge ratio, she would sell forward the USD by an amount equal to half of the dollar increase in asset value. We show that a significant fraction of currency hedgers act in this way, meaning they rebalance their foreign exchange exposures when the underlying value of their equity and fixed income positions move. In addition, we show that investors adjust their hedges relatively quickly: most of the adjustment occurs at a horizon of one month.

Sixth, we explore what drives variations in hedge ratios across currencies and over time. We have already noted that hedge ratios in practice bear little relation to theory, but what drives them? In addition to the post-GFC increase in hedging, we examine the influence of factors such as carry, volatility, FX momentum, and the volatility and correlation of the underlying asset with currency returns. For equity investors, we find that higher carry and lower FX volatility are associated with stronger hedging. USD equity investors hedge low-momentum currencies more aggressively, while Euro equity investors do the opposite. For fixed-income investors, higher carry, lower currency momentum, lower FX volatility, higher bond volatility, and—among USD investors—higher FX-FI correlations are associated with stronger hedging. We also find increased hedging across domiciles and asset classes post-GFC, both at the intensive and extensive margins. These results expand upon Du and Huber (2024), who study cross-

sectional USD hedging patterns. They also complement recent research by Bräuer and Hau (2024) who study European investment funds and assess the optimality of their hedging strategies relative to theoretical benchmarks. Overall, however, we find inconsistent evidence in the time-series and the cross-section or panel, except for two findings: currency past returns (momentum) and a post-GFC dummy variable consistently enter as explanatory variables.

Our findings are related to a large normative literature in asset pricing on how global investors should hedge their exposure to currency risk, including Solnik (1974), Black (1990), Glen and Jorion (1993), Campbell, Serfaty-de Medeiros, and Viceira (2010) and Campbell, Viceira, and White (2003).[2] Liao and Zhang (2021) suggest a model where investors increase their currency hedging during periods of financial distress, driving changes in exchange rate. Greenwood, Hanson, Stein and Sunderam (2024) consider the role of FX hedging for covered interest parity (CIP) deviations. Our paper also relates naturally to the even larger literature documenting how international investors adjust their portfolios, including Froot, O'Connell, and Seasholes (2001), Froot and Ramadorai (2005) and Portes and Rey (2005), among others.

The paper proceeds as follows. Section I describes the data and steps required to reach a sample that is suitable for analysis. Section II describes how we measure currency hedging at the currency and portfolio level, and presents a number of statistics regarding how USD-domiciled and other investors hedge their currency risk. Section III outlines the evidence that investors tend to dynamically adjust their portfolios towards a target hedge ratio. Section IV investigates what drives hedge ratios in the time series and cross-section. Section V concludes.

I. Data: Measuring Asset and Currency Positions

Overview

[2] See also Froot (1993), Walker (2008).

We observe monthly historical stock, fixed income, and currency positions from a large group of institutional investors represented by anonymized custodial data provided by State Street Corporation[3]. State Street is among the world's largest global custodians, with assets under custody or administration amounting to over $51 trillion as of September 30th 2025[4]. These anonymized data comprise complete fiduciary accounts of all transactions and positions for the portfolios in which these assets are held (including foreign-exchange and underlying securities). Previous studies using parts of this data include Froot, O'Connell, and Seasholes (2001), Froot and Donohue (2002), Froot and Teo (2008), and Cheema-Fox et al (2021). We use two State Street datasets: one on holdings of underlying assets (equity, fixed-income, and money-market / cash holdings) and another with foreign-exchange forward positions. This dataset extends from February 1998 to December 2025, over a quarter century of history. We focus on assets denominated in "G10" currencies, comprising the Australian Dollar (AUD), the Canadian Dollar (CAD), the British Pound (GBP), the Euro (EUR), the Swiss Franc (CHF), the Japanese Yen (JPY), the Norwegian Krone (NOK), the Swedish Krona (SEK), the New Zealand Dollar (NZD), and the US Dollar (USD).

Utilizing State Street's custodial records, we construct portfolio level holdings consisting of public equities, fixed-income instruments, and money-market instruments. Cash equities primarily consist of holdings of common stocks. We utilize positions taken in securities within the MSCI ACWI IMI, which covers more than 99% of public equity by market value. We also include positions in depository receipts connected to MSCI securities. ETFs are included but constitute a very small proportion of sample assets.[5] We utilize MSCI pricing to value positions. We map State Street positions

[3] All analysis was performed within State Street's secure environment and was subject to anonymization to protect client confidentiality.

[4]State Street 10Q Filing, October 2023 https://s203.q4cdn.com/888565246/files/doc_financials/2025/q3/STT-2025-09-30-10-Q.pdf

[5] ETF positions, where present, are factored into underlying security constituents at index weights (for instance, if we observe a holding of an SP500 tracking ETF, we would break this down into a certain proportion of implied shares of APPL, AMZN, etc.); these ETF positions comprise a very small portion of our sample, under 1%.

to MSCI market data using a combination of SEDOL, ISIN, and CUSIP identifiers. Similarly, we connect State Street data to fixed-income market data from Refinitiv Datascope and utilize pricing from Refinitiv Datascope to value positions for corporate bonds, sovereign bonds, mortgage-backed securities, and, where available, commercial paper.[6] We define the portfolio as the set of positions for which we have complete prices and holdings. Below we describe an additional set of screens that we impose to ensure that the portfolios we measure are representative of the actual portfolios.

Our analysis requires us to match the foreign exchange trading of a fund with its underlying positions, with all fund identifiers having been anonymized. We take the conservative approach and consider a fund for analysis only if we observe it trading FX over the past 12 months. While this approach may seem overly conservative and biased in favor of finding more hedging behavior, it allows us to avoid misclassifying funds as non-hedgers simply because we do not ever observe them doing FX transactions, which they may execute in another account (such as an overlay account, a common practice). This results in a universe of portfolios that we have established as permitted to utilize FX forwards, so that our study delineates the behavior of such funds conditional on such mandates. We use the term "matched funds" to describe the sample where we have both position data, securities prices, matched FX transactions, and for which we can identify the funds as being either equity or fixed income oriented, on which we elaborate below. Similar to Sialm and Zhu (2024) and Opie and Riddiough (2024) we find the funds in our sample primarily use FX forwards rather than FX options, futures, or other derivatives; approximately 95% of the foreign exchange derivative transactions we observe are in FX forwards.

[6] Following Cheema-Fox et al., our universe and pricing of equity securities is taken from Morgan Stanley Capital International (MSCI) All Country World Investible Market Indices, which are designed to encompass over 99% of investible market capitalization of global equities according to MSCI. For fixed-income investments, our pricing data are derived from Refinitiv Datascope. These encompass global sovereign bonds (local-currency only), corporate bonds, and US Agency Mortgage-Backed security (MBS) assets. We focus primarily on cash instruments (excluding fixed-income futures, derivatives and swap positions), with the exception of MBS TBA (to be announced) forward positions, which are included. Money-market instrument pricing is taken from the State Street accounting systems (using point-in-time information), except where commercial paper instruments are mappable to the Refinitiv Datascope asset universe, in which case we use Datascope pricing.

Last, when we have this sample of matched funds, we implement a series of data screens, such as requiring funds to have more than ten positions. These data screens are detailed in Appendix A. Appendix Figure 1 provides a diagram to describe the complete set of steps taken to arrive at our final sample. After passing these screens, we refer to the dataset used in the bulk of the paper as "our sample." In section III, where we study dynamic hedge ratios estimated via regression for each fund, we impose a further set of screens to ensure that hedge ratios are being estimated on sufficient data. Data confidentiality does not allow us to list estimates of AUM and limits our discussion of observation counts.

Foreign Exchange Market Data

We obtain spot exchange rates valued each day as of 11 a.m. EST from WMR/Reuters where available, and Refinitiv Datastream where WMR/Reuters lack data. To compute present values of FX forward positions, we obtain interest rate data from Refinitiv Datastream. We use daily interbank rates where available for tenors up to one year; where these are absent, we use deposit rates or country treasury rates. While most forward contracts have tenors expiring within a year, we discount longer-term contracts using swap or sovereign bond rates for maturities from 1 to 30 years.

FX Forward Contracts

Foreign exchange forward positions are from State Street's custodial records. We define a forward transaction as a paired-buy-sell currency trade having a tenor exceeding 7 days. We separately decompose each forward into the two currency legs - currency bought and currency sold - and compute the discounted value of these two legs in USD using the current spot exchange rate. To permit aggregation across forward contracts of different tenors, we take the present value of each leg of the forward and convert to USD.

For forward contracts of maturity one-year or less, for a given currency *c,* a contract with notional value *X* measured in local currency bought or sold and maturity *t*, the present value of the forward *PV* is

$$PV = \frac{X_c}{\left(1 + R * \frac{m}{360}\right)} \tag{1}$$

where R denotes the annualized interest rate and m is the remaining maturity, defined as the value date minus the trade date. m is the remaining maturity in days, which we divide by 360 except for GBP where we use a 365-day count convention. Equation (1) needs to be adjusted for contracts of maturities greater than one year.[7] For a given forward, if the percentage difference of the discounted USD value of the bought and sold legs exceeds 30%, we discard the transaction as erroneous. Where the remaining term of the forward does not match available interest rates, we linearly interpolate between the nearest available rates.

As an example of (1), suppose we observe a transaction to buy 100 JPY and sell 1 USD 180-days forward. Suppose the US 6-month interest rate is 5% (annualized), the Japanese rate is 1%, and the current spot rate (JPY per USD) is 101. Then we have:

$$PV_{JPY} = \frac{100}{1+.01*.5} = 99.5025 \text{ JPY}$$

$$PV_{USD} = \frac{1}{1+.05*.5} = .9756 \text{ USD}$$

We then convert each leg to USD

$$PV_{USD} = .9756 \text{ USD}$$

$$PV_{JPY} = 99.5025 \text{ JPY}*(1 \text{ USD}/ 101 \text{ JPY}) = .9852 \text{ USD}.$$

These calculations are performed for each forward transaction in each currency by each fund. We sum over forwards for each currency in each fund to compute fund-currency level forward positions (for instance, a fund may have multiple forwards in a given currency pair with varying maturities). We use these fund-currency level FX forward holdings to compute hedge ratios at a later stage.

$$FX_{f,c,t} = \sum_{contracts\ j\ held\ by\ fund\ f} FX_{f,c,j,t} \quad (2)$$

[7] Specifically, $PV = \frac{X_c}{(1+R)^{\lfloor t \rfloor} * (1+R*frac(t))}$, where $\lfloor t \rfloor$ refers to the floor function. t is the remaining contract term, measured in days, divided by a day count. *frac(t)* refers to the fractional part of t. E.g. for a 500 day non-GBP contract, these components would result in $\lfloor t \rfloor$ = 1 and *frac(t)* = 140/360 respectively

Prior to 1999, we aggregate EUR constituent countries into a EUR aggregate.

Identifying Fund Types

Funds in the data are anonymized, meaning that we cannot identify their objectives from their name or description. We use their asset holdings to identify their base currencies as well as whether they have equity or fixed income mandates. We omit funds whose allocations appear to be multi-asset or money market in focus.

A fund is classified as an equity portfolio if (a) at least 60% of its total assets are in cash equities and (b) cash equities combined with cash instruments constitute at least 90% of its total assets. A fund is classified as a fixed-income portfolio if (a) at least 55% of its assets are in fixed-income instruments of tenor over one year and (b) these plus cash instruments (which include T-bills as well as money market assets and commercial paper) constitute at least 90% of total fund assets. Typically, less than 5% of assets in the universe we study are invested in multi-asset portfolios.[8]

Additional Screens and notation

As noted above, once we have a sample of funds for which we can identify objectives and match FX and underlying asset data, we apply a final set of screens, including removing funds that have fewer than $1 million USD in foreign assets or less than 10 underlying asset positions. The complete details of these screens are listed in Appendix 1. Of the G10 currencies we analyze, so-called "major" currencies include EUR, GBP, USD, CHF, and JPY. The others: AUD, CAD, NOK, NZD, SEK are "non-majors".

Summary Statistics of Final Sample

Table 1 summarizes our data by fund type (equity, fixed income) and currency domicile.[9] Panel A shows that over half of the funds in the sample are USD domiciled (53% by number and 56% by value). The next most frequent domicile by number is Euro, followed by British pounds. Panel A also

[8] This is similar to the proportion of hybrid US mutual fund assets tracked by the Investment Company Institute https://www.ici.org/research/stats/trends_12_22

[9] The sample summarized in Table I is used for the bulk of our analysis. Appendix Figure A1 shows a schematic guide to data requirements and screens required for each of the tables and figures. Specifically, for some of the later analysis, we require a set of further screens that further narrow the sample.

shows that we have greater representation of equity funds in USD, CAD, and AUD, but more fixed income funds in other currencies. These summary statistics refer to averages first computed for each month and then averaged over time.

Panel B of Table 1 summarizes the foreign asset composition for USD and Euro domiciled investors in our sample. USD-based investors' largest foreign holdings are denominated in Euros (38% on a value-weighted basis), with British Pounds (21%) and Yen (20%) coming in second and third. Not surprisingly, given the size of US equity markets, Panel B also shows that Euro-based investors hold far more dollar-denominated assets than US investors own Euro-denominated assets.

II. Measuring Hedge Ratios

In this section, we document the first three of our findings, namely, how investors hedge currency risk on average, how this varies over time, and how it varies over currency domiciles.

We define the instantaneous hedge ratio *HR* for fund *f* in period *t* and foreign currency *c* as the level of FX forward positioning relative to underlying foreign assets:

$$HR_{f,c,t} = \frac{-\ FX_{f,c,t}}{FA_{f,c,t}} \tag{3}$$

Note the minus sign in Equation (3), there because currency hedging involves taking a short position in the currency associated with the asset; the unhedged investor is naturally long the currency. For example, suppose a USD base investor has foreign asset positions in GBP(100 units), EUR (100 units) and JPY (10,000 units). This investor holds a short FX forward position of 40 euros vs the dollar, a short JPY position versus USD of 5,000 yen, and no FX position in GBP. This implies hedge ratios respectively of 40% for EUR, 50% for JPY, and 0% for GBP.

We also compute a portfolio-level weighted hedge ratio from the perspective of the base currency over all foreign assets held by the fund. To compute the portfolio hedge ratio, we divide the *long* positions in the fund's base currency in the numerator by sum the value of all foreign asset holdings across currencies in the denominator, i.e., total foreign assets *TFA*:

$$TFA_{f,t} = \sum_{c} FA_{f,c,t} \tag{4}$$

We define the portfolio hedge ratio for fund *f* at time *t* as the sum of all long positions in the fund's base currency divided by foreign asset holdings across currencies in the denominator:

$$HR_{f,t}^{portfolio} = \frac{FX_{f,t}^{BaseCurrency}}{TFA_{f,t}}. \tag{5}$$

Continuing with our previous example, suppose the Japanese exchange rate is 100 yen per dollar, and the Euro and British Pound exchange rates are 1 per dollar. Then the portfolio weights of our EUR, GBP, and JPY assets are all equal at 1/3 each. The portfolio hedge ratio $HR_{f,t}^{portfolio}$ is the weighted average of these three: 1/3 * (40% + 50% + 0%) = 30%. The portfolio hedge ratio mirrors, for each base currency, the various foreign currency positions taken against that base currency. Relative to Eq. (3), the portfolio hedge ratio drops a minus sign because it is computed from the perspective of the base currency.[10]

Note that for portfolio hedge ratios, exchange rates fluctuations impact the weighting across currencies. In our earlier example, if the GBP spot rate had appreciated versus USD while the others did not, this would lower the portfolio hedge ratio. This contrasts with currency-by-currency foreign hedge ratios, which are unaffected by exchange rate moves because currency effects cancel out in the numerator and denominator of Equation (3).

How US investors hedge currency risk

Table 2 summarizes hedging levels for USD-based investors by currency, at both the intensive and extensive margins. Panel A and B compare equity versus fixed-income investors. We also show both full sample (March 1998-December 2025 average) behavior compared to a more recent 5-year period (2021-2025), which can be seen by comparing the left- and right-sides of each panel. In each month, we

[10] A more subtle point is that for portfolio hedge ratios, exchange rate fluctuations affect weights and thus affect hedge ratios, in a way that they do not at the individual currency-pair. In the preceding example, if the GBP spot rate had appreciated versus USD while the others did not, then the final hedge ratio would be lower, since the GBP hedge ratio was zero. This contrasts with currency-by-currency foreign hedge ratios, which are unaffected by exchange rate moves because currency effects cancel out in the numerator and denominator of Equation (3).

average hedge ratios across funds, then we report cross-time statistics based upon these monthly cross-fund averages. Average hedge ratios are only computed based upon hedgers.

Consider the first row of Table 2 Panel A. On average, US equity funds have hedged their AUD equity exposure 28% of the time, though more recently they are hedging 38% of the time; 66% of the time they held unhedged equity, 5% of the time they hold AUD FX forward with no AUD equity. Of the 28% who hedge, the average hedge ratio was a mere 8% historically; more recently, this has risen to 16%.

The results on portfolio hedging resemble that of individual currency averages, but need not, since it is a weighted average and weights will be larger on larger positions, typically taken in the so-called "majors" (EUR, GBP, USD, CHF, JPY). Average hedge ratios are slightly lower than portfolio hedge ratios because more funds hedge their larger weights than hedge any individual currency. Non-majors (AUD, CAD, NOK, NZD, SEK) tend to have lower proportions of positions hedged. With the exception of the JPY, proportions hedged have increased. NZD is notable for having few equity funds choosing to hedge, but conditional on hedging, hedging with high ratios (73% in 2021-2025).

With the exception of CHF, NOK, and JPY, hedge ratios for equity investors have increased over time. Portfolio level hedging has increased from a mean of 36% to 47%, with hedge ratios rising from 30% to 44%. JPY and CHF are notable for having low hedge ratios, perhaps because of their well-known equity-foreign exchange correlations.

Panel B shows the results for US-domiciled fixed-income funds. Starting again with AUD, 45% of funds hedge their currency, and of those that do, the average hedge ratio was 63%. A large number of funds (45%) trade AUD without owning underlying AUD assets, perhaps because they use it to hedge exposure to correlated assets in the region. 85% of fixed income funds hedge their Euro exposure, with an average hedge ratio of 65%. Overall, USD-based fixed income funds are both more likely to hedge than equity funds, and conditional on hedging, have higher hedge ratios.

Panel B also shows increased hedging activity over time. At the extensive margin, the fraction of funds hedging has moved modestly, for example, rising from 45% to 58% for AUD and from 78% to 89% for GBP. But for every currency, conditional on hedging, the average hedge ratio has risen. For

example, Panel B reports that the average hedge ratio for EUR is 88% at the end of the sample, compared with 65% sample mean.

Another observation gleaned from Table 2 concerns the portion of portfolios that have FX positions without owning the underlying. For fixed-income investors, "FX-only" proportions are higher than in equities, and cluster in currencies with smaller bond markets such as NZD and CHF. This is consistent with market folklore that fixed-income managers express macroeconomic views via the more liquid vehicle of currency forwards, rather than buying bonds or equities.

While Table 2 shows averages over the full period as well as a recent snapshot, in Figure 1 Panel A we illustrate how hedging patterns for USD investors have evolved over time. The figure shows three graphs. The first displays the fraction of equity funds that hedge, don't hedge, or take FX positions without owning the underlying. The second displays the corresponding fraction for fixed income funds. The third graph shows the average hedge ratio, for the subset of funds we identify as hedging their currency risk. A greater proportion of US equity investors have hedged over time, with similar but less dramatic trends for fixed income investors. The average hedge ratio evolved in a similar fashion, with hedge ratios rising more for equity investors.

Figure 1 Panel B illustrates how hedging patterns have evolved for Euro-based investors hedging their USD assets. Here we see less evidence of a trend: there is a slight increase in the proportions of funds hedging in the second half of the sample period, but the hedge ratios themselves are relatively similar across time, even decreasing somewhat in recent years for equity investors. What is more differentiated is the behavior of USD vs EUR based investors. US funds are much less likely to hedge, particularly equity investors, and hedge less intensively, although in recent years US funds' behavior has come to resemble European funds' behavior.

Figure 2 presents statistics on portfolio-level hedging for USD and Euro-based investors, following a similar format to Figure 1. Recall that the portfolio hedge ratio is the weighted average of individual currency hedge ratios. Panel A shows USD funds' portfolio hedging; Panel B shows Euro-based funds' portfolio hedging. As can be seen, USD-based funds have steadily increased their hedging

since the early 2000s. Both USD- and Euro-based fixed income funds have a much higher incidence of portfolio hedging, and for the funds that hedge, hedge ratios tend to be higher.

How non-US investors hedge currency risk

Table 3 and Table 4 expand our analysis to funds with different base currencies, showing full sample averages (1998-2025). Table 3 reports the extensive margin (the proportion of funds that hedge) and Table 4 reports the intensive margin (the mean hedge ratio, conditional on hedging); note that henceforth we exclude the "FX Only" funds reported in Table 2. For each currency pair (for example, an AUD-based investor holding JPY assets), Table 3 reports the fraction of hedgers. The bottom lines of each Panel report means across all G10 currency assets. For example, AUD-based equity investors with CAD assets tend to hedge this exposure about 53% of the time, while USD-based equity investors with CAD assets tend to hedge this exposure only 28% of the time. The bottom lines of each panel report averages across currencies (taking a mean across rows) as well as the mean portfolio-level hedge. The main takeaway from Table 3 Panel A is that US-domiciled equity investors hedge far less than their counterparts in other domiciles.

Turning to Panel B of Table 3, we see the same conclusion holds for fixed income funds, although here the differences between US- and non-US investors are less dramatic. On average, USD-based investors are 78% likely to hedge their foreign fixed income risk, compared with 92%, 84%, 85% and 82% for AUD-, CAD-, EUR-, and GBP-based investors.

Table 4 turns to the intensive margin. Using a corresponding structure to Table 3, for each currency pair we report the average hedge ratio for investors we have identified as hedging. We also report averages for each domicile. USD-based equity investors who hedge, for example, hedge their Euro exposure with an average ratio of 32%. Euro investors, on the other hand, hedge their dollar equity exposures with an average ratio of 59%. These patterns are equally dramatic when we look at fixed income funds, in Panel B. As can be seen, AUD-, CAD- and Euro based investors tend to have hedge

ratios near 1. GBP-based investors have an average hedge ratio of 78%; USD-based investors are even lower with 60%.

In Appendix Table A5, we have further drilled down on intensive and extensive margin changes in hedging of the USD. We find large increases in both extensive and intensive margins of hedging across the board post-GFC. The one exception is AUD fixed income investors who hedge with approximately the same frequency across funds, but with hedge ratios that are lower post-GFC. These results are overall consistent with Du and Huber (2024) who find increases in hedge ratios of 15 percentage points for USD assets post-GFC.

What distributions of fund-level hedge ratios may underlie these averages? Figure 3 and Table 5 provide color. In Figure 3 we plot the cross-sectional cumulative distribution of US funds' hedge ratios for Euro equity and Euro fixed income assets in 2025. The second panel shows their portfolio-level hedge ratios. In each case, the equity CDFs are shifted to the left of those for fixed income, implying a larger share of equity funds, compared to fixed income, hedging at lower ratios. Fixed-income investors see a sharp spike in the CDF around 1; many fixed-income funds have hedge ratios close to unity. Equity hedge ratios exhibit an even progression from around zero to 50%, and then an uptick near 100% as well, albeit less clear and pronounced than in fixed income. While the pictures are similar for EUR assets and at the portfolio level, we see for both asset classes a substantial left tail in portfolio hedging – around 20% of portfolios exhibit negative portfolio hedge ratios, meaning they are net *long* foreign currency vis a vis their base (far fewer are long EUR).

Table 5 shows that for both USD and EUR fixed-income funds, there is considerably more bunching around a hedge ratio of 1, a pattern that is also visible, but slightly less pronounced, for EUR equity funds. That said, for US fixed income funds, the 25th percentile of hedge ratio is always below 50%, suggesting than even for this class of investors, there are many who use hedge ratios less than 1.0. European equity funds show a much greater likelihood of being fully hedged. We observe a median-to-75th percentile spread of 83% to 100% hedge ratios for major currencies, for example. Appendix Figure A2 further displays these patterns by currency for EUR and USD portfolios. Appendix Figure A3 shows

distributions across funds of average hedge ratios and exhibits similar patterns as Figure 3, however when we additionally plot EUR base investors, we find all distributions shifted to the right (reflecting higher hedge ratios).

Additional observations about fund hedging behavior

The broad patterns we described above raise a number of additional questions that we have tackled in appendix tables A1-A4, but describe briefly here. How consistent are funds in their behavior? Do funds sometimes change between hedging and not hedging a currency? For funds that we observe hedge a particular currency exposure, how much does their hedge ratio move around over time? Relatedly, if a fund hedges their exposure to one currency, is it likely that they hedge all currencies?

Broadly, the data reveal the following patterns. For both EUR and USD fixed income investors, there is evidence of consistency in hedging behavior for currency exposures, in the sense that conditional on seeing a fund hedging at all, we observe it as hedging most of the time. Time series standard deviations of cross-fund average hedge ratios typically range between 15% and 30% (Table A1)[11]. Equity investors are more eclectic in their approach. For example, conditional on hedging at all, the median USD-based investor hedges her Euro exposure only 2/3 of the time, and chooses not to hedge 1/3 of the time (Appendix Table A2). There is less consistency in sticking to any given hedge ratio, a topic we return to in Section III.

We have also studied the question of whether investors take uniform approaches to their hedging across the different currencies they are exposed to. For example, if an investor hedges their Euro exposure, does that automatically imply they will also hedge their AUD exposure? We find (Table A3) that for fixed income investors, they are typically holding only a handful of currencies, and are generally hedging all of them or nearly all of them. For equities, global investors typically have exposure to a far

[11] We observe similar values when we first compute standard deviations of hedge ratios for each fund-currency over time, then examine the distribution these values across funds (Table A4).

larger number of currencies, and they tend to hedge a smaller fraction of them. For both types of investors, there is substantial variation across currencies.

Above we have shown that many institutional investors, especially fixed income investors, hedge their currency risk and tend to adjust their hedges quickly in response to underlying asset movements. However, we also showed earlier that the average hedge ratio has moved around over time and varies cross-sectionally by base-currency-hedged-currency pair. In this section of the paper, we study what drives this variation at the currency-pair month level.

Comparing FX hedging with risk-minimizing benchmarks

Actual hedging behavior bears little relation to the optimal risk-minimizing strategies suggested by the literature. Table 6 compares observed hedge ratios to those implied by a minimum-variance framework. Following Schmittmann, the risk-minimizing hedge ratio is given by the coefficient from a regression of unhedged returns (in the investor's base currency) on currency excess returns, defined as the spot return minus the forward premium. This delivers the hedge ratio that minimizes portfolio variance at a one-month horizon, matching the frequency of our data.

The first rows of each panel report the minimum-variance hedge ratios. Consistent with prior work, these are large in magnitude across most currencies, and especially so for fixed-income portfolios, where the average optimal hedge ratio is 93% for EUR-based investors and 97% for USD-based investors. Even for equities, the average minimum-variance hedge ratio is economically large—107% for EUR-based investors and 121% for USD-based investors—though with substantial dispersion across currencies.

The next rows report actual hedging behavior, separately for the extensive and intensive margins (as in Table 2, except that we eliminate the "FX only" hedgers so the numbers are based off a different denominator). These averages are markedly lower. For example, the average intensive hedge ratio for equity investors is 58% (EUR base) and 33% (USD base), far below the corresponding minimum-variance benchmarks. For fixed income, where theory prescribes hedge ratios close to one, observed

hedge ratios are also lower—92% for EUR-based investors and 60% for USD-based investors—and display substantial cross-currency variation.

Most strikingly, the cross-sectional relation between theory and practice is weakly negative or close to zero. For equity investors, the correlation between minimum-variance hedge ratios and observed hedge ratios is -75% for EUR-based investors and -54% for USD-based investors at the extensive margin, and only 14% and 25%, respectively, at the intensive margin. For fixed-income investors, the corresponding correlations are -14% and -4% at the extensive margin, and 34% and -16% at the intensive margin.

Taken together, these results indicate not just a gap in levels, but a fundamental disconnect in the cross-section: currencies for which theory prescribes more hedging are not systematically hedged more in practice, and in several cases are hedged less.

III. Dynamic Hedge Ratios: How Investors Adjust Hedges

Instantaneous hedge ratios give us a snapshot of currency risk positioning at a moment in time. In this section, we define a parallel set of "dynamic hedge ratios" that capture the degree to which investors adjust their currency forward positions to changes in the currency risk of their asset positions. For example, consider a USD-based investor who owns 100 JPY of Japanese equities, currently hedged at a ratio of 50%, meaning that they are short a forward for 50 JPY. Now, consider what happens when Japanese equities rise by 10% in local currency terms, from 100 JPY to 110 JPY. Given a fixed forward position, the hedge ratio has shrunk to ~45% (=50/110). To maintain a 50% hedge ratio, the investor would need to add to their FX forward short position by selling JPY forward.. The degree to which they do this is captured by what we call the dynamic hedge ratio, denoted by *DHR*.

In the example above, to maintain a *DHR* of 50%, the investor would need to sell forward half the amount of the underlying asset move, which in this case means selling 5 JPY forward to incrementally hedge the increase of 10 JPY in underlying equity value. Dynamic hedge ratios, like static hedge ratios, can be computed separately for individual currency foreign hedge ratios and portfolio level hedge ratios.

Intuitively, if investors hedge programmatically and stick to target hedge ratios, then the dynamic hedge ratio should correspond to the instantaneous hedge ratios that we computed and described earlier.

Specifically, for fund *f*, currency *c*, and time *t* with lag *k* (in months) we regress changes in FX forward positions from *t-k* to *t* on scaled changes in the underlying asset positions. To limit heteroskedasticity, we scale both sides of the regression by lagged foreign asset holdings.

$$-\frac{\Delta_{t-k,t}FX_{f,c,t}}{FA_{f,c,t-k}} = a + DHR_{f,c} \cdot \frac{\Delta_{t-k,t}FA_{f,c,t}}{FA_{f,c,t-k}} + e_{f,c,t} \quad (6)$$

Equation (6) defines *DHR* as the dynamic hedge ratio. If the intercept is zero, then *DHR* gives us the ratio of the change in FX forward position relative to the change in underlying asset position. *DHR* has a fund-currency subscript, although if (6) estimated on a sample of pooled funds it represents an average dynamic hedge ratio across funds. Like in Eq. (3) the minus sign captures the fact that more hedging requires more *selling* of the foreign currency.

Equation (6) requires us to difference the data, because we are analyzing changes in hedges as they respond to changes in assets. We study changes at horizons of *k*=1 month and *k*=12 months. As it turns out, most adjustment is quick and can be detected already at a horizon of one month.

These analyses focus on variation in intensive margin, namely how a fund that is hedging at *t-k* evolves its hedge to period *t*. We restrict to funds, currencies, and months where we observe non-trivial hedge ratios (over 5% in absolute value). By construction, this means that we do not capture entry into or exit from hedging activity, i.e., the extensive margin.

Equation (6) specifies a hedge ratio at the level of a base-currency-foreign-currency pair, e.g., how a USD investor dynamically adjusts their JPY hedge. But analogously to earlier, where we computed a "portfolio" level hedge ratio, we can compute a portfolio-level dynamic hedge ratio. To do so, we convert FX holdings and underlying foreign assets to USD terms to again yield dimensionless quantities, before running the analogous regression to (6):

$$\frac{\Delta_{t-k,t}FX_{f,t}^{BaseCurrency}}{TFA_{f,t-k}} = a + DHR_{f}^{portfolio} \cdot \frac{\Delta_{t-k,t}TFA_{f,t}}{TFA_{f,t-k}} + e_{f,t} \quad (7)$$

Here we are gauging the degree to which a portfolio's aggregate currency exposure from all foreign currency holdings has been matched by net purchases of the base currency versus all foreign crosses. In (7), we can analogously interpret *DHR* as capturing the degree to which aggregate foreign currency exposure movements from changes in the value of foreign assets are met by adjustments to aggregate FX forward positions, typically accomplished by buying the base currency and selling various foreign currencies. Once more, to maintain a given initial portfolio hedge ratio, the investor must sell FX forward proportionate to the amount of change in the underlying asset value. However, as in the case of static portfolio hedge ratios, exchange rate changes impact the dynamic portfolio hedge ratio (due to the weights applied to different foreign currencies as we aggregate to one portfolio level figure), while they do not affect the dynamic foreign hedge ratio. Note that, in comparison with Eq. (6), Eq. (7) drops a minus sign, similar to the sign flip that we explained in comparing Eq. (3) and Eq. (5). This is because incremental hedging at the portfolio level means, over various foreign currencies, buying domestic and selling foreign currency.

As an illustration of Equation (7), consider a USD-based investor who initially holds 100 GBP of UK equities, and 100 Euros of Euro equity, hedged at 50% and 25% respectively, meaning that the investor has forward short positions of 50 GBP and 25 EUR vs. the USD. For simplicity, suppose GBP/USD and EUR/USD exchange rates are both at unity. The portfolio hedge ratio is 0.5*0.5 + 0.5*0.25 = 37.5%. Suppose the GBP equity rises in local terms, by 10% to 110 GBP while the EUR equity rises in local terms by 20% to 120 Euro, while exchange rates remain the same at unity. To maintain the portfolio hedge ratio, the investor must either maintain each foreign hedge ratio (sell 0.5*10 = 2.5 GBP and sell 0.25*20 = 5 EUR) for a total purchase of 7.5 USD, or they could maintain the portfolio hedge ratio by permitting the individual foreign hedge ratios to change, for instance by selling 7.5 GBP forward (increasing the GBP foreign hedge ratio) and holding the EUR FX position constant (decreasing the EUR foreign hedge ratio).

Table 7 presents estimates from Equation (6). For each regression, we pool funds of a particular type, so that the regression coefficients should be interpreted as an average across funds hedging in that

currency or group of currencies. For example, the first column of Panel A shows that for USD equity funds with EUR exposures and for changes estimated at a one-month horizon (k=1 month), *DHR* attracts a coefficient of 0.31, meaning that investors adjust their hedge by an average of $0.31 for every $1.00 change in the value of the underlying assets. This is close to the average hedge ratio of 0.32 that we reported in Table 2 of USD investors hedging their EUR exposure. Across major currencies, we obtain a regression coefficient of 0.39, which again is similar to our findings that we reported in Table 2. Table 7 also shows the R-squared, which is below 10% for USD equity funds, and rises to 28% for EUR-based funds. The R-squared is a measure of how closely funds adhere to their hedge ratios (an R-squared of 100% would mean immediate adjustment of all funds to a target hedge ratio).

The next lines of Panel A report the same analysis for k=12 months. As can be seen, our estimated regression coefficient *DHR* is 0.49, a bit larger in magnitude than our results for k=1 months. In other words, we see funds adjusting their hedge ratios quite quickly in response to movements in their asset holdings, but some of this becomes stronger at longer horizons, consistent with some funds taking time to return to a target hedge ratio.

Panel B repeats this analysis for fixed income funds. Turning first to column 1, where we show the dynamic hedging coefficient associated with USD investors hedging of Euro, 0.49. This is a bit lower than the average hedge ratio of hedging fixed income funds of 65% reported in Table 2. However, when we study DHR estimated using 12-month changes, it rises in magnitude to 0.68. Similar magnitudes appear across currency groups across the table.

Figure 4 shows estimates of *DHR* for a larger group of currencies. Panel A shows results for USD funds; Panel B shows estimates for EUR funds. For each currency, we show *DHR* for equity investors and fixed income investors. In each case, we show DHR estimated using one-month and twelve-month changes. The figure reveals the following broad patterns, many of which are consistent with our earlier observations. First, comparing across Panel A and Panel B, EUR-based investors hedge more. Second, fixed income investors hedge more. Third, especially for fixed income investors, there are differences in hedging adjustment depending on the horizon. Specifically, when we measure changes over a 12-month

period, we find greater responsiveness to changes in the underlying assets. In addition, we examine dynamic hedging across portfolios. In Table 8, we conduct the same regressions for each fund-currency and summarize their distributions. Mean and median values across funds resemble our pooled estimates from Table 7.

In our examination of static hedge ratios, we noted a general upward trend in typical levels of hedging over the course of our sample, particularly for USD investors. In Figure 5 we see a similar pattern unfold in dynamic hedging across time, using a rolling pooled regression to estimate how DHR evolves over time.

Do funds stick to their hedges?

We suggested earlier that it would be natural to expect our results for dynamic hedge ratios to be closely aligned with the instantaneous hedge ratios we reported earlier. But we can analyze this directly, which we do in Figure 6. Here we plot the average hedge ratio against the dynamic hedge ratio coefficient estimated from pooled regressions across funds. We do so for equity and fixed income investors, and for USD and Euro-based investors. The figure reveals a close alignment between the two. For example, the bottom right panel shows that for EUR fixed income investors, both estimated dynamic hedge ratios and mean static hedge ratios are in the 80% to 100% for most hedged currencies.

Although these results reveal that funds appear to have target hedge ratios, they do not explain whether funds closely adhere to these ratios. Table 8 conducts such an analysis. Here we compute for each USD-based fund, the average hedge ratio *HR* for a given base-currency-foreign currency pair. We also estimate via equation (6) that fund's dynamic hedge ratio *DHR* for the same base-currency-foreign currency pair. Table 9 then reports the correlation between these two quantities across funds. We also report the correlation between the R-squared from estimating equation (6) with the average hedge ratio. Table 9 shows the following results. First, when studying the correlation between DHR and average HR, these average approximately 50%. We interpret this as most funds adhering to target hedge ratios but with some noise. Second, there is a positive correlation between DHR R-squared and the average HR, which can be interpreted as saying that funds with higher hedge ratios also tend to stick to the hedge ratio more.

We have repeated the analysis in Table 9 for Euro-based investors, with similar results (Appendix Table A6). Figure 7 examines this pattern visually for USD investors, depicting the bivariate distribution of fund-level dynamic versus static hedge ratios. We see a positive correlation – higher static hedge ratios cluster alongside higher dynamic hedge ratios. Figure 8 depicts the same pattern for EUR investors.

IV. Determinants of Hedge Ratios over Time and across Currencies

The evidence suggests that forces apart from risk minimizing, such as hedging costs, return expectations, or institutional considerations—appear to play a more central role. Motivated by this disconnect, the remainder of this section examines which factors do explain variation in hedge ratios across currencies and over time.

Specifically, we investigate how hedge ratios evolve and whether there are characteristics that explain variation across currencies and over time. A similar analysis is done by Du and Huber (2024) who analyze cross-sectional determinants of USD hedging. Relative to previous work, an attractive feature of our panel data is that we can use variation across both base and hedge currencies, as well as variation over time.

Motivated by a large literature on foreign exchange, we study variables of three types (1) measures of risk and correlation (2) measures of hedging cost or carry, and (3) measures related to return forecasts such as momentum (features are summarized in Appendix Tables A7 and A8). Specifically, we study:

Asset and Currency Risk: Mean-variance logic suggests that currencies with higher correlation with local currency asset returns should be more aggressively hedged than currencies with lower correlations. For this reason, Campbell, Serfaty-de Medeiros, and Viceira (2010) suggest that optimal currency positions tend to be long the US dollar, the Swiss franc and the euro, and short the other currencies. Following the same logic, they show that most currency returns are almost uncorrelated with bond returns and thus investors should fully currency hedge their bond positions. We examine the impact of the following variables: FX volatility σ_{FX} measured as the standard deviation of weekly currency spot

returns vis-à-vis base currency spot, over the past year; Asset volatility σ_A measured as the weekly foreign equity or bond index return volatility over the prior year, measured in local currency terms; $\rho_{FX,A}$ as the correlation between monthly foreign equity or fixed income index local return and foreign currency USD spot returns over the same period.

Hedging cost or "carry": Hedging currencies with high interest rates relative to the base currency imposes a high flow cost on the investor (even if uncovered interest parity suggests the investor should recover this differential in expectation through currency appreciation). Hedgers may be dissuaded by these costs and hedge less when the cost is greater. We measure the hedging cost from the perspective of the hedging fund: *Carry* is the 3-month foreign yield minus the base currency 3-month yield.

Momentum: Momentum strategies are popular among institutional investors, although a number of studies have shown a lack of efficacy in recent years. Following Asness, Moskowitz, and Pedersen (2013) we define FX momentum, MOM_{FX} as the cumulative currency spot return between *t*-12 months and *t*-1 months relative to month *t*. Asset momentum, MOM_A, is the foreign equity or bond index local market return between *t*-12 months and *t*-1 months relative to month *t*.

Understanding average hedge ratios

We start by analyzing hedge ratios averaged across funds for the same currency-pair. The dependent variable in all analysis that follows is the mean hedge ratio for that currency, $\overline{HR_{c,t}}$.[12] Note that these hedge ratios are computed only over the set of funds engaged in hedging – this means we are attempting to explain variation in the intensive margin of hedgers (how much funds hedge given they have chosen to hedge) and setting aside variation in extensive margin (whether funds are choosing to hedge).

[12] This raises the question of how much these results explain fund-level variation in hedge ratios. We return to this question below, but to preview, fund-level fixed effects explain more of the variation than any of the time-series predictors that we study.

We begin by examining correlations between these features and hedge ratios in Table 10, which report time series correlations between the average hedge ratio of USD funds hedging Euro, shown in the first column of the table. Significant results are shown in bold. As can be seen, a number of strong time series correlations emerge. First, the mean hedge ratio is positively correlated with a Post-GFC dummy (ρ=76%) and negatively correlated with the hedging cost (ρ=-38%), FX volatility (ρ=-46%), and local asset return volatility (ρ=-29%). These results conform with intuition, except for FX volatility, which has the opposite sign. Column (2) extends these results to the full panel of currency pairs with the USD. Here, the results are considerably weaker, in part because they mix time-series correlations with cross-currency correlations.

Columns (3) and (4) show the results for USD-fixed income funds. Many of the patterns mirror those seen with equity funds: hedge ratios are larger when hedging costs are low and FX volatility is low. The impact of correlation between local asset returns flips sign, however, for both the EUR time series as well as the full panel.

Columns (5)-(8) repeat the analysis for Euro domiciled investors, beginning with Euro-based equity investors. As can be seen, the patterns are quite different in some dimensions and similar in others. Hedge ratios over time are positively correlated with hedging cost (significantly for the USD in particular), and only weakly correlated with other predictors. For Euro-based fixed income investors hedging of the USD, no significant relationships emerge.

Table 11 shows multivariate regressions of the determinants of mean hedge ratios for USD-domiciled investors. Compared with the results shown in Table 10, there are two advantages to this specification. First, we can study the collective impact of these variables in a multivariate regression. Second, and more importantly, we can separate time-series and cross-sectional variation through the use of currency-pair fixed effects.

Column (1) shows that for equity investors, currency fixed effects explain a substantial share (39%) of the variation in hedge ratios for US investors. Column (2) shows that in a multivariate specification, dropping the fixed effects but adding covariates. As can be seen, the post-GFC dummy,

hedging cost, FX spot momentum, FX volatility, correlation between local and FX are significant explanatory variables. However, the variation explained by these characteristics is less than explained by fixed effects alone. Column (3) shows the same multivariate regression but with both the covariates and currency fixed effects included. There are some notable changes, such as the coefficient on carry disappearing. Put differently, column (3) shows that for any given currency hedge, as the hedging cost falls investors are likely to increase their hedging, but hedging cost does not much explain patterns across different currencies, such as why USD investors are more likely to hedge Euros compared to Swedish Krona. But column (2) suggests that comparing across currency pairs, higher hedging costs predict more hedging. While currency fixed effects explain more variation than our set of controls, the adjusted R^2 obtained by adding controls is additive, taking us from ~39% with fixed effects alone to ~48% by including controls.

Columns (4), (5), and (6) in Panel B repeat the analysis for USD-based fixed income investors. The results on Carry are similar to Panel A, namely that carry is positively related to hedge ratios, but negatively related once you include currency fixed effects. Compared to Panel A, however, the results related to risk measures (FX and local volatility, and correlations) are much stronger, and in line with theory. Hedge ratios are higher when asset volatility is high and correlations are high and when FX volatility is low. For fixed-income investors, controls are less additive to explanatory power than for equity investors: adjusted R^2 increases from ~34% with fixed effects alone to ~45% after adding controls.

Table 12 shows the same panel regressions for Euro investors. We generally see weaker relationships for Euro investors than for USD investors, and several effects point in opposite directions. Among Euro equity investors, we again in Column (3) see a positive coefficient for the post-GFC dummy and for hedging costs, however the relation to FX spot momentum has flipped from positive to negative. While USD equity investors hedge winning currencies less, Euro investors hedge them more. When we include currency fixed effects in Column (4) we see the strength of the hedging cost effect diluted but, unlike for USD investors, it does not reverse. The inclusion of controls is similarly additive in adjusted R^2 , rising from ~7% with fixed effects to ~16% after adding controls.

For Euro fixed-income investors, Column (5) generally echoes results for US investors, excepting the relation to asset-FX correlation. When we include currency fixed effects in Column (6), while the coefficient on hedging costs does not reverse as sharply as for USD investors, it does fade to insignificance. FX momentum is more negatively related to Euro fixed-income investors' hedging, after including fixed effects, than for USD investors. As in the USD investor case, including controls is less additive to adjusted R^2 for fixed-income than Euro equity investors.

The bottom line from Table 11 and 12 is that (a) there is a large and robust post-GFC effect across currency pairs (b) hedging costs are not reliably related to average hedge ratios, and (c) currency-pair fixed effects matter.

Understanding fund level ratios

Now we drill down into fund-level hedging in Table 13, reporting only the R-squared. In the first row, we first run analogous regressions as we did for average hedge ratios and see similar patterns – controls have some explanatory power, though currency fixed effects matter somewhat more. When we omit fund and currency fixed effects, the explanatory power of the controls is very low, ranging from 1.19% to 3.62%.

Next, we add in the vast number of fund-level fixed effects in a separate group of specifications. Given the number of funds is substantial, it is unsurprising that fund-level fixed effects explain a higher degree of variation than controls or currency effects. This indicates that variation across funds exceeds variation across currencies or over time. Nonetheless, adding currency fixed effects and controls does provide further explanatory power at the fund-currency level after including fund fixed effects.

The variance across fund-currency hedging through time explained by fund effects, currency effects, and controls is of comparable magnitude to the variance across average hedge ratios and through time controls with currency fixed effects. The smoothing obtained from averaging across funds parallels the cross-fund variation captured by fund fixed effects.

V. Conclusions

In this paper, we use portfolio data from one of the world's largest custodian banks to study how global portfolio investors hedge foreign exchange risk. As we have shown, hedging activity has increased steadily over time, both for USD-domiciled and non-USD-domiciled investors. With respect to hedging, USD domiciled investors have become more like their global counterparts over time. And, consistent with conventional market wisdom, fixed income investors are more likely to hedge, but equity investors increasingly hedge their currency exposure as well. We document a number of other patterns across different currency markets, and show how they vary across equity and fixed income investors. A remarkably large number of investors appear to adjust their currency hedges quickly in response to change in the underlying assets, consistent with them having target hedge ratios. We also investigate a number of variables that have been predicted by theory to influence hedge ratios. Remarkably, we find only mixed evidence relating higher hedging cost with less hedging. Most importantly, FX hedging deviates substantially from risk-minimizing benchmarks suggested by the literature.

One implication of our findings is that asset allocation decisions, such as selling stocks and buying bonds in a market, have implications for foreign exchange because of variation in the hedge ratios. Similarly, local return shocks can lead to variation in currency demand. For example, if Euro equities appreciate in local terms, to maintain hedges investors will sell Euros, potentially leading to price effects. A more subtle implication is that symmetric demand for assets (for example, a Euro investor selling USD equity to a USD investor who buys Euro equity) is not neutral with respect to currency demand.

Our findings leave open a number of other questions that we hope can be addressed by future work. What fraction of investor currency demand is driven by hedging decisions compared to portfolio decisions about the underlying assets, with fixed hedge ratios? What is the relationship between investor hedging and demand for global safe assets? And most importantly, what hedging practices have contributed to investor risk and returns?

References

Asness, C. S., Moskowitz, T. J., and Pedersen, L. 2013. "Value and Momentum Everywhere." *Journal of Finance* 68(3), 929-985.

Black, F. 1990. "Equilibrium Exchange Rate Hedging." *Journal of Finance* 45(3), 899-907.

Bräuer, L., and Hau, H. 2023. "Can Time-Varying Currency Risk Hedging Explain Exchange Rates?" *Swiss Finance Institute Research Paper* 22-77.

Bräuer, L., and Hau, H. 2024. "Fund-Level FX Hedging Redux." Swiss Finance Institute Research Paper No. 24-12.

Burnside, C., Eichenbaum, M., and Rebelo, S. 2011. "Carry Trade and Momentum in Currency Markets." *Annual Review of Financial Economics* 3, 511-535.

Campbell, J. Y., Viceira, L. M., and White, J. S. 2003. "Foreign Currency for Long-Term Investors." *The Economic Journal* 113, C1-C25.

Campbell, J. Y., Serfaty-de Medeiros, K., and Viceira, L. M. 2010. "Global Currency Hedging." *Journal of Finance* 65, 87-121.

Cheema-Fox, A., LaPerla, B. R., Serafeim, G., Turkington, D., and Wang, H. S. 2021. "Decarbonization Factors." *The Journal of Impact and ESG Investing* 2, 47-73.

Du, W., and Huber, A. W. 2024. "Dollar Asset Holdings and Hedging Around the Globe." *NBER Working Paper* 32453, National Bureau of Economic Research.

Froot, K. A. 1993. "Currency Hedging Over Long Horizons." *NBER Working Paper* 4355, National Bureau of Economic Research.

Froot, K. A., O'Connell, P. G. J., and Seasholes, M. S. 2001. "The Portfolio Flows of International Investors." *Journal of Financial Economics* 59, 151-193.

Froot, K. A., and Donohue, J. T. 2002. "The Persistence of Emerging Market Equity Flows." *Emerging Markets Review* 3, 338–364.

Froot, K. A., and Donohue, J. T. 2004. "Decomposing the Persistence of International Equity Flows." *Finance Research Letters* 1, 154-170.

Froot, K. A., and Ramadorai, T. 2005. "Currency Returns, Intrinsic Value, and Institutional-Investor Flows." *Journal of Finance* 60, 1535-1566.

Froot, K. A., and Teo, M. 2008. "Style Investing and Institutional Investors." *Journal of Financial and Quantitative Analysis* 43, 883-906.

Glen, J., and Jorion, P. 1993. "Currency Hedging for International Portfolios." *Journal of Finance* 48, 1865-1886.

Greenwood, R., Hanson, S. G., Stein, J. C., and Sunderam, A. 2024. "A Quantity-Driven Theory of Term Premia and Exchange Rates." *Quarterly Journal of Economics* 138(4), 2327–2389.

Liao, G., and Zhang, T. 2021. "The Hedging Channel of Exchange Rate Determination." *Review of Financial Studies* (forthcoming).

Lilley, A., Maggiori, M., Neiman, B., and Schreger, J. 2022. "Exchange Rate Reconnect." *Review of Economics and Statistics* 104(4), 845–855.

Maggiori, M., Neiman, B., and Schreger, J. 2020. "International Currencies and Capital Allocation." *Journal of Political Economy* 128(6), 2019-2066.

Menkhoff, L., Sarno, L., Schmeling, M., and Schrimpf, A. 2012. "Carry Trades and Global Foreign Exchange Volatility." *Journal of Finance* 67, 681-718.

Michenaud, S., and Solnik, B. 2008. "Applying Regret Theory to Investment Choices: Currency Hedging Decisions." *Journal of International Money and Finance* 27, 677-694.

Newey, W., and West, K. 1987. "A Simple, Positive Semi-Definite, Heteroscedastic and Autocorrelation Consistent Covariance Matrix. *Econometric* 55, 703-708.

Opie, W., and Riddiough, S. J. 2024. "On the Use of Currency Forwards: Evidence from International Equity Mutual Funds." *NBER Working Paper*, National Bureau of Economic Research.

Perold, A. F., and Schulman, E. C. 1998. "The Free Lunch in Currency Hedging: Implications for Investment Policy and Performance Standards." *Financial Analysts Journal* 44, 45-50.

Petersen, M. A. 2009. "Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches." *Review of Financial Studies* 22, 435–480.

Portes, R., and Rey, H. 2005. "The Determinants of Cross-Border Equity Flows." *Journal of International Economics* 65, 269-296.

Sialm, C., and Zhu, Q. 2024. "Currency Management by International Fixed Income Mutual Funds." *Journal of Finance* 79(6) 4037-4081.

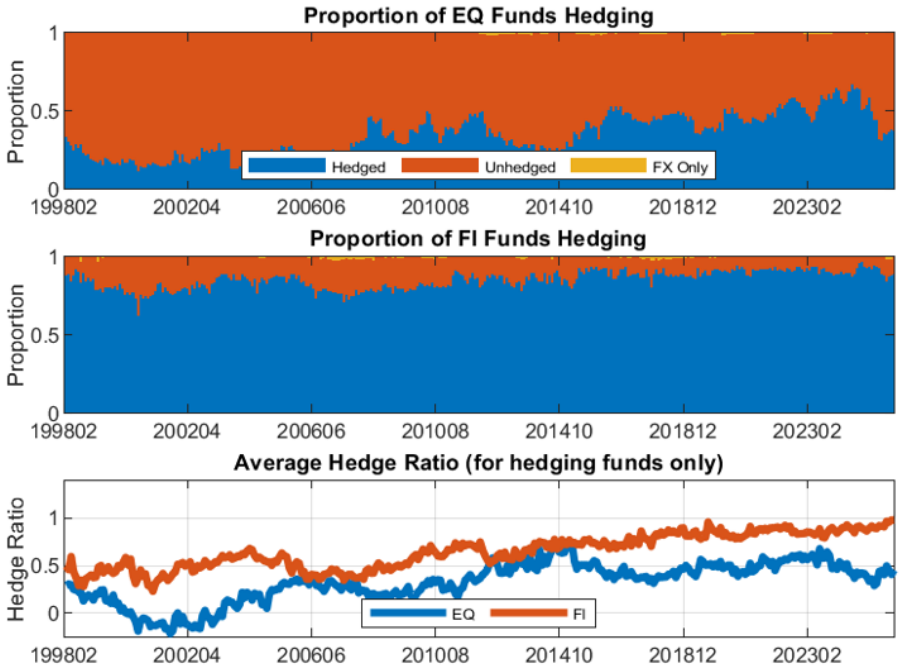
Solnik, B. H. 1974. "An Equilibrium Model of the International Capital Market." *Journal of Economic Theory* 8, 500-524.

Statman, M. 2005. "Hedging Currencies with Hindsight and Regret." *The Journal of Investing* 14, 15-19.

Zeev, N. B., and Nathan, D. 2024. "Shorting the Dollar When Global Stock Markets Roar: The Equity Hedging Channel of Exchange Rate Determination." *The Review of Asset Pricing Studies* 14(4), 640-666

Figure 1: Foreign Currency Hedging Through Time. This figure shows how foreign hedging of EUR and USD assets by USD and EUR funds respectively has evolved through time: In each panel, the top time series show the proportion of equity portfolios hedging a currency, holding a currency unhedged, or holding only FX forwards in a currency; the middle shows the corresponding numbers for fixed-income portfolios; the bottom shows average hedge ratios of equity and fixed-income funds with nontrivial hedge ratios.

Panel A. USD Funds' Hedging of EUR Assets



Panel B. EUR Funds' Hedging of USD Assets

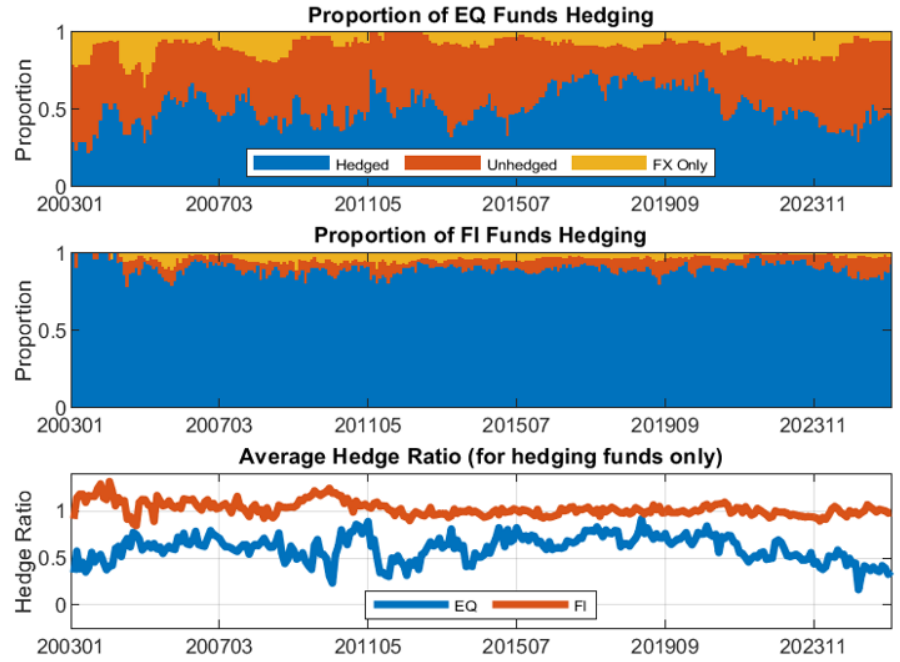
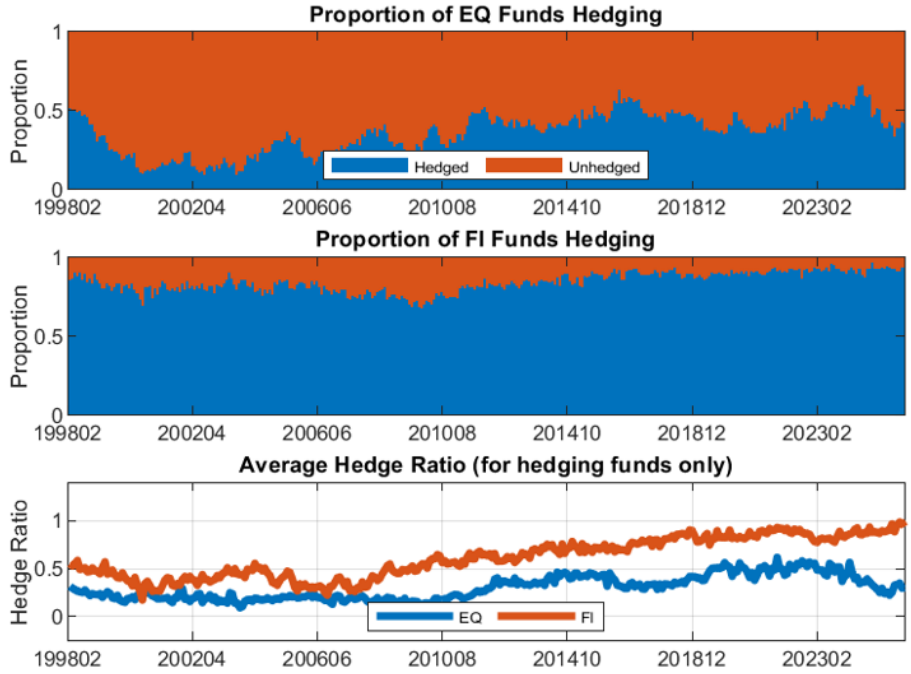


Figure 2: Portfolio Hedging Through Time. This figure shows portfolio level by USD (Panel A) and EUR funds (Panel B) has evolved through time: In each panel, the top time series show the proportion of equity portfolios hedging a currency, holding a currency unhedged, or holding only FX forwards in a currency; the middle shows the corresponding numbers for fixed-income portfolios; the bottom shows average hedge ratios of equity and fixed-income funds with nontrivial hedge ratios. Portfolio hedging is defined as base currency FX holdings divided by total foreign assets.

Panel A. USD Funds' Portfolio Hedging



Panel B. EUR Funds' Portfolio Hedging

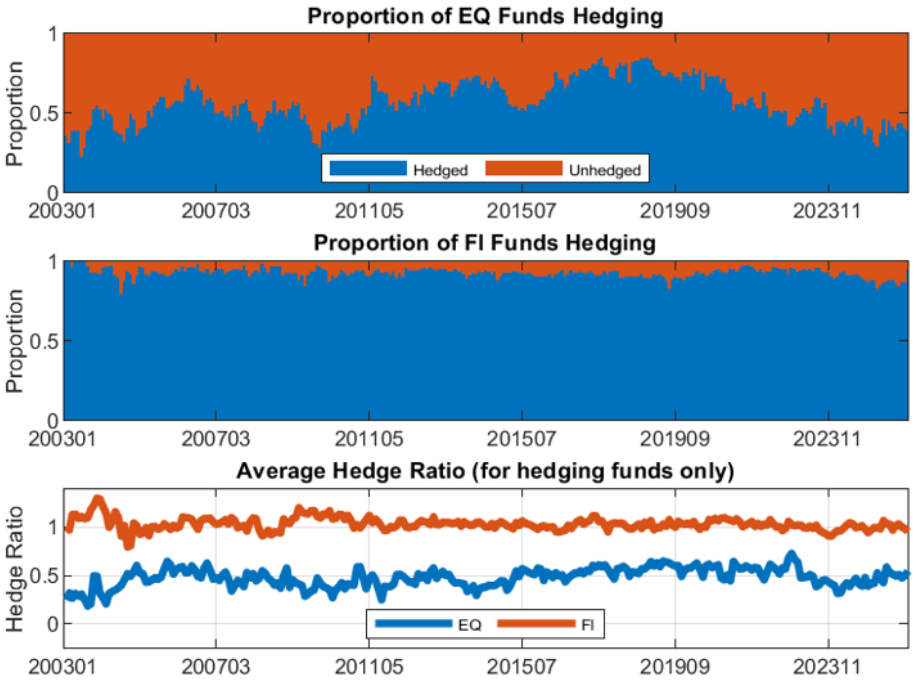


Figure 3: The Cross-section of Hedge Ratios. Cumulative distribution functions of hedge ratios of US equity and fixed-income funds in 2025. We restrict to funds with nonzero hedge ratios. Hedging of EUR refers to foreign hedge ratios of EUR denominated assets. Portfolio hedging refers to portfolio hedge ratios of US funds.

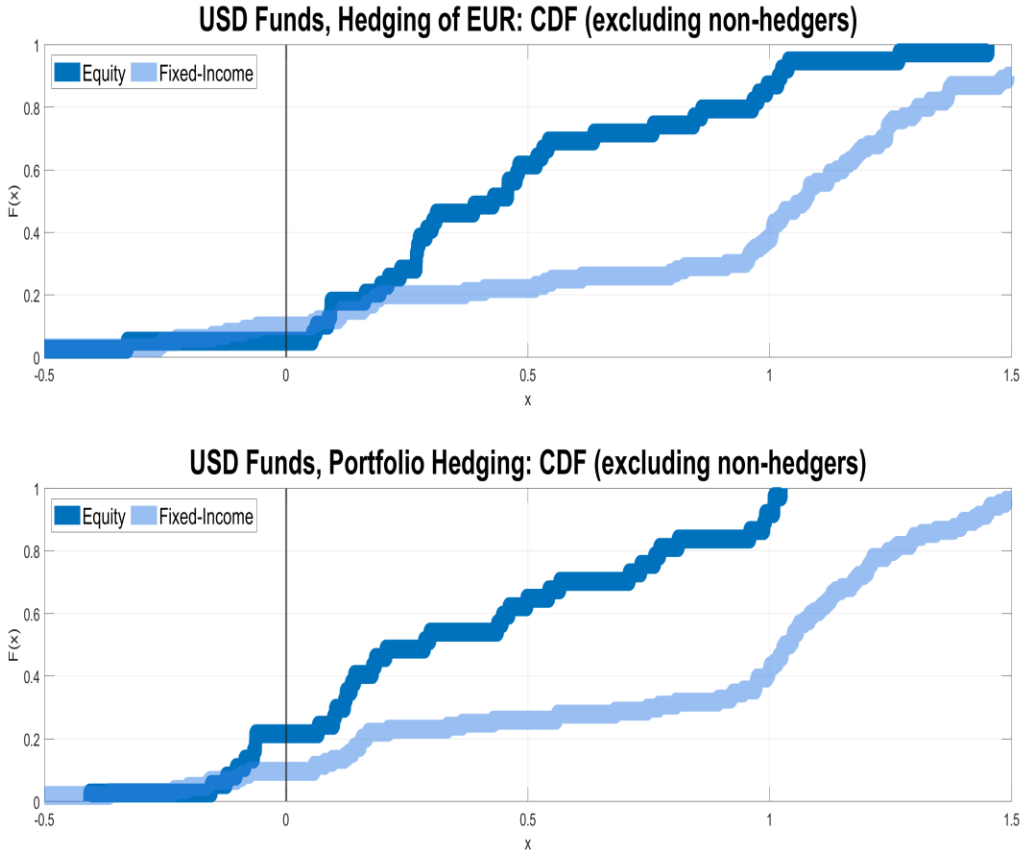
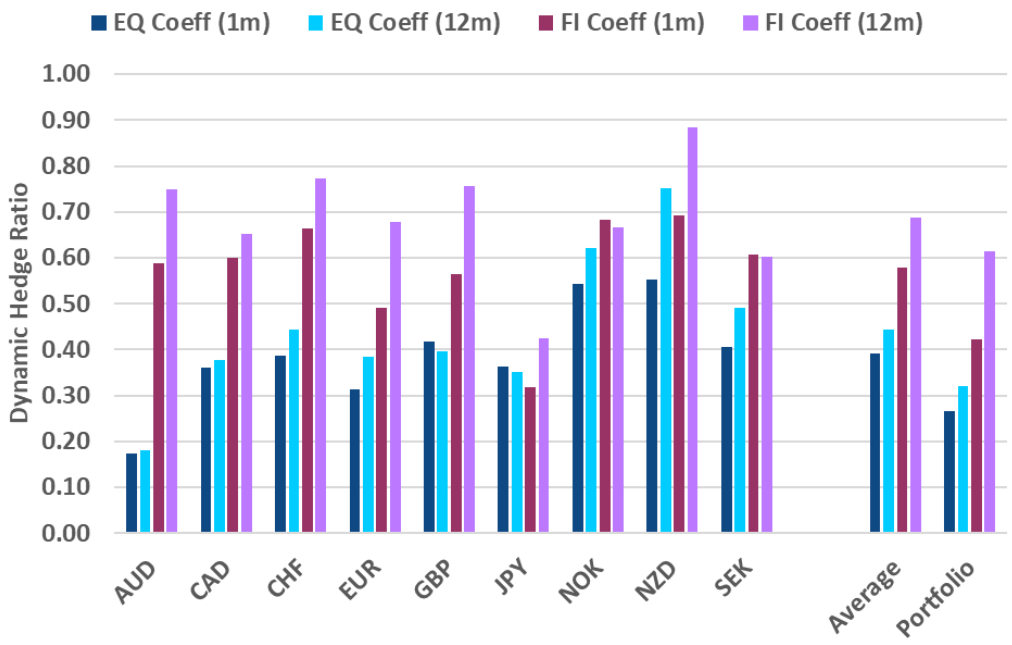


Figure 4: Dynamic Hedging by Currency: This figure shows dynamic hedge ratio coefficients from pooled regressions across funds.

$$-\frac{\Delta_{t-k,t}FX_{f,c,t}}{FA_{f,c,t-k}} = a + DHR_{f,c} \cdot \frac{\Delta_{t-k,t}FA_{f,c,t}}{FA_{f,c,t-k}} + e_{f,c,t},$$

where *FX* refers to forward *FX* position, *FA* refers to foreign assets, and *DHR* is the estimated hedge ratio. The figures show estimates of DHR for EUR and USD base investors for equity and fixed-income portfolios for different currencies. "Average" refers to the average across foreign currency coefficients. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"); we further require at least 12 observations to estimate a given regression.

Panel A: USD funds



Panel B: EUR funds

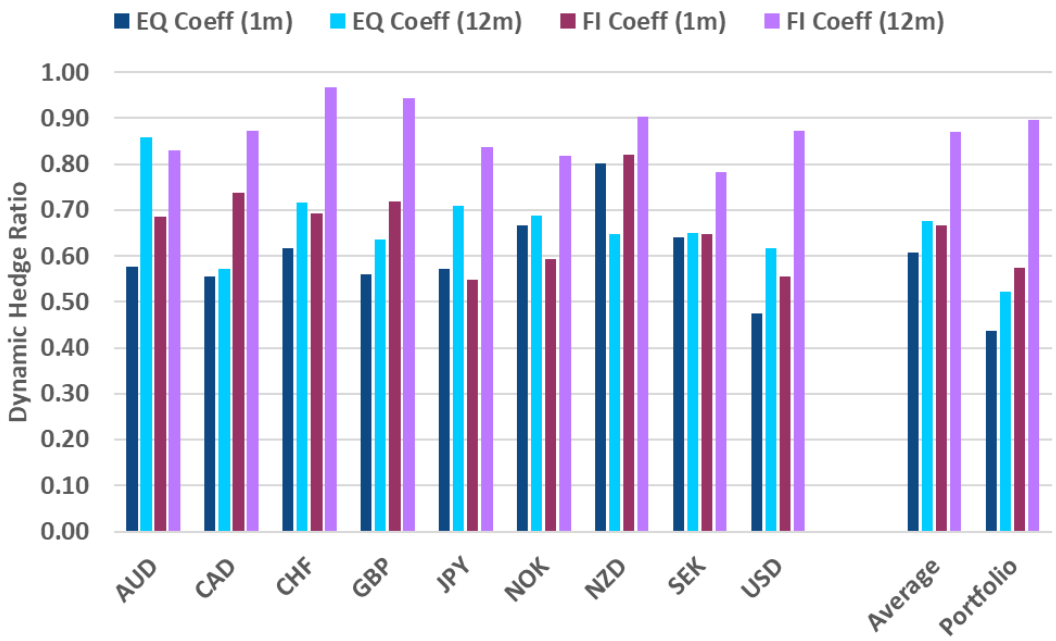


Figure 5: Dynamic Hedging Through Time: This figure shows rolling panel (over funds and months) coefficients of dynamic hedging regressions (equations (6) and (7) above, pooling all fund-currency observations over a rolling 24 month window) using a 12 month differencing horizon. We conduct one regression each month, using 24 months of historical fund-currency observations. Reported for EUR and USD base investors, equity and fixed-income portfolios. We report: US investors' dynamic hedging of EUR assets, EUR investors' hedging of USD assets, and for each base the respective dynamic portfolio hedge ratio regressions. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions").

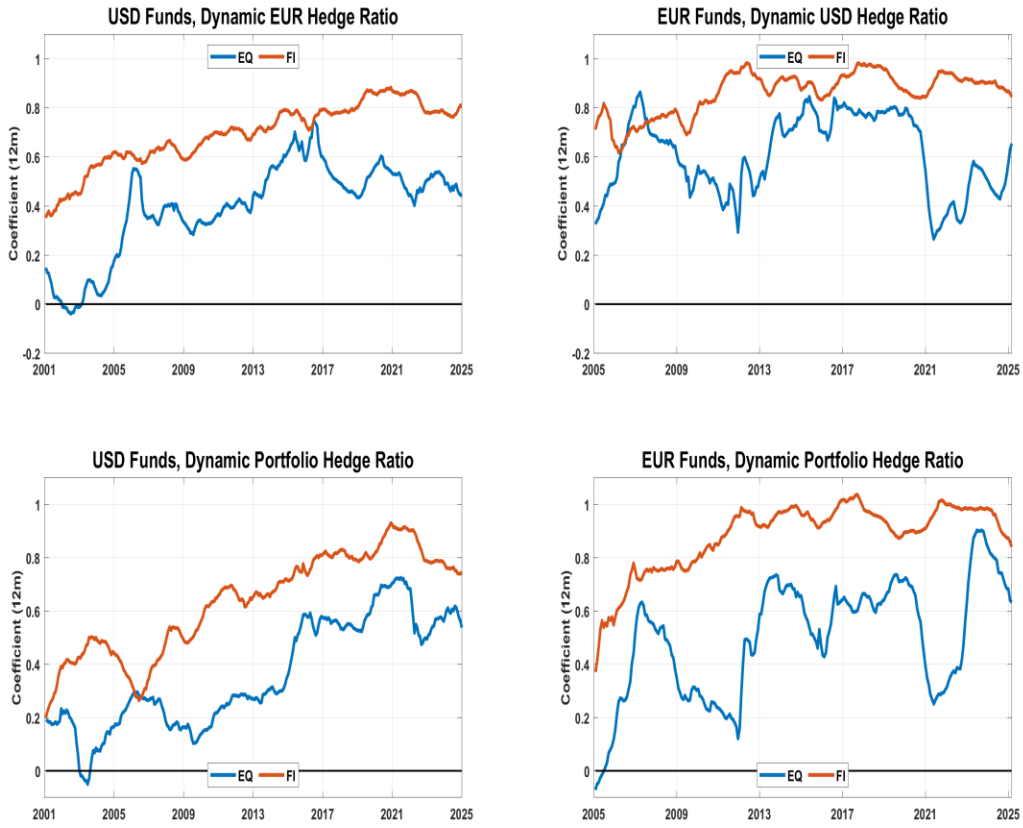


Figure 6: Static vs Dynamic Hedging (Pooled): This figure plots average hedge ratios (averaged over time by fund-currency, then averaged across funds) against dynamic hedge ratio coefficients estimated from pooled regressions across funds . Reported for EUR and USD base investors, equity and fixed-income portfolios. Dynamic coefficients reported for a 12 month differencing horizon. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). We further require that each fund-currency is hedged for at least 12 months (not necessarily contiguous), and for dynamic coefficients require at least 12 observations be present to estimate, after imposing the previous restrictions.

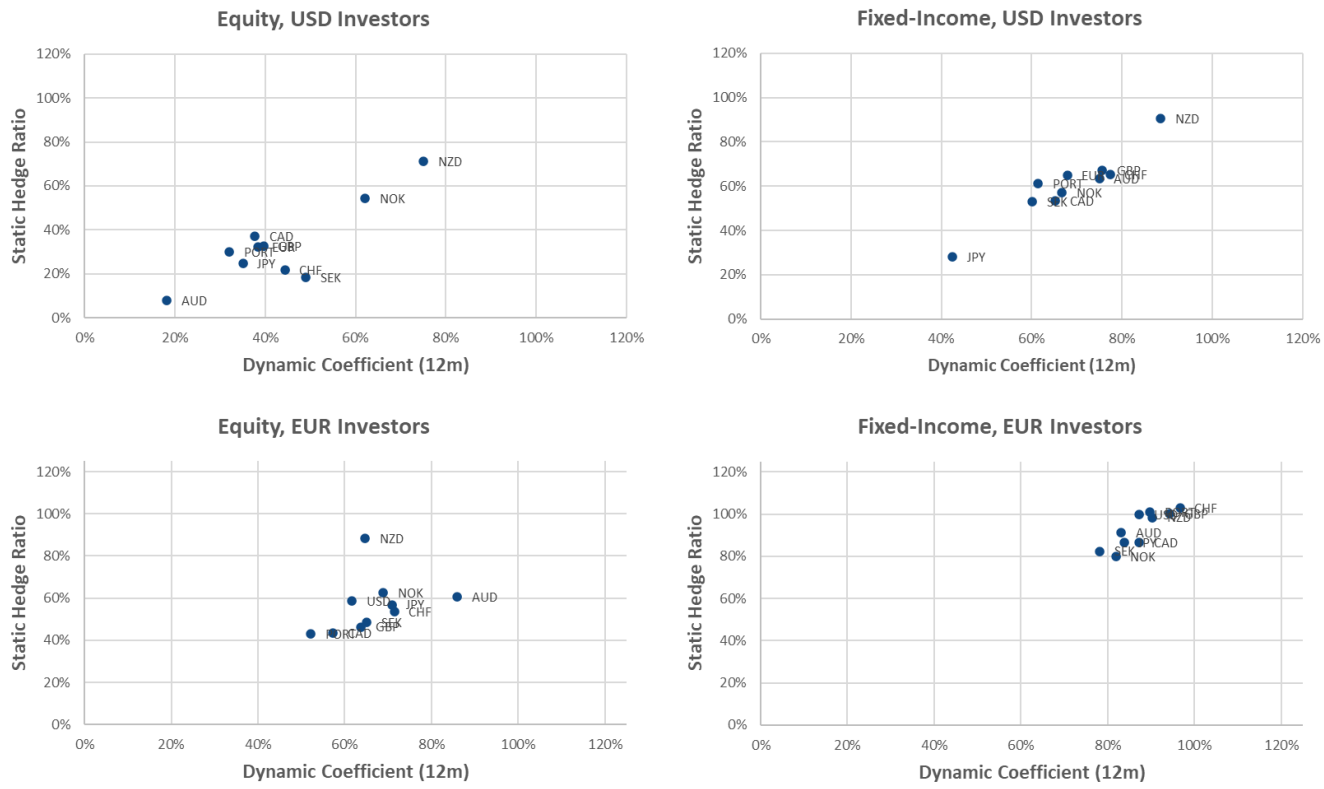


Figure 7: Connecting Dynamic and Static Hedging, USD Funds

This figure shows a kernel density plot across funds of average static hedge ratios (x axis) and dynamic hedge ratio coefficients (y axis). Blue indicates low density, yellow high density of funds. Reported for USD base investors, equity and fixed-income portfolios. We report USD investors' hedging of EUR assets and USD portfolio hedging. Dynamic hedge ratios are reported for a 12 month differencing horizon. These refer to the differencing horizons in equations (6) and (7) above. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). Each individual fund-currency regression and static hedge ratio used requires at least 12 fund-currency-month observations underlying the average or coefficient. We further require that dynamic hedge ratio coefficients are of <= 2 in absolute value.

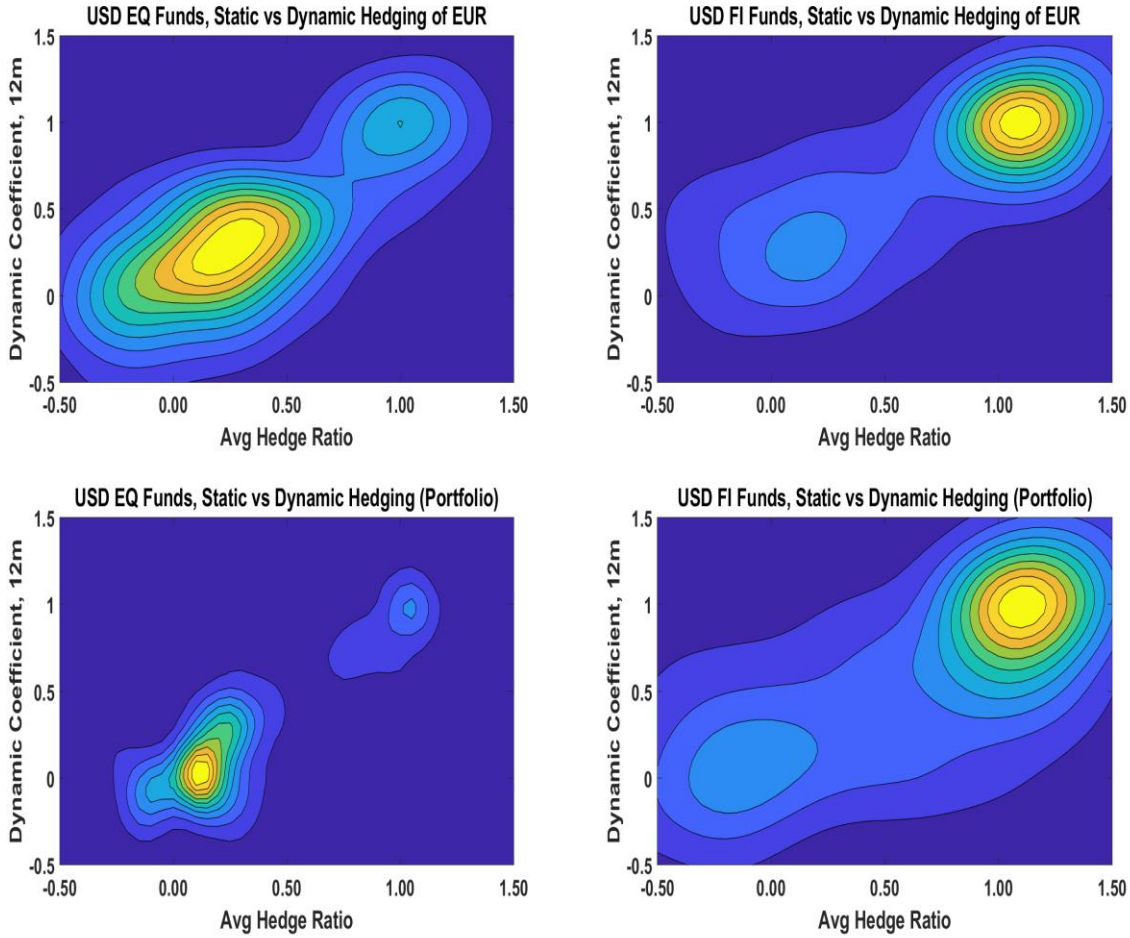


Figure 8: Connecting Dynamic and Static Hedging, EUR Funds

This figure shows a kernel density plot across funds of average static hedge ratios (x axis) and dynamic hedge ratio coefficients (y axis). Blue indicates low density, yellow high density of funds. Reported for USD base investors, equity and fixed-income portfolios. We report EUR investors' hedging of USD assets and EUR portfolio hedging. Dynamic hedge ratios are reported for a 12 month differencing horizon. These refer to the differencing horizons in equations (6) and (7) above. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). Each individual fund-currency regression and static hedge ratio used requires at least 12 fund-currency-month observations underlying the average or coefficient. We further require that dynamic hedge ratio coefficients are of <= 2 in absolute value.

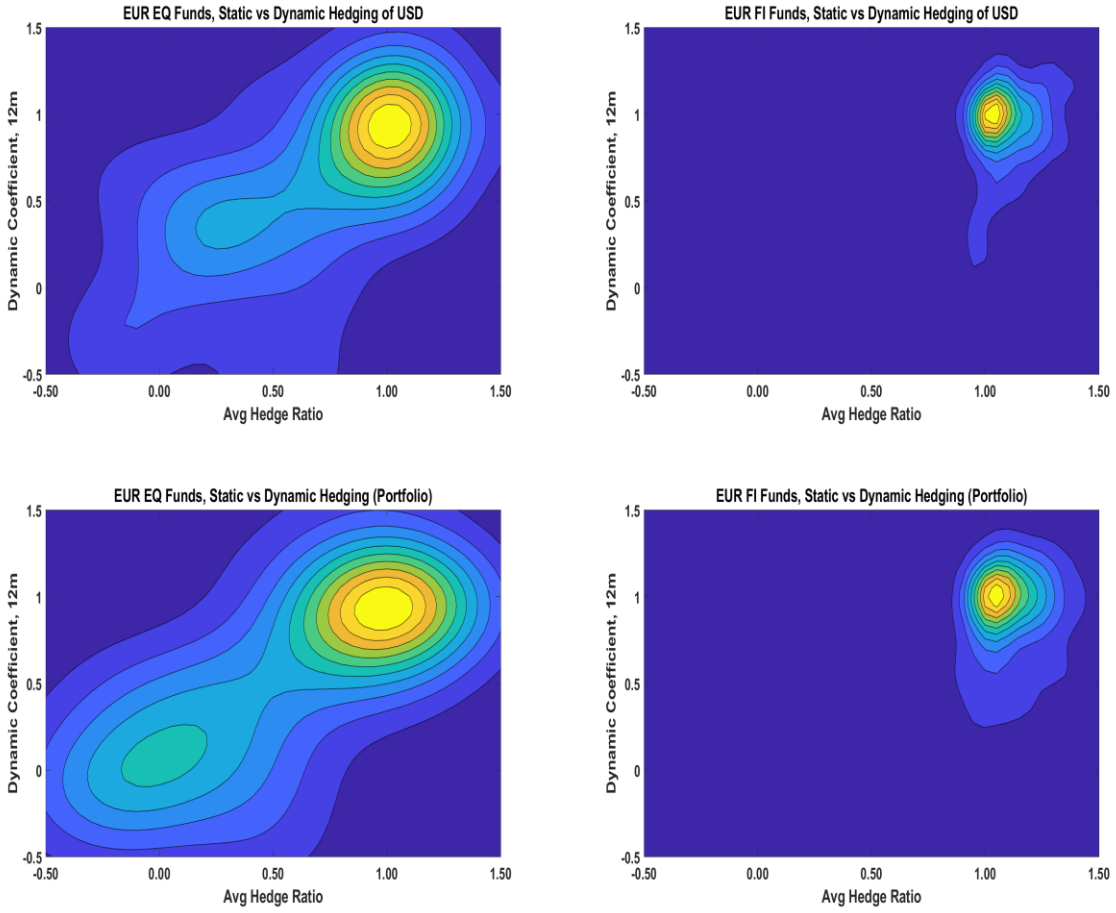


Table 1: Portfolio Statistics by Currency

Panel A depicts the relative proportions of observations (at the fund-currency level) and the value of underlying assets (in USD terms) across different base currencies and equity vs. fixed-income portfolios. Each month we compute the proportion of observations by the respective splits, then we average these proportions across time. Panel B depicts the relative proportions of observations (at the fund-currency level) and the value of underlying assets (in USD terms) across different base currencies and for equity versus fixed-income portfolios. For both panels, VW refers to the proportion of value in USD terms; EW refers to the proportion of fund-currency observations. In Panel B, proportions are computed within a given asset class and base currency, relative to all positions within that asset class and base currency.

Panel A: Base Currency Composition

Base Currency	Weighting	EQ	FI	Fraction of Sample
AUD	EW	57.1%	42.9%	7.6%
	VW	63.2%	36.8%	6.5%
CAD	EW	76.0%	24.0%	6.9%
	VW	73.1%	26.9%	5.0%
EUR	EW	49.5%	50.5%	12.9%
	VW	46.7%	53.3%	9.8%
GBP	EW	54.4%	45.6%	11.0%
	VW	59.7%	40.3%	16.7%
USD	EW	60.3%	39.7%	53.2%
	VW	77.1%	22.9%	55.7%
All Others	EW	35.5%	64.5%	8.4%
	VW	25.8%	74.2%	6.4%

Panel B: Foreign Asset Composition for USD and Euro domiciled investors

	USD-domiciled Funds				Euro-domiciled Funds			
	Equity		Fixed-Income		Equity		Fixed-Income	
Assets	**EW**	**VW**	**EW**	**VW**	**EW**	**VW**	**EW**	**VW**
AUD	11.4%	4.0%	11.7%	2.1%	6.8%	1.4%	8.4%	0.5%
CAD	9.4%	3.7%	13.1%	4.9%	7.8%	1.8%	10.9%	2.1%
CHF	13.1%	9.5%	5.6%	0.3%	16.3%	9.9%	3.8%	0.1%
EUR	14.4%	37.7%	17.5%	57.3%				
GBP	14.3%	21.4%	16.8%	17.2%	17.4%	20.3%	21.0%	16.2%
JPY	13.7%	19.9%	11.6%	14.9%	12.0%	11.9%	10.8%	10.7%
NOK	8.1%	0.8%	6.6%	0.5%	10.5%	1.6%	4.2%	0.2%
NZD	4.7%	0.2%	7.5%	0.9%	1.7%	0.03%	3.9%	0.2%
SEK	10.8%	2.8%	9.7%	1.8%	13.1%	3.0%	9.5%	1.5%
USD					14.5%	50.1%	27.6%	68.4%

Table 2: Hedging Snapshots: USD Investors

This table presents, for US-dollar domiciled investors, in each month for each foreign currency the proportion of funds hedging, unhedged, and FX only (holding only FX forwards, without owning any underlying asset in that currency). We then calculate the average hedge ratio for the entities that hedge. We require at least 3 fund-currency observations in a given month to include a monthly observation before computing the averages across time, from February 1998 to December 2025. Portfolio refers to portfolio hedge ratios, defined in the text.

Panel A: USD Equity Funds

	Avg 1998-2025				Avg 2021-2025			
	%Hedged	**%Unhedged**	**%FX Only**	**Avg HR**	**%Hedged**	**%Unhedged**	**%FX Only**	**Avg HR**
AUD	28%	66%	5%	8%	38%	54%	8%	16%
CAD	26%	68%	6%	37%	35%	56%	9%	49%
CHF	31%	67%	3%	22%	44%	51%	5%	18%
EUR	35%	65%	0%	32%	51%	49%	0%	50%
GBP	32%	67%	1%	33%	47%	51%	2%	42%
JPY	36%	63%	1%	25%	34%	63%	3%	19%
NOK	19%	69%	12%	54%	30%	51%	19%	37%
NZD	12%	61%	27%	71%	14%	43%	43%	73%
SEK	21%	71%	8%	18%	27%	53%	20%	30%
Average	27%	66%	7%	33%	36%	52%	12%	37%
Portfolio	36%	64%	0%	30%	47%	53%	0%	44%

Panel B: USD Fixed-Income Funds

	Avg 1998-2025				Avg 2021-2025			
	%Hedged	**%Unhedged**	**%FX Only**	**Avg HR**	**%Hedged**	**%Unhedged**	**%FX Only**	**Avg HR**
AUD	45%	10%	45%	63%	58%	8%	34%	79%
CAD	59%	15%	26%	53%	57%	6%	37%	69%
CHF	24%	6%	71%	65%	37%	6%	57%	72%
EUR	85%	15%	1%	65%	91%	9%	0.3%	88%
GBP	78%	15%	7%	67%	89%	9%	3%	88%
JPY	58%	11%	31%	28%	66%	7%	27%	63%
NOK	27%	14%	59%	57%	30%	11%	59%	74%
NZD	35%	10%	54%	91%	49%	9%	42%	93%
SEK	48%	16%	36%	53%	43%	9%	48%	78%
Average	51%	12%	37%	60%	58%	8%	34%	78%
Portfolio	84%	16%	0%	61%	92%	8%	0%	88%

Table 3: Extensive Margin, Average Proportion of Funds Hedging, Multiple Base Currencies

This table presents, for each base currency and each foreign currency, the average, over time, of the monthly cross-fund average proportion of funds hedging, in addition to the same evaluated at the portfolio level for each base currency. See appendix for details on the set of funds used. We further require that each currency-month has at least 3 observations, and that each currency has 12 months of observations after imposing the previous restrictions. The column average reflects an average across base currencies for each foreign currency; the row average reflects the average across foreign currencies for each base currency.

Panel A: Equity Funds

	Base Currency					
Hedged Currency:	**AUD**	**CAD**	**EUR**	**GBP**	**USD**	**Average**
AUD		43%	39%	20%	30%	33%
CAD	53%		36%	18%	28%	34%
CHF	48%	38%	35%	26%	32%	36%
EUR	58%	46%		37%	35%	44%
GBP	52%	42%	42%		32%	42%
JPY	63%	53%	52%	36%	36%	48%
NOK	43%	38%	28%	18%	22%	30%
NZD	70%	41%	34%	16%	18%	36%
SEK	44%	34%	30%	21%	23%	30%
USD	61%	54%	52%	37%		51%
Average	55%	43%	39%	25%	28%	38%
Portfolio	54%	44%	54%	32%	36%	44%

Panel B: Fixed-Income Funds

	Base Currency					
Hedged Currency:	**AUD**	**CAD**	**EUR**	**GBP**	**USD**	**Average**
AUD		89%	84%	84%	80%	84%
CAD	91%		88%	75%	80%	83%
CHF	96%		83%	93%	71%	86%
EUR	94%	85%		89%	85%	88%
GBP	94%	80%	90%		83%	87%
JPY	92%	84%	90%	80%	85%	86%
NOK	85%	86%	76%	69%	63%	76%
NZD	94%	89%	83%	88%	77%	86%
SEK	89%	73%	83%	71%	76%	78%
USD	93%	88%	91%	88%		90%
Average	92%	84%	85%	82%	78%	84%
Portfolio	89%	86%	90%	86%	84%	87%

Table 4: Intensive Margin: Average Hedge Ratios of Hedgers, Multiple Base Currencies

This table presents, for each base currency and each foreign currency, the average, over time, of the monthly cross-fund average hedge ratio taken over the set of funds hedging, in addition to the same evaluated at the portfolio level for each base currency. Sample restrictions are described in the text. We further require that each currency-month has at least 3 observations, and that each currency has 12 months of observations. The column average reflects an average across base currencies for each foreign currency; the row average reflects the average across foreign currencies for each base currency.

Panel A: Equity Funds

	Base Currency					
Hedged Currency:	**AUD**	**CAD**	**EUR**	**GBP**	**USD**	**Average**
AUD		31%	61%	39%	8%	34%
CAD	68%		43%	40%	37%	47%
CHF	57%	27%	54%	39%	22%	39%
EUR	52%	34%		40%	32%	40%
GBP	63%	40%	46%		33%	45%
JPY	55%	15%	57%	43%	25%	39%
NOK	48%	48%	63%	63%	54%	55%
NZD	97%	80%	88%		71%	84%
SEK	67%	32%	49%	51%	18%	43%
USD	51%	40%	59%	28%		44%
Average	62%	38%	58%	43%	33%	47%
Portfolio	60%	49%	43%	44%	30%	45%

Panel B: Fixed-Income Funds

	Base Currency					
Hedged Currency:	**AUD**	**CAD**	**EUR**	**GBP**	**USD**	**Average**
AUD		110%	91%	72%	63%	84%
CAD	96%		87%	68%	53%	76%
CHF	98%		103%	93%	65%	90%
EUR	109%	87%		91%	65%	88%
GBP	106%	98%	100%		67%	93%
JPY	84%	39%	87%	41%	28%	56%
NOK	71%	75%	80%	81%	57%	73%
NZD	100%	116%	98%	99%	91%	101%
SEK	93%	88%	82%	61%	53%	75%
USD	101%	90%	100%	92%		96%
Average	95%	88%	92%	78%	60%	83%
Portfolio	105%	93%	101%	97%	61%	91%

Table 5: Hedge Ratios (Intensive Margin) - Fund Distributions

This table presents statistics across portfolios of average hedge ratios for funds over time. These are first computed for each fund, then distributions are calculated across funds. Reported for EUR and USD base investors, equity and fixed-income portfolios. We report: US investors' hedging of EUR assets, EUR investors' hedging of USD assets, and for each base the respective portfolio hedge ratios as well as averages of statistics (first computed currency by currency) across groups of foreign currencies. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). We further require that each fund-currency is hedged for at least 12 months (not necessarily contiguous) after imposing the previous restrictions.

Panel A: USD Funds

	Equity Funds				Fixed-Income Funds			
	25th	**Median**	**75th**	**Mean**	**25th**	**Median**	**75th**	**Mean**
EUR	0%	23%	51%	29%	14%	90%	112%	65%
Avg. (All)	-4%	31%	66%	29%	19%	75%	101%	59%
Portfolio	9%	19%	45%	29%	2%	83%	111%	59%

Panel B: EUR Funds

	Equity Funds				Fixed-Income Funds			
	25th	**Median**	**75th**	**Mean**	**25th**	**Median**	**75th**	**Mean**
USD	22%	72%	101%	61%	97%	104%	118%	98%
Avg. (All)	29%	83%	100%	60%	85%	100%	109%	91%
Portfolio	10%	51%	99%	50%	95%	105%	120%	100%

Table 6: Comparing Hedge Ratios to Minimum Variance Benchmarks

The first two rows of each panel show the variance minimizing hedge ratios for EUR- and USD-based investors hedging different currencies, based on covariances over the full sample period. The remaining rows compare these hedge ratios to the intensive and extensive margin means, as reported in Table 3.

		Equity Funds											
	Base Currency	**AUD**	**CAD**	**CHF**	**EUR**	**GBP**	**JPY**	**NOK**	**NZD**	**SEK**	**USD**	**Mean**	**ρ with MinVar**
Min Var	EUR	156%	136%	32%		75%	33%	174%	133%	177%	50%	107%	
	USD	147%	187%	79%	117%	111%	39%	157%	127%	127%		121%	
Actuals Extensive	EUR	39%	36%	35%		42%	52%	28%	34%	30%	52%	39%	-75%
	USD	30%	28%	32%	35%	32%	36%	22%	18%	23%		28%	-54%
Actuals Intensive	EUR	61%	43%	54%		46%	57%	63%	88%	49%	59%	58%	14%
	USD	8%	37%	22%	32%	33%	25%	54%	71%	18%		33%	25%
		Fixed-Income Funds											
	Base Currency	**AUD**	**CAD**	**CHF**	**EUR**	**GBP**	**JPY**	**NOK**	**NZD**	**SEK**	**USD**	**Mean**	
Min Var	EUR	87%	85%	118%		86%	103%	92%	93%	87%	90%	93%	
	USD	94%	92%	104%	103%	92%	103%	97%	98%	94%		97%	
Actuals Extensive	EUR	84%	88%	83%		90%	90%	76%	83%	83%	91%	85%	-14%
	USD	80%	80%	71%	85%	83%	85%	63%	77%	76%		78%	-4%
Actuals Intensive	EUR	91%	87%	103%		100%	87%	80%	98%	82%	100%	92%	34%
	USD	63%	53%	65%	65%	67%	28%	57%	91%	53%		60%	-16%

Table 7: Dynamic Hedging: Pooled Regressions, USD and EUR Funds

This table presents pooled (across funds) regression estimates of dynamic hedge ratios from estimating the impact of a change in foreign asset holdings on the corresponding change in FX position. Specifically, we estimate:

$$-\frac{\Delta_{t-k,t}FX_{f,c,t}}{FA_{f,c,t-k}} = a + DHR_{f,c} \cdot \frac{\Delta_{t-k,t}FA_{f,c,t}}{FA_{f,c,t-k}} + e_{f,c,t}$$

where the estimated coefficient *DHR* measures the dynamic hedge ratio. We shows results for USD and EUR based investors across different groups of currencies they hedge. We report two differencing horizons, 1 and 12 months. We require at least 12 observations to estimate *DHR* for a fund. *t*-statistics are based on standard errors clustered by fund and month.

Panel A: Equity Funds

		USD funds			EUR funds		
k:		**EUR**	**Mean all**	**Portfolio**	**USD**	**Mean all**	**Portfolio**
1 Month	*DHR*	0.31	0.39	0.26	0.48	0.61	0.44
	[*t*-stat]	[8.53]	[10.03]	[5.87]	[8.41]	[10.35]	[5.57]
	Adj R2	6%	9%	5%	14%	28%	9%
12 Month	*DHR*	0.38	0.44	0.32	0.62	0.68	0.52
	[*t*-stat]	[11.08]	[10.25]	[9.09]	[9.27]	[10.20]	[7.84]
	Adj R2	20%	22%	21%	38%	44%	32%

Panel B: Fixed Income Funds

		USD funds			EUR funds		
k:		**EUR**	**Mean all**	**Portfolio**	**USD**	**Mean all**	**Portfolio**
1 Month	*DHR*	0.49	0.58	0.42	0.55	0.67	0.58
	[*t*-stat]	[18.95]	[16.64]	[14.75]	[15.06]	[14.91]	[16.35]
	Adj R2	13%	14%	8%	16%	22%	17%
12 Month	*DHR*	0.68	0.69	0.61	0.87	0.87	0.90
	[*t*-stat]	[27.76]	[22.01]	[19.40]	[37.51]	[25.46]	[39.61]
	Adj R2	39%	33%	31%	60%	58%	60%

Table 8: Dynamic Hedging: Fund-level Regression Distributions, USD and EUR Base

We estimate:

$$-\frac{\Delta_{t-k,t}FX_{f,c,t}}{FA_{f,c,t-k}} = a + DHR_{f,c} \cdot \frac{\Delta_{t-k,t}FA_{f,c,t}}{FA_{f,c,t-k}} + e_{f,c,t}$$

for each fund, then report below distributions of *DHR* coefficients across funds. The differencing horizon k is one month. Reported for USD and EUR base investors, equity and fixed-income portfolios. For each group we report: US investors' dynamic hedging of EUR assets and EUR investors' dynamic hedging of USD assets, mean hedge ratios across all currencies, and portfolio hedge ratios. Each fund-currency regression requires 12 observations.

Panel A: USD funds

	Equity funds				Fixed income funds			
	25th	**Median**	**75th**	**Mean**	**25th**	**Median**	**75th**	**Mean**
EUR	-0.04	0.18	0.46	0.24	0.16	0.55	0.88	0.51
Avg. (All)	0.08	0.33	0.62	0.33	0.22	0.63	0.91	0.55
Portfolio	-0.01	0.10	0.34	0.19	0.08	0.39	0.76	0.39

Panel B: EUR funds

	Equity funds				Fixed income funds			
	25th	**Median**	**75th**	**Mean**	**25th**	**Median**	**75th**	**Mean**
USD	0.13	0.45	0.78	0.47	0.28	0.64	0.92	0.61
Avg. (All)	0.19	0.56	0.86	0.51	0.43	0.75	0.95	0.68
Portfolio	0.04	0.38	0.78	0.41	0.32	0.67	0.93	0.63

Table 9: Hedging Tightness – Avg. HR vs Dynamic Coefficients, USD Funds

This table presents statistics across portfolios of funds' relating to funds' dynamic hedge ratio coefficients and average static hedge ratios. First we correlate, over funds, dynamic hedging coefficients with their respective average static hedge ratios. Second, we correlate the same average static hedge ratios to the adjusted R^2 from dynamic hedging regressions. Reported for USD base investors, equity and fixed-income portfolios. We report for: US investors' hedging of EUR assets, USD portfolio hedging, and averages across groups of foreign currencies. Currency group averages are of the associated single currencies' correlations. We report two differencing horizons, 1 and 12 months. These refer to the differencing horizons in equations (6) and (7) above. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). Each individual fund-currency regression and static hedge ratio used requires at least 12 fund-currency-month observations underlying the average or coefficient. We further require that dynamic hedge ratio coefficients are of <= 2 in absolute value.

Panel A: Equity Funds

		EUR	Avg. (Majors)	Avg. (Non-Majors)	Avg. (All)	Portfolio
1 M	Corr(*DHR*, Avg *HR*)	60%	44%	43%	43%	55%
	Corr(*DHR* R^2, Avg *HR*)	43%	36%	36%	36%	39%
12 M	Corr(*DHR*, Avg *HR*)	66%	47%	59%	54%	68%
	Corr(*DHR* R^2, Avg *HR*)	45%	43%	40%	41%	52%

Panel B: Fixed-Income Funds

		EUR	Avg. (Majors)	Avg. (Non-Majors)	Avg. (All)	Portfolio
1 M	Corr(*DHR*, Avg *HR*)	58%	52%	33%	41%	46%
	Corr(*DHR* R^2, Avg *HR*)	46%	42%	34%	38%	32%
12 M	Corr(*DHR*, Avg *HR*)	68%	62%	44%	52%	60%
	Corr(*DHR* R^2, Avg *HR*)	62%	58%	51%	54%	53%

Table 10: Determinants of Hedging – Correlations

This table shows correlations between aggregate foreign hedge ratios (averaged across funds in each month for each currency) and various economic and financial features of these currencies (See Appendix table A7 for definitions of the features). Correlations are computed from 1998-2025 for USD base currency results, 2003-2025 for EUR base currency results. We report panel correlations (across all currency hedge ratios and their associated financial characteristics) for USD and EUR investors across their different foreign hedge ratios, and timeseries correlations for USD investors' hedging of EUR and EUR investors' hedging of USD respectively. See appendix for details on the set of funds used. We further require that each currency-month has at least 3 observations, and that each currency has 12 months of observations after imposing the previous restrictions. **Bold** indicates the correlation is significant at the 95th percent confidence level; we adjust standard errors for the correlations by Newey-West (1987) modified for use in a panel (Petersen 2009).

	USD Funds				**EUR Funds**			
	EQ Funds		**FI Funds**		**EQ Funds**		**FI Funds**	
	EUR TS	**Panel**	**EUR TS**	**Panel**	**USD TS**	**Panel**	**USD TS**	**Panel**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post GFC Dummy	**76%**	**19%**	**82%**	**27%**	-1%	4%	**-32%**	**21%**
Hedging Cost	**-38%**	9%	**-35%**	**17%**	17%	**16%**	**-28%**	6%
FX Spot Momentum	-15%	**-20%**	-2%	-3%	11%	**12%**	**-28%**	**-17%**
Local Asset Momentum	23%	6%	**-34%**	-4%	2%	9%	10%	-3%
FX Volatility	**-46%**	-9%	**-40%**	-4%	-12%	-6%	**33%**	-8%
Asset Local Volatility	**-29%**	**-13%**	**38%**	**25%**	-24%	-5%	16%	**27%**
Correl (Asset Local, FX Spot)	**65%**	**19%**	-14%	-6%	**28%**	**-16%**	**-27%**	-5%

Table 11: Determinants of Hedging – Aggregate Regressions, USD Base

This table shows the result of panel regressions (equation (8) above) of aggregate foreign hedge ratios (averaged across funds in each month for each currency) on various economic and financial features of these currencies (See Appendix table A7 for definitions of the features). Estimated from 1998-2025, USD investors' monthly foreign hedge ratios. See appendix for details on the set of funds used. We further require that each currency-month has at least 3 observations, and that each currency has 12 months of observations after imposing the previous restrictions. We adjust standard errors by Newey-West (1987) modified for use in a panel (Petersen 2009) with a 12 month window. For currency fixed effects, AUD is the reference group.

	Panel A: Equity Investors			**Panel B: Fixed-Income Investors**		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.08	0.40	0.19	0.63	0.45	0.62
[*t*]	*[4.31]*	*[12.71]*	*[7.63]*	*[44.43]*	*[14.34]*	*[20.65]*
Post GFC Dummy		0.08	0.08		0.18	0.19
[*t*]		*[5.74]*	*[6.43]*		*[9.68]*	*[12.11]*
Hedging Cost (Carry)		2.14	0.01		3.73	-1.10
[*t*]		*[6.37]*	*[0.02]*		*[10.11]*	*[-2.98]*
FX Spot Momentum		-0.68	-0.52		-0.18	-0.06
[*t*]		*[-9.34]*	*[-8.49]*		*[-2.17]*	*[-0.98]*
Local Asset Momentum		0.11	0.08		0.10	-0.09
[*t*]		*[2.57]*	*[2.03]*		*[0.72]*	*[-0.77]*
FX Volatility		-1.15	-1.77		-0.90	-0.76
[*t*]		*[-4.71]*	*[-8.35]*		*[-3.88]*	*[-3.74]*
Asset Local Volatility		-0.11	0.05		3.23	1.00
[*t*]		*[-1.09]*	*[0.52]*		*[12.27]*	*[2.90]*
Correl (Asset Local, FX Spot)		0.06	0.06		0.13	0.21
[*t*]		*[3.62]*	*[2.73]*		*[4.78]*	*[9.28]*
R^2 Adj	39.07%	11.82%	48.29%	33.60%	17.81%	45.35%
N Obs.	2947	2947	2947	2853	2853	2853
Currency Fixed Effects	y	n	y	y	n	y

Table 12: Determinants of Hedging – Aggregate Regressions, EUR Base

This table shows the result of panel regressions (equation (8) above) of aggregate foreign hedge ratios (averaged across funds in each month for each currency) on features of these currencies (See Appendix table A7 for definitions of the features). Estimated from 2003-2025, EUR investors' monthly foreign hedge ratios. See appendix for details on the set of funds used. We further require that each currency-month has at least 3 observations, and that each currency has 12 months of observations after imposing the previous restrictions. We adjust standard errors by Newey-West (1987) modified for use in a panel (Petersen 2009) with a 12 month window. For currency fixed effects, AUD is the reference group.

	Panel A: Equity Investors			**Panel B: Fixed-Income Investors**		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.61	0.48	0.54	0.91	0.84	0.81
[*t*]	*[18.90]*	*[10.15]*	*[9.64]*	*[55.39]*	*[33.65]*	*[26.34]*
Post GFC Dummy		0.03	0.02		0.07	0.06
[*t*]		*[1.34]*	*[0.60]*		*[4.54]*	*[3.60]*
Hedging Cost (Carry)		4.72	5.76		1.15	1.36
[*t*]		*[5.53]*	*[5.22]*		*[3.66]*	*[3.34]*
FX Spot Momentum		0.28	0.26		-0.34	-0.36
[*t*]		*[2.80]*	*[2.71]*		*[-6.87]*	*[-7.08]*
Local Asset Momentum		0.11	0.07		0.19	0.01
[*t*]		*[1.75]*	*[1.03]*		*[2.10]*	*[0.08]*
FX Volatility		0.32	-0.33		-0.89	-0.35
[*t*]		*[0.73]*	*[-0.82]*		*[-4.80]*	*[-1.51]*
Asset Local Volatility		0.01	0.07		2.76	1.50
[*t*]		*[0.03]*	*[0.32]*		*[11.62]*	*[4.78]*
Correl (Asset Local, FX Spot)		-0.18	-0.13		0.05	-0.02
[*t*]		*[-6.43]*	*[-3.00]*		*[2.49]*	*[-0.76]*
R^2 Adj	6.22%	9.25%	13.58%	15.79%	13.91%	23.07%
N Obs.	2015	2015	2015	2212	2212	2212
Currency Fixed Effects	y	n	y	y	n	y

Table 13: Determinants of Hedging Variance Decomposition – Adjusted R^2

This table shows the adjusted R^2 obtained from a set of panel regressions (equation (9) above) estimated from fund-currency foreign hedge ratios regressed on features of these currencies (See Appendix table A7 for definitions of the features). Estimated from 1998-2025 for USD base investors, from 2003-2025 for EUR base currency investors. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). We further require that each fund has 12 months of hedged observations for inclusion, after imposing the previous restrictions. Standard errors are clustered by fund and month. For currency fixed effects, AUD is the reference group. Fund FE refers to the inclusion of fund-level fixed effects. Currency FE refers to the inclusion of currency fixed effects. For currency fixed effects, AUD is the reference group.

			USD Funds		EUR Funds	
Fund FE	**Currency FE**	**Controls**	**EQ**	**FI**	**EQ**	**FI**
N	N	Y	2.60%	3.62%	1.19%	2.15%
N	Y	N	3.66%	3.91%	2.12%	2.57%
N	Y	Y	5.65%	6.27%	2.81%	3.38%
Y	N	N	39.23%	46.26%	63.36%	38.88%
Y	N	Y	40.11%	47.21%	63.46%	39.91%
Y	Y	N	41.79%	48.03%	63.98%	39.84%
Y	Y	Y	42.17%	48.13%	64.05%	40.49%

Supplementary Appendices for:

How do Global Portfolio Investors Hedge Currency Risk?

Appendix: Data Cleaning

Data Cleaning: Aggregate Analyses

A portfolio of equity or fixed income assets is classified as **matched** if it has traded any FX forwards in the prior year, and if it holds assets whose local currency differs from the fund's base currency. This condition is determined at the fund level. For example, a USD based equity investor holding Japanese equities that has not undertaken any trading in FX forwards over the prior year would not be classified as matched, but a USD based equity fund that holds Japanese equities and traded an FX forward in EURUSD would be classified as matched.[13]

We then apply an additional basic screen, removing funds with fewer than 2 distinct months with some forward trade of tenor at least 2 weeks over their entire history in the sample. This ensures that we do not include funds that may have been spuriously flagged as "matched" due only to a few very short-dated forward trades. Our initial observation count is 3,927,793 which falls to 3,538,127 after this filter.

Next, we apply data filters ("Basic Fund Filters") before tabulating statistics below. First we screen funds based on their historical behavior (computing statistics over time for each fund) to ensure we are restricting to funds who primarily hold the equity, fixed-income, and money-market assets that comprise our hedge ratio denominators. We tabulate the proportion of foreign asset holdings held in these categories ("tracked assets") and exclude funds that hold significant assets from other categories. This help ensure that we do not overstate hedge ratios by under-measurement of the denominator. We also apply filters to exclude funds that engage in very low degrees of international investment, exhibit extreme ratios of FX forward vs foreign asset holdings, and funds that do not primarily invest in developed market assets (as the focus of this study is G10 currencies). Accordingly, we remove funds where the following bind:

1. The 25th percentile of the proportion of all tracked foreign G10 currency assets issued by G10 currency countries or by tax havens[14] assets is < 90%
2. Fewer than 12 months of historical data.
3. Median of the ratio of portfolio gross FX forward holdings to foreign assets > 400%.[15]
4. Maximum % of AUM in foreign assets less than 10%

[13] The latter portfolio could hold unhedged Japanese equities. We would include such a position – a fund that has traded FX forwards currently holding Japanese equities without any FX position in JPY – in our hedge ratio calculations (in this case with a hedge ratio of zero). We analyze these daily data on a monthly basis.

[14] ISO country codes used for tax havens: BM, LU, KY, VG, VI, JE, IM, GG, BS.

[15] "Gross FX" refers to the sum of absolute FX forward holdings after first aggregating to the currency level (after decomposing each trade into its constituent currency legs) within each fund.

5. Median % of non-developed market[16] foreign holdings > 15% or 75th percentile >20%.

Applying the above filters leaves us with 2,266,036 observations. We then evaluate funds each month, removing fund-months where funds have:

1. Less than 1 million USD in foreign assets or less than 20 million USD in total assets
2. Under 20 underlying asset positions (securities) for equity funds, 10 for bond funds.
3. Under 10 underlying foreign asset positions (securities) for equity funds, 5 for bond funds.
4. Less than 1% of AUM in foreign assets

The above leaves us with 1,818,910 observations. We finally enumerate a set of "hedger" *positions* before averaging across funds to compute statistics on static hedge ratios. To qualify as a "hedger position" we require that a given fund-currency-month satisfy:

1. Absolute hedge ratio >= 5% and <=200%
2. Underlying asset value >= 10,000 USD

A fund or position failing to meet conditions in one fund-currency-month may later qualify (for instance, if a fund has grown a very small initial position up to a size matching our threshold). Where we compute cross-fund average hedge ratios, we compute these averages over the set of cleaned "hedger" fund-currency-month observations.

Note that classification as a hedger is specific to a given currency in a fund. Suppose a fund holds equity assets in all G10 currencies. The fund may count as a hedger for NZD equity if it has a nontrivial hedge ratio in NZD equity in a given month. The same fund may fail to count as a hedger in NOK if it has below threshold hedge ratio for its NOK equity. Note also that we tabulate portfolio and foreign hedge ratios separately for the above. A fund with a USD base currency that hedges EUR and JPY sufficiently, but holds unhedged positions in CAD would count as hedger with regard EUR and JPY foreign hedge ratios as well as the USD portfolio hedge ratio, but not for CAD. After the above filtering we have 1,787,746 fund-currency-month observations, and 744,561 observations for hedger positions.

Data Cleaning: Fund-Currency Analyses

For our regression and other analyses performed at the fund-currency level, we begin with the same fund and fund-currency filters as above, excluding the "hedger position" filter step. We then apply a similar general filter, again requiring fund-currency-months satisfy:

1. Absolute hedge ratio <=200%

[16] We include DKK, HKD, and SGD assets as "developed" in addition to G10, following MSCI classifications. As many funds have developed market mandates, including these alongside G10 assets allows us to more precisely target emerging market funds for exclusion, in order to better align foreign and portfolio hedge ratio denominators.

2. Underlying asset value >= 10,000 USD

We next enumerate a set "hedger *funds*", and we do so foreign currency by foreign currency, as well as separately at the portfolio level. A fund might be labeled as a hedger for AUD, but not for CAD, depending on its behavior. For fund-currency level analysis, we tag a given fund in a given currency as a hedger by averaging over time and counting nontrivial hedge ratio observations. We require that:

1. Average (over time) fund-currency absolute hedge ratio >= 5%.
2. At least 3 months with fund-currency absolute hedge ratio >=5%

for a fund to qualify as a hedger in a given currency. This is a classification that binds across time for a given fund in a given foreign currency or, separately, for the portfolio hedge ratio.

For analyses of **extensive** margin, we include fund-currency-months where a fund might have ceased to hedge a currency for which it otherwise qualified as a hedger. For instance if a fund has an average hedge ratio in AUD of 10% but has over time flipped between 100% hedging and 0% hedging, we would include its unhedged observations in analyses of extensive margin. This enables us to gauge how frequently these funds in these currencies, which we know at least occasionally hedge, choose to hedge, while excluding non-hedger funds that rarely hedge particular currencies at all.

For analyses focused on **intensive** margins, we focus specifically on hedged *positions* of hedger *funds* by impose more granular filters at the position (fund-currency-month) level:

- Remove fund-currency-month positions with absolute hedge ratios under 5%.

The additional filters yield 1,514,999, fund-currency-month observations with 715,858 for hedgers. For the same AUD hedging fund example above, we would only use its hedged observations, yielding an average hedge ratio of 100%.

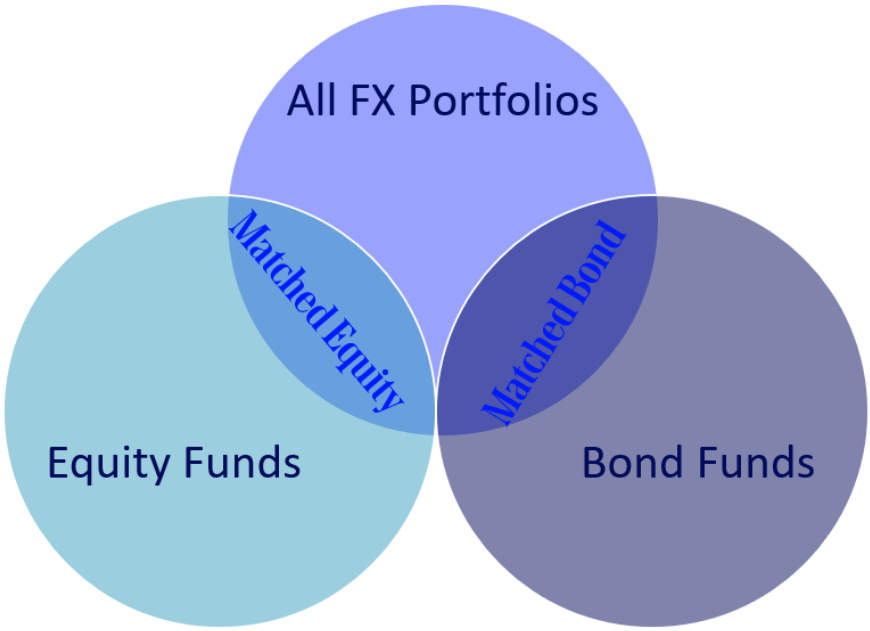
Data Cleaning Glossary:

Matched Funds: portfolios that both hold foreign assets and have traded FX forwards in the past year

Hedger Funds: funds having an average absolute hedge ratio of at least 5% in at least one currency

Hedger Positions: fund-currency positions having a hedge ratio with absolute value of at least 5% in that specific currency in that month.

Figure A1: Dataset Components This figure shows schematics of the different components of the dataset used, and the sequence of filters that winnow the dataset for various stages of analysis.



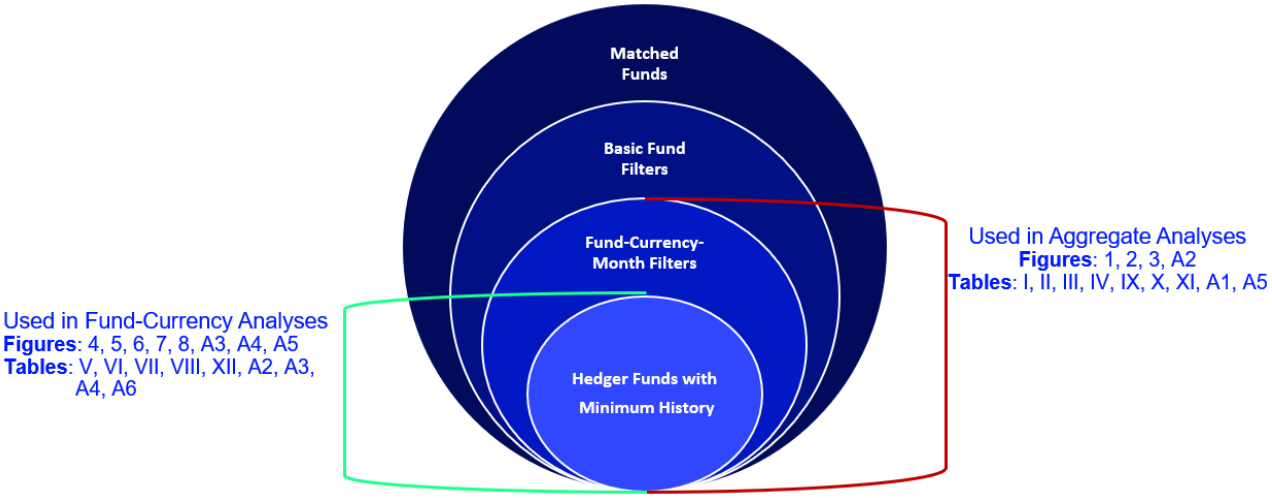
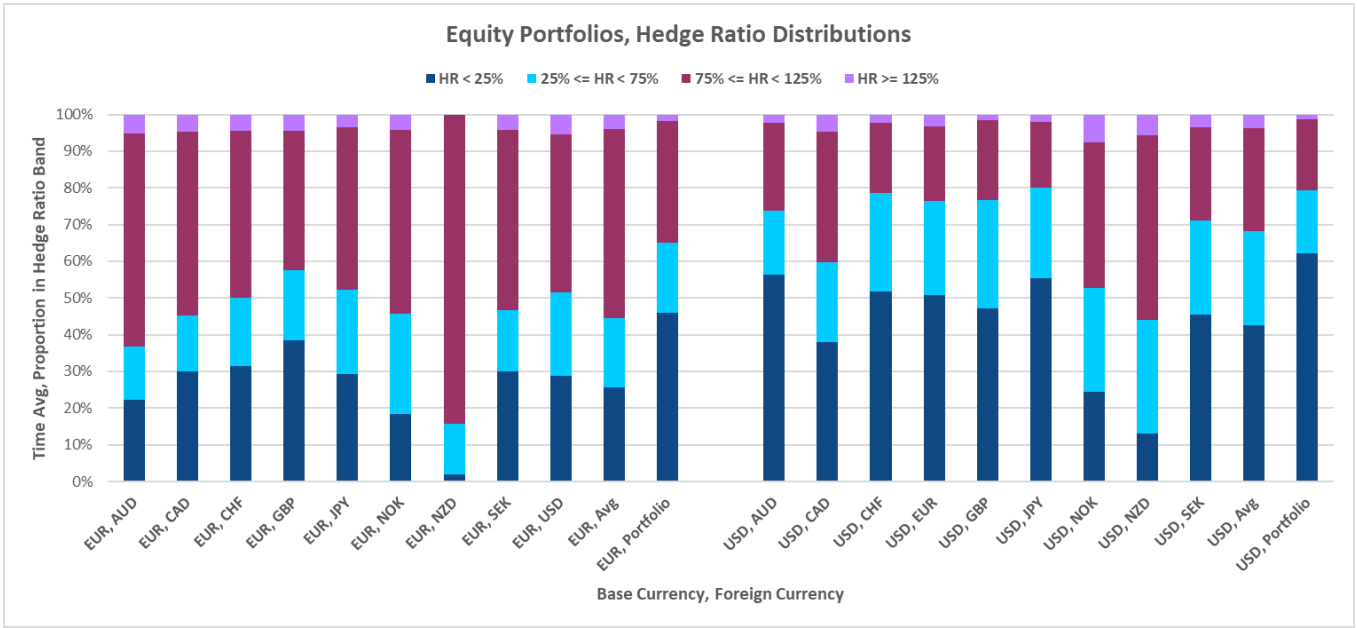


Figure A2: Average Hedging Frequency by Band: This figure shows the average (over time) proportion of US and European equity and fixed-income funds between February 1998 and December 2025 with hedge ratios within several ranges: under 25%, 25% to 75%, 75% to 125%, and over 125%. Each month we compute the proportion of funds with hedge ratios in the given range before averaging across time. We restrict to funds with nonzero hedge ratios (see appendix for details; "hedger" funds and "hedger" positions). We further require that each currency-month has at least 3 observations, and that each currency has 12 months of observations after imposing the previous restrictions.



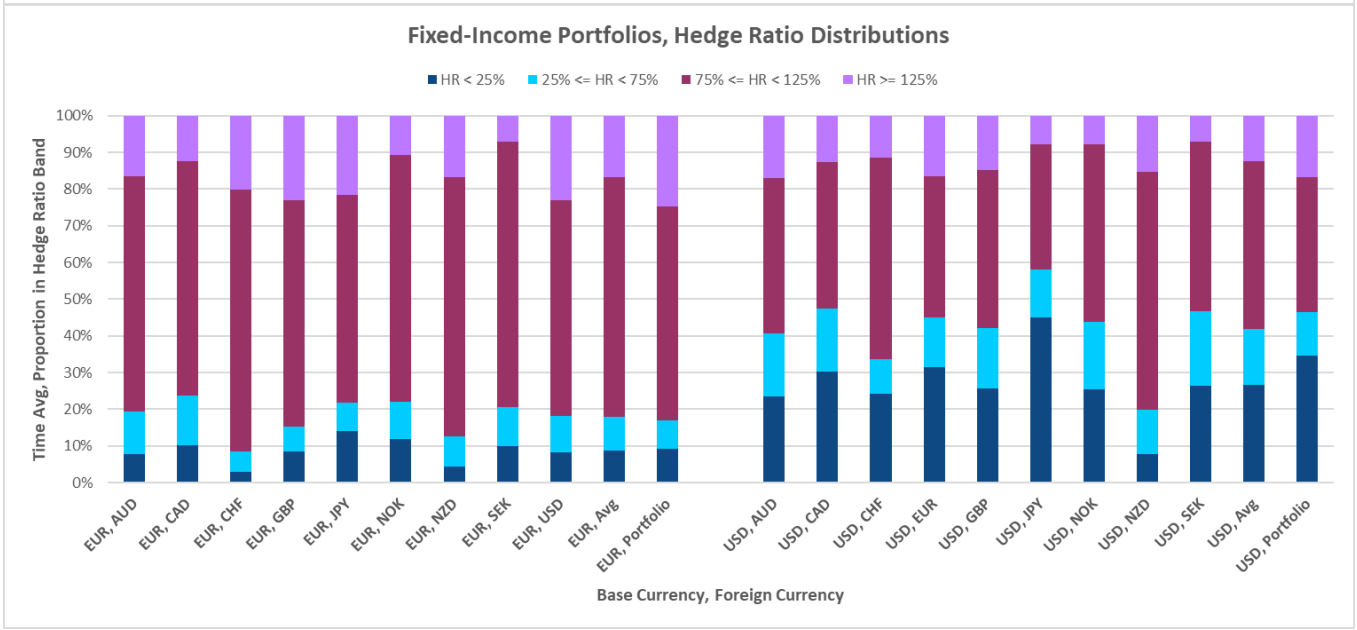


Figure A3: Static Hedge Ratio CDFs: This figure shows the cumulative distribution functions across funds of average hedge ratios. We compute an average across time for each fund-currency and plot the averages. Reported for EUR and USD base investors, equity and fixed-income portfolios. We report: US investors' hedging of EUR assets, EUR investors' hedging of USD assets, and for each base the respective portfolio hedge ratios. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). We further require that each fund-currency is hedged for at least 12 months (not necessarily contiguous) after imposing the previous restrictions.

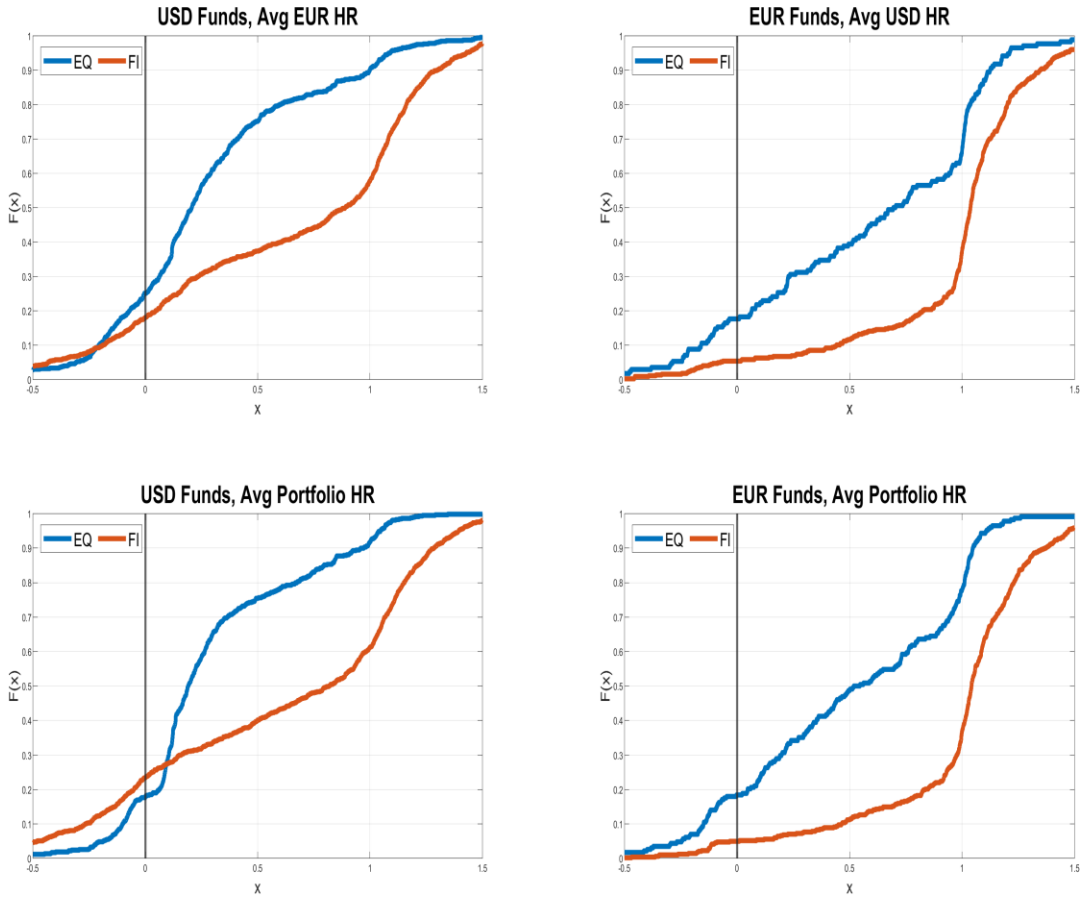


Figure A4: Dynamic Hedge Ratio CDFs, USD Funds: This figure shows the cumulative distribution functions across funds of dynamic hedge ratio coefficients for USD base investors, equity and fixed-income portfolios. We report US investors' hedging of EUR assets and USD portfolio hedge ratios. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). We further require at least 12 observations (for 1 month horizon, 12 monthly differences; for 12 month horizon, 12 distinct 12-month differences) to estimate a given coefficient.

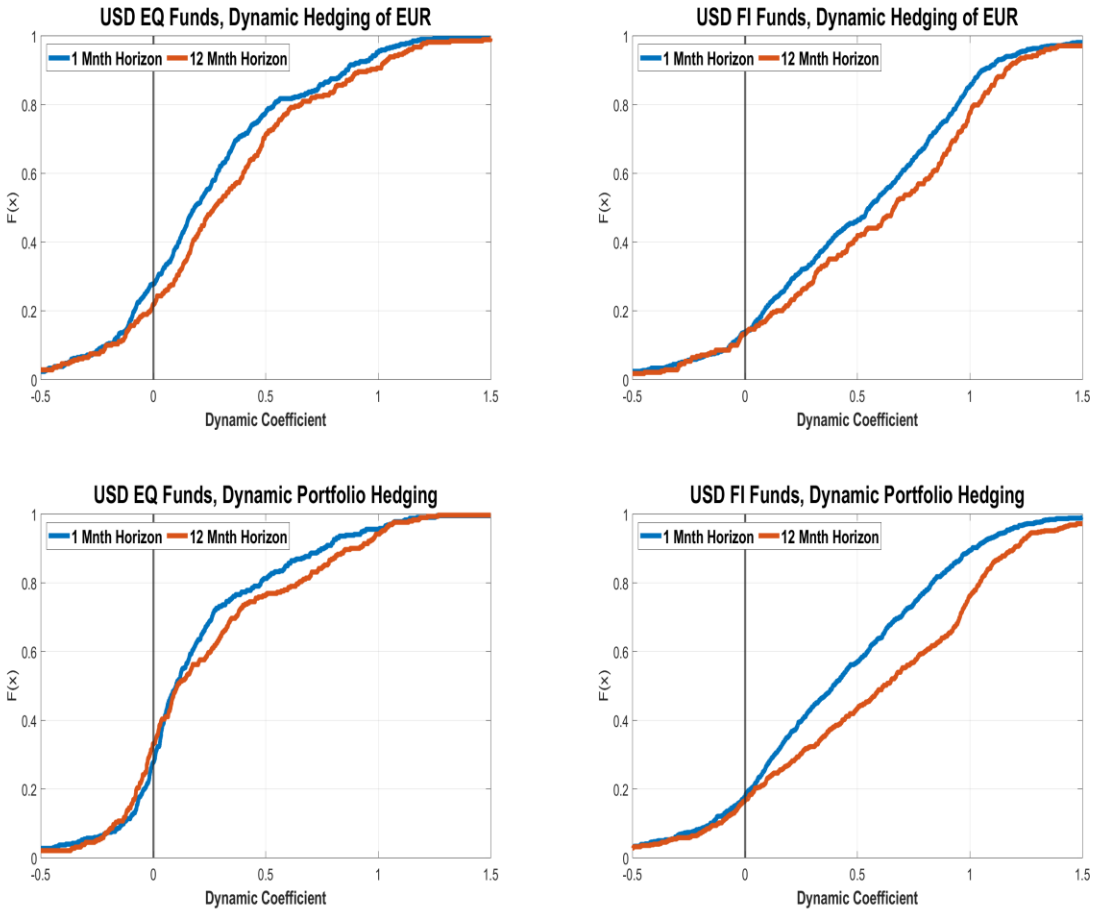


Figure A5: Dynamic Hedge Ratio CDFs, EUR Funds: This figure shows the cumulative distribution functions across funds of dynamic hedge ratio coefficients for EUR base investors, equity and fixed-income portfolios. We report EUR investors' hedging of USD assets, and EUR portfolio hedge ratios. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). We further require at least 12 observations (for 1 month horizon, 12 monthly differences; for 12 month horizon, 12 distinct 12-month differences) to estimate a given coefficient.

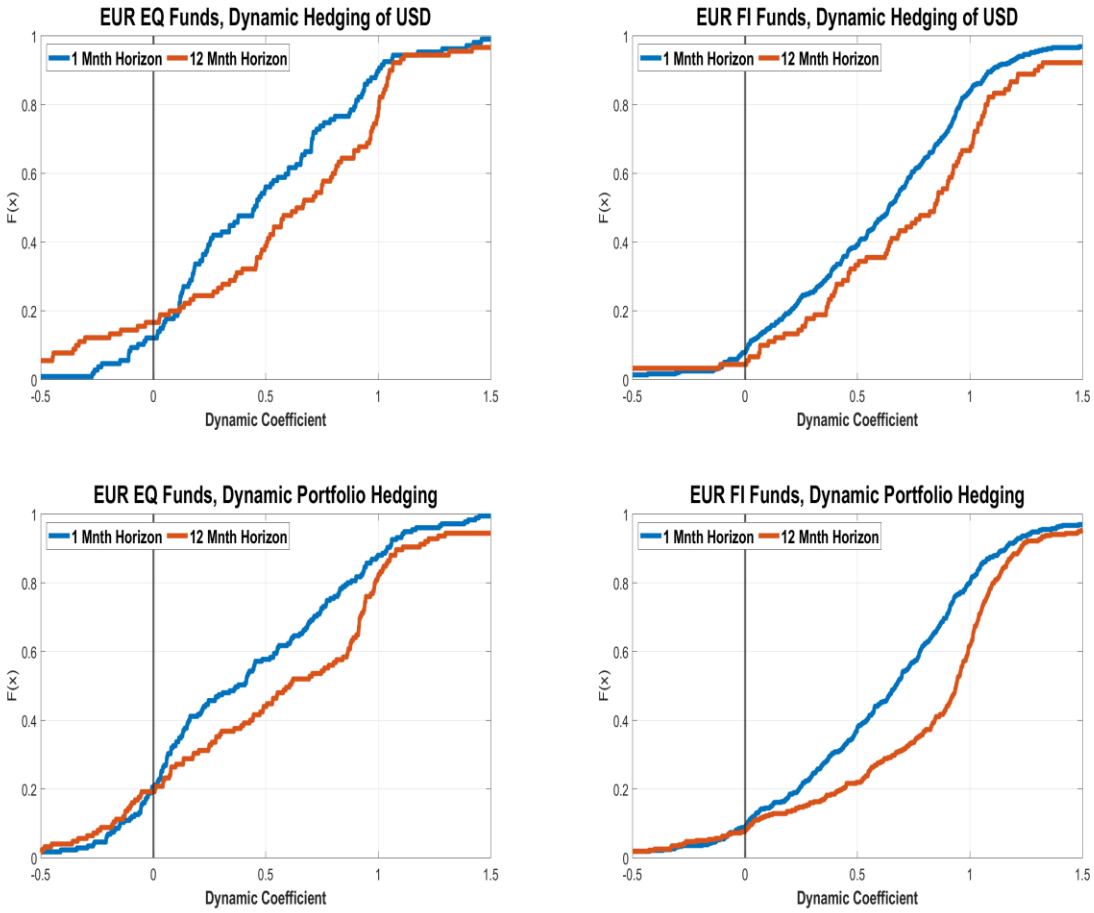


Table A1: Hedging Variability (Aggregate)

This table presents, for EUR and USD base investors, the standard deviation, over time, of average hedge ratios for equity and fixed-income portfolios. We report: US investors' hedging of EUR assets, EUR investors' hedging of USD assets, and for each base the respective portfolio hedge ratios as well as average standard deviations of foreign hedge ratios across groups of foreign currencies. The column All Base Average refers to the average standard deviation across all base currencies we cover (EUR, USD, CAD, AUD, and GBP funds). See appendix for details on the set of funds used ("hedger" funds and "hedger" positions). We further require that each currency-month has at least 3 observations, and that each currency has 12 months of observations after imposing the previous restrictions.

	Equity			**Fixed-Income**		
	EUR Base	**USD Base**	**All Base Average**	**EUR Base**	**USD Base**	**All Base Average**
EUR		21%	27%		18%	22%
USD	18%		22%	14%		19%
Avg. (Majors)	23%	17%	23%	17%	23%	22%
Avg. (Non-Majors)	29%	25%	33%	22%	22%	26%
Avg. (All)	27%	22%	28%	20%	22%	25%
Portfolio	16%	12%	20%	13%	21%	17%

Table A2: Proportion of Time Hedged (Extensive Margin) – Fund Distributions

This table presents statistics across portfolios of the proportion of time asset positions were hedged (the number of months where we observe a hedged underlying position divided by the number of months an underlying position is held for each currency in each fund). These are first computed for each fund, then distributions are calculated across funds. Reported for EUR and USD base investors, equity and fixed-income portfolios. We report: US investors' hedging of EUR assets, EUR investors' hedging of USD assets, and for each base the respective portfolio hedging as well as averages of statistics (first computed currency by currency) across groups of foreign currencies. See appendix for details on the set of funds used ("hedger funds"). We further require that each fund-currency underlying is held for at least 12 months (not necessarily contiguous) after imposing the previous restrictions.

Panel A: USD Funds

	EQ Funds				FI Funds			
	25th	**Median**	**75th**	**Mean**	**25th**	**Median**	**75th**	**Mean**
EUR	26%	60%	89%	57%	81%	93%	100%	86%
Avg. (Majors)	22%	56%	87%	54%	77%	93%	99%	83%
Avg. (Non-Majors)	1%	26%	73%	38%	60%	88%	97%	74%
Avg. (All)	10%	40%	80%	45%	68%	90%	98%	78%
Portfolio	50%	71%	94%	70%	83%	97%	100%	88%

Panel B: EUR Funds

	EQ Funds				FI Funds			
	25th	**Median**	**75th**	**Mean**	**25th**	**Median**	**75th**	**Mean**
USD	48%	86%	100%	70%	93%	98%	100%	92%
Avg. (Majors)	31%	75%	97%	63%	82%	97%	100%	87%
Avg. (Non-Majors)	0%	39%	91%	45%	70%	90%	98%	79%
Avg. (All)	13%	56%	94%	53%	76%	94%	99%	83%
Portfolio	62%	92%	100%	79%	93%	99%	100%	93%

Table A3: Hedging Selectivity

This table presents statistics across portfolios of fund-level averages of: numbers of currencies held (including unhedged), the number hedged, the proportion hedged, and the cross-sectional mean absolute deviation of time-averaged foreign hedge ratios within each fund over currencies. These are first computed for each fund-month and averaged over time for each fund; we then calculate distributions below, across the fund averages. These are reported for equity and fixed-income portfolios, USD and EUR base investors from "hedger" funds, including their unhedged positions. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). We further restrict MAD calculation to funds that have held assets in at least 2 distinct currencies over their history.

		Equity Funds				Fixed-Income Funds			
		#Held	**#Hedged**	**%Hedged**	**MAD(HR)**	**#Held**	**#Hedged**	**%Hedged**	**MAD(HR)**
USD Funds	**25th**	5.00	1.26	24%	8%	2.00	1.79	78%	11%
	Median	6.21	2.55	46%	14%	3.15	2.47	91%	22%
	75th	7.18	4.29	81%	25%	4.39	3.56	97%	36%
	Mean	5.93	2.92	52%	19%	3.40	2.73	83%	26%
EUR Funds	**25th**	3.45	1.00	27%	8%	1.24	1.00	86%	7%
	Median	4.26	2.19	65%	17%	1.96	1.75	96%	20%
	75th	6.21	3.98	93%	29%	2.77	2.33	100%	47%
	Mean	4.67	2.65	60%	22%	2.27	1.99	89%	34%

Table A4: Hedging Variability- Fund Distributions

This table presents statistics across portfolios of hedge ratio standard deviations for funds over time. These are first computed for each fund, then distributions are calculated across funds. Reported for EUR and USD base investors, equity and fixed-income portfolios. We report: US investors' hedging of EUR assets, EUR investors' hedging of USD assets, and for each base the respective portfolio hedge ratios as well as averages of foreign hedging across groups of foreign currencies of statistics (first computed currency by currency) across groups of foreign currencies. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). We further require that each fund-currency is hedged for at least 12 months (not necessarily contiguous) after imposing the previous restrictions.

Panel A: USD Funds

	Equity Funds				Fixed-Income Funds			
	25th	**Median**	**75th**	**Mean**	**25th**	**Median**	**75th**	**Mean**
EUR	11%	17%	25%	20%	14%	25%	40%	29%
Avg. (Majors)	13%	24%	42%	30%	17%	33%	53%	38%
Avg. (Non-Majors)	12%	21%	36%	26%	15%	29%	49%	34%
Avg. (All)	16%	31%	51%	36%	23%	40%	64%	45%
Portfolio	14%	26%	44%	32%	19%	35%	57%	40%

Panel B: EUR Funds

	Equity Funds				Fixed-Income Funds			
	25th	**Median**	**75th**	**Mean**	**25th**	**Median**	**75th**	**Mean**
USD	7%	15%	28%	21%	10%	19%	31%	22%
Avg. (Majors)	9%	18%	32%	24%	12%	21%	37%	26%
Avg. (Non-Majors)	8%	19%	32%	24%	11%	21%	35%	25%
Avg. (All)	10%	17%	34%	24%	13%	24%	52%	33%
Portfolio	9%	18%	33%	24%	12%	23%	44%	29%

Table A5: USD Asset Hedging by non-USD Investors: Pre vs. Post GFC Average Hedging Frequencies and Levels

This table presents, for each base currency excluding the USD, the differences between average hedging frequencies and average hedging levels for USD assets for the pre-GFC vs post-GFC periods (excluding the GFC itself, which we specify as extending from March 2007 until March 2009). We first compute the % funds hedging and hedge ratios (of those that hedge) each month for each base currency, then average these over time. See appendix for details on the set of funds used. We further require that each currency-month has at least 3 observations, and that each currency has 12 months of observations after imposing the previous restrictions. The row average reflects the average across base currencies.

Base Currency	**Equity**		**Fixed-Income**	
	Δ %Hedged	Δ Hedge Ratio	Δ %Hedged	Δ Hedge Ratio
AUD	34%	15%	4%	-12%
CAD	32%	22%	6%	39%
EUR	19%	9%	4%	4%
GBP	14%	23%	15%	13%
Average	25%	17%	7%	11%

Table A6: Hedging Tightness – Avg. HR vs Dynamic Coefficients, EUR Funds

This table presents statistics across portfolios of funds' relating to funds' dynamic hedge ratio coefficients and average static hedge ratios. First we correlate, over funds, dynamic hedging coefficients with their respective average static hedge ratios. Second, we correlate the same average static hedge ratios to the adjusted R^2 from dynamic hedging regressions. Reported for USD base investors, equity and fixed-income portfolios. We report for: EUR investors' hedging of USD assets, EUR portfolio hedging, and averages across groups of foreign currencies. Currency group averages are of the associated single currencies' correlations. We report two differencing horizons, 1 and 12 months. These refer to the differencing horizons in equations (6) and (7) above. See appendix for details on the set of funds and observations used ("hedger funds" and "hedger positions"). Each individual fund-currency regression and static hedge ratio used requires at least 12 fund-currency-month observations underlying the average or coefficient. We further require that dynamic hedge ratio coefficients are of <= 2 in absolute value.

Panel A: Equity Funds

		USD	Avg. (Majors)	Avg. (Non-Majors)	Avg. (All)	Portfolio
1 M	Corr(*DHR*, Avg *HR*)	46%	55%	61%	58%	65%
	Corr(*DHR* R^2, Avg *HR*)	45%	50%	47%	49%	48%
12 M	Corr(*DHR*, Avg *HR*)	46%	57%	64%	61%	73%
	Corr(*DHR* R^2, Avg *HR*)	49%	59%	59%	59%	57%

Panel B: Fixed-Income Funds

		USD	Avg. (Majors)	Avg. (Non-Majors)	Avg. (All)	Portfolio
1 M	Corr(*DHR*, Avg *HR*)	32%	24%	29%	27%	27%
	Corr(*DHR* R^2, Avg *HR*)	16%	20%	35%	28%	17%
12 M	Corr(*DHR*, Avg *HR*)	48%	50%	28%	38%	48%
	Corr(*DHR* R^2, Avg *HR*)	34%	39%	46%	43%	31%

Table A7: Determinants of Hedging – Feature Definitions

This table enumerates definitions of economic and financial features used in panel regressions above.

FEATURE	DEFINITION	RATIONALE
Post GFC Dummy	True after March 2009, false before	Gauge difference in hedging levels pre vs post GFC
Hedging Cost (Carry)	3m foreign yield minus the base currency 3m yield. This corresponds to the cost of hedging, (long base, short foreign). Higher number means hedging is more expensive.	Investors may either hedge less when the cost is greater (negative coefficient), or, if yields reflect a risk premium, hedge riskier currencies more, despite the cost (positive coefficient).
FX Momentum	12-1 currency spot return (vs base currency). Positive number means the foreign currency appreciated vs the base currency (EUR or USD)	Hedgers may engage in market timing - hedging outperformers less than underperformers (negative coefficient), or expect reversion (positive coefficient).
Asset Momentum	12-1 foreign equity country or bond index momentum, in local currency terms	Mechanically, positive asset returns reduce the hedge ratio by growing the denominator. Absent rebalancing, hedge ratios would be lower (negative coefficient), while if investors pre-hedge in anticipated of further returns, hedge ratios would be higher (positive coefficient).
FX Volatility	Weekly foreign currency (vs base currency spot) volatility over prior year.	Where FX volatility is high, investors may hedge the FX risk more aggressively (positive coefficient). Conversely, relatively high volatility may leave investors unwilling to commit to FX positions and to hedge less (negative coefficient).
Asset Volatility	Weekly foreign equity or bond index volatility over prior year, in local currency terms	Investors may hedge currency risk less aggressively where underlying local market asset returns are themselves more volatile (negative coefficient).
Correl(Asset, FX)	Correlation between monthly foreign equity or fixed-income index local return and foreign currency USD spot returns (monthly) over prior 5 years	Higher hedge ratios, indicating larger currency shorts, may reduce volatility when the currency is positively correlated to the underlying asset (positive coefficient).

Table A8: Determinants of Hedging, Summary Statistics

This table shows panel means and standard deviations (across currencies and months) of regressors utilized in panel regressions (equation (8) above) of aggregate foreign hedge ratios (averaged across funds in each month for each currency) on features of these currencies (See Appendix table A7 for definitions of the features). Estimated from 2003-2025 for EUR , 1998-2025 for USD investors.

	USD Base		EUR Base	
	Mean	**Stdev**	**Mean**	**Stdev**
Hedging Cost (carry)	-0.2%	2.1%	0.7%	1.6%
FX Mom	-0.2%	9.7%	0.1%	9.6%
EQ Mom	7.9%	16.6%	9.0%	15.1%
FI Mom	3.3%	4.8%	2.9%	4.8%
FX Vol	10.0%	3.3%	9.9%	3.5%
EQ Vol	17.2%	6.8%	16.4%	6.7%
FI Vol	4.1%	1.8%	4.2%	1.9%
ρ(EQ, FX)	11.3%	36.0%	8.7%	38.7%
ρ(FI, FX)	-5.6%	26.9%	-10.2%	28.3%