The hedging ability of the US dollar and currency risk premia

Abstract

This paper introduces the US dollar's hedging state as a key determinant of currency risk premia. The US dollar's hedging state captures whether the US dollar hedges or amplifies international equity-specific risk. Consistent with intermediary-based asset pricing models, we find that currency risk premia are positive when the dollar serves as a hedge for international equity risk, but turn negative when it amplifies such risk. This predictability is increasing in the equity betas of currencies and in measures of financial risk in general. Our findings help explain the previously documented absence of an unconditional relationship between currency risk premia and equity markets, revealing instead a state-dependent relation.

Keywords: Exchange rates; Currency premia;

JEL Classification: F31, F37, G12, G15

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1. Introduction

Recent literature has established the US dollar's property as a safe-haven currency (Jiang, Krishnamurthy, and Lustig, 2018, 2021, 2023, 2024). Accordingly, a flight to safety might be expected from countries with more risky foreign equity markets, suggesting that risk premia would be required for market participants to hold the associated foreign currencies. Nevertheless, existing literature fails to reveal a relation between equity markets and exchange rates (Cenedese, Payne, Sarno, and Valente, 2016). In this paper, we show that the key to understanding this puzzle revolves around the role of global financial intermediaries. Since the liabilities of these institutions are primarily denominated in US dollars, their collective actions make the dollar a key indicator of global financial conditions (Avdjiev, Du, Koch, and Shin, 2019). The risk-bearing capacity of the financial intermediaries depends largely on the riskiness of their investments, with lower risk-bearing capacity leading to higher currency risk premia (Gabaix and Maggiori, 2015, Fang and Liu, 2021). We introduce the hedging ability of the US dollar against international equity risk as a novel proxy for the risk-bearing capacity of international intermediaries. We show that the hedging ability is not static over time, and that this has implications for expected currency returns. When the dollar serves as a hedge against international equity risk, foreign currency holdings increase the riskiness of intermediaries' international equity positions, thereby reducing their risk-bearing capacity and increasing currency risk premia. In contrast, when the dollar amplifies international equity risk, holding foreign currency rather than dollars instead reduces risk and thus improves the risk-bearing capacity of intermediaries, hence reducing currency risk premia. Thus, the safe-haven property of the dollar is transient, consistent with the lack of an unconditional relation between international equity risk and currency premia.

Using daily data for the G10 currencies, we document that the US dollar only serves as a hedge against international equity risk in 56% of the months in our sample.Over the remaining 44% of the period, it actually amplifies risk, hence contradicting the supposed safe-haven property. The phenomenon exhibits no simple trend pattern, as the dollar moves multiple times between the hedging and risk-amplifying states over the period. The dollar's time-varying hedging state has significant economic implications for currency risk premia: the spread in dollar returns between hedging and amplifying states is 0.86% per month, or more than 10% annually. Furthermore, we show that this predictability is increasing in the riskiness of the currencies, measured across a wide range of financial risk measures.

Global financial intermediaries carefully manage their risk exposure under strict regulatory requirements, particularly Value-at-Risk (VaR) limits, which influence their investment decisions and trading behavior. For international equity positions, risk comes through three channels: changes in foreign equity prices, movements in exchange rates and, importantly, the comovement of the former two. Whether equity prices and exchange rates correlate positively or negatively fundamentally changes the risk-bearing capacity of the international intermediaries and, in turn, their market behavior.

Defining the US dollar's hedging state as a dichotomous variable indicating whether the dollar hedges or amplifies international equity-specific risk, we establish the link between the hedging state, the risk-bearing capacity of global intermediaries, and currency risk premia. The link between the risk-bearing capacity of intermediaries and currency risk premia has been studied both theorically and empirically. On the theoretical side, Gabaix and Maggiori (2015) develop a two-country model where exchange rates are determined by capital flows and intermediaries' risk-bearing capacity. Their model predicts that currency risk premia decrease as intermediaries' ability to bear risk increases. Similarly, Fang and Liu (2021) propose a two-country DSGE model with intermediaries facing risk constraints, and arrive at the same fundamental prediction: higher risk-bearing capacity leads to lower currency risk premia. On the empirical side, Della Corte, Riddiough, and Sarno (2016) confirm some of the central predictions of Gabaix and Maggiori (2015).

We formally link the hedging state of the US dollar to intermediaries' risk-bearing capacity and, thus, to currency risk premia, by extending the framework of Fang and Liu (2021). Specifically, we introduce different risk weights for assets denominated in domestic and foreign currencies. The extension captures the intuitive feature that a foreign asset receives a larger risk weight when the exchange rate exposure amplifies risk, hence making the international position riskier, than when it reduces risk. The central prediction from the extended model is that when the US dollar serves as a hedge against international equity risk, exchange rate exposure amplifies risk, and intermediaries' foreign positions become riskier, leading them to require higher risk premia for holding the positions. Conversely, when the dollar amplifies risk, exchange rate exposure hedges equity risk, and intermediaries require lower compensation. In essence, currency risk premia should be larger when foreign exchange risk amplifies the risk of international equity positions, i.e., when the dollar serves as a hedge.

We develop a simple and straightforward empirical approach to measuring the hedging state of the US dollar against international equity-specific risk. We consider regressions of the average G10 currency return on the cross-sectional average of the corresponding international equity market returns over consecutive nonoverlapping subperiods, controlling for bond market movements. While the average regression coefficient is positive, supporting the traditional view of the dollar as a safe-haven currency, we document substantial time variation in the relation, with the coefficient turning negative multiple times over the period. The hedging ability, and implicit safe-haven property, of the US dollar against international equity risk is therefore not stable over time.

We then test the central prediction of our model: that currency risk premia should be larger when the US dollar serves as a hedge against international equity risk than when it amplifies risk. The evidence strongly supports this hypothesis, with the dollar's hedging state significantly predicting next-month excess currency return to the dollar factor—the cross-sectional average of G10 foreign currency exchange rates against the US dollar (Verdelhan, 2018). The difference in the dollar factor's risk premia between the hedging and amplifying states is above 10% annualized.

The finding of a positive coefficient on the dollar's hedging state extends from the full basket to each of the nine constituent G10 currencies in bilateral monthly predictive excess currency return regressions. Still, we document notable heterogeneity across individual exchange rates. Specifically, despite the positive coefficients, the predictive power of the dollar's hedging state is only statistically significant for four of the nine other G10 currencies. We show that this heterogeneity correlates with the currency's exposure to international equity risk. To formalize this relation, we construct five portfolios sorted on international equity exposure. The results reveal a roughly monotonic pattern, showing that the predictability of excess currency returns increases with international equity exposure, and that the effect is both economically and statistically significant. This finding has important implications for the price of financial risk in currency markets: the dollar's hedging state determines whether financial risk carries a positive or a negative risk premium. When the dollar hedges international equity risk, financial risk commands a positive price, and when it amplifies risk, the price turns negative. This state dependence explains why equity exposure appears unpriced in unconditional analyses of currency markets.

We exploit the dependence of the currency market price of international equity risk on the US dollar's hedging state to develop a timing strategy. The strategy generates substantial economic returns, 8.00% per annum, which remain significant after controlling for traditional currency factors. To ensure robustness, we confirm our findings across multiple measures of currency risk exposure, including FX volatility innovations (Menkhoff, Sarno, Schmeling, and Schrimpf, 2012a), intermediary risk factors (He, Kelly, and Manela, 2017), VIX innovations, skewness, coskewness with international equity returns, and many more.

What drives the dollar's time-varying hedging ability? Our analysis reveals that traditional financial factors, including equity returns, bond returns, and common currency factors like dollar and carry, do not explain this variation. Instead, we uncover two key drivers: first, we show that changes in the dollar's hedging ability are significantly related to a common volatility factor in exchange rates and global equities, reinforcing the dollar's role as a safe haven, consistently with Jiang et al. (2018, 2021, 2024). Second, the positioning of hedge funds in FX futures markets contributes to the dollar's relation with international equity risk, aligning with the findings of Kremens (2020). However, while these drivers explain some of the variation in the dollar's hedging state, neither of them predicts currency returns. Traditional time-series predictors from the literature (Lustig, Roussanov, and Verdelhan, 2014, Londono and Zhou, 2017, Fang and Liu, 2021) do not explain the predictive ability of the dollar's hedging state, either. This suggests that the US dollar's hedging state represents a novel source of currency risk premia.

Thus, our analysis establishes that the US dollar's capacity to hedge international equity risk varies systematically over time, with profound implications for currency risk premia. Our empirical results add to a rich literature studying currency excess returns. First, we contribute to the literature trying to understand time-variation in currency risk premia. Lustig et al. (2014) show that the cross-sectional average of forward discounts predicts the excess returns of a currency against the US dollar. Londono and Zhou (2017) show that both the US equity variance risk premium (Bollerslev, Tauchen, and Zhou, 2009) and the currency variance risk premium predict exchange rates. Adrian, Etula, and Shin (2015) show that currency risk premia are related to the amount of financial commercial paper. In relation to this literature, we document that the US dollar's hedging state against international equity-specific risk contains distinct information about currency risk premia.

Second, we contribute to a growing literature on intermediary-based asset pricing in international finance. Du, Hébert, and Huber (2023) show that intermediary constraints are priced across many assets, and Korsaye, Trojani, and Vedolin (2023) find a strong link between international stochastic discount factors and proxies for intermediary constraints. Further, a number of papers examine how hedging behavior affects exchange rates. Bräuer and Hau (2022) suggest a link between aggregate net hedging pressure from investment funds and exchange rates. Liao and Zhang (2024) propose a hedging channel of exchange rate determination and find support for this channel in exchange rate behavior. On the theoretical side, both Gabaix and Maggiori (2015) and Fang and Liu (2021) propose models in which currency risk premia are decreasing in the risk-bearing capacity of international intermediaries. We contribute to this literature by proposing the hedging ability of the US dollar against international equity risk as a new proxy for the risk-bearing capacity of international intermediaries, and by showing its importance for understanding currency risk premia.

Finally, we contribute to the literature linking currencies to equity risk. Glen and Jorion (1993) and Campbell, Serfaty-De Medeiros, and Viceira (2010) show that currencies can be used to hedge equity risks, while Ranaldo and Söderlind (2010) show that traditional safe-haven currencies appreciate when US equities decline. Kremens (2020) finds that hedge fund positions in currency futures strongly predict exchange rate exposure to equity markets. Consistent with this, we show that the safe-haven property of the US dollar is time-varying. Cenedese et al. (2016) find that equity market returns are unrelated to currency risk premia unconditionally, while Fan, Londono, and Xiao (2022) find that equity tail-risk is priced in the cross-section of currencies. We contribute to this literature by showing that the price of financial risk in currency markets is state-dependent: depending on the dollar's hedging state, currency equity market beta carries either a positive or a negative risk premium. In other words, we show that we can utilize the US dollar's hedging state to time the risk price of equity market exposure, and of financial risk more generally, in currency markets.

The reminder of the paper is organized as follows. Section 2 presents a heuristic argument for how the hedging state of the US dollar is related to currency risk premia. Section 3 describes the data on exchange rates, international equity returns, and international bond returns. Section 4 shows that the US dollar's hedging state significantly predicts currency risk premia. Section 5 shows that this predictability increases with currency financial risk. Section 6 shows that the hedging ability of the US dollar is related to FX volatility, equity volatility, and the net position of hedge funds in FX futures, but that these drivers do not predict currrency risk premia. Section 7 presents additional results and robustness. Section 8 concludes.

2. Motivation

Financial intermediaries play a central role in global financial markets, particularly the foreign exchange (FX) market. These institutions, primarily global banks and specialized trading firms, serve as critical market makers bridging economic agents with diverse currency needs and risk preferences.

To ensure financial stability, global financial intermediaries operate within the Basel regulatory framework, which mandates stringent capital requirements. Specifically, they must maintain capital ratios above prescribed thresholds: 8% for risk-weighted assets, and 3% for the leverage ratio. Since Basel II, financial institutions are allowed to calculate risk weights internally. Beyond these general requirements, intermediaries face additional restrictions in relation to balance sheet management and the risk taking of traders, typically implemented in the form of Value-at-Risk (VaR) requirements. For both types of constraints, the correlation structure of assets affects the risk-bearing capacity of the intermediary, as correlations either amplify or mitigate portfolio risk.

Building upon the regulatory insights and methodological approach of Fang and Liu (2021), we provide in this section a link between the hedging ability of the exchange rate against risk in the economy and the currency risk premium. As our focus is on the empirical analysis and results, we do not review the full equilibrium model of Fang and Liu (2021), but instead focus on our (slight) extension, and the implications for currency risk premia.

2.1. Model sketch

Following the literature on intermediary asset pricing, we assume that households do not hold risky financial assets, and only have access to risk-free money market accounts through local intermediaries. We extend the theoretical framework of Fang and Liu (2021) to explore the relation between the hedging state of the exchange rate and the currency risk premium. Building on their original model, which examined interactions between foreign and domestic intermediaries, we focus specifically on a domestic intermediary facing a risk constraint.

We assume that the intermediary accepts deposits from households and invests them in domestic and foreign risky assets (equities), as well as domestic and foreign risk-free bonds denominated in different consumption baskets (and in different currencies), whereas Fang and Liu (2021) for the risk-free portion restricted attention to an international bond paying off in both the domestic and foreign consumption baskets. Further, unlike Fang and Liu (2021), we allow the risk weights of different assets to depend on their currency denominations. This is intended to reflect that the risk weight on a foreign position depends on whether the exchange rate hedges or amplifies the risk of the asset, thus causing improving or deteriorating risk-bearing capacity of the intermediary. The extended framework allows us to directly examine the links between the hedging state of the exchange rate toward risk in the economy, the risk-bearing capacity of the intermediary, and the currency risk premium.

We introduce an exogeneous variable, ρ_t, representing the hedging state of the domestic currency against the risk θ_t in the economy per unit of asset. In Fang and Liu (2021), θ_t is interpreted as the risk (VaR) per unit of asset, and the intermediary faces a risk constraint such that the intermediary's market value must be greater than or equal to the fraction θ_t of its risky position. In our extension, ρ_t captures the potential hedging or amplification effects of exchange rate movements toward risk. A positive (negative) ρ_t indicates that the exchange rate amplifies (hedges) the risk. With θ_t the risk per unit of the domestic asset, this is shifted by ρ_t, so that the risk per unit of the foreign asset is $\theta_t + \rho_t$.

To derive the relation between ρ_t and the currency risk premium formally, consider the domestic intermediary who chooses optimal holdings of the domestic and foreign risky assets $S_{x,t}$ and $S_{y,t}$, and domestic and foreign bonds, $D_{I,t}$ and $D^*_{I,t}$. Write P_t, P^*_t for the prices and R_t, R^*_t for the returns to the domestic and foreign risky assets in their consumption baskets, $R_{f,t}$ and $R^*_{f,t}$ for the domestic and foreign risk-free rates, and Q_t for the real exchange (an increase indicates foreign appreciation). Further, M_t denotes the domestic stochastic discount factor, and N_t the net worth of the intermediary. The latter maximizes its market value of equity under a budget contraint and a risk constraint, given domestic deposits D_t:

$$
\begin{aligned}
V(N_t) \quad = \quad & \max_{S_{x,t},S_{y,t},D_{I,t},D^*_{I,t}} E_t \quad M_{t+1}(P_t R_{t+1} S_{x,t} + P^*_t Q_{t+1} R^*_{t+1} S_{y,t} \\
& \qquad\qquad + D_{I,t} R_{f,t} + D^*_{I,t} R^*_{f,t} Q_{t+1} - D_t R_{f,t}) \,, \qquad (1) \\
\text{s.t.} \quad & P_t S_{x,t} + P^*_t Q_t S_{y,t} + D_{I,t} + D^*_{I,t} Q_t = N_t + D_t \,, \qquad (2) \\
& V(N_t) \geq \theta_t P_t S_{x,t} + (\theta_t + \rho_t) Q_t P^*_t S_{y,t} + (\theta_t + \rho_t) D^*_{I,t} Q_t \,. \qquad (3)
\end{aligned}
$$

Relative to Fang and Liu (2021), our extension is the separation between domestic and foreign risk-free bonds, and the risk shift in (3), given by the hedging state ρ_t of the domestic currency. This allows us to characterize the exchange rate return using the Euler equation for the foreign bond in the domestic country:

$$E_t\left(M_{t+1} R^*_{f,t} \frac{Q_{t+1}}{Q_t}\right) = 1 + \kappa_t(\theta_t + \rho_t), \qquad (4)$$

where κ_t is the non-negative Lagrange multiplier on the risk constraint (3). Assuming joint log-normality of the stochastic discount factor and the spot exchange rate return, the Euler equation is recast as

$$E_t(m_{t+1}) + r^*_{f,t} + E_t(\Delta q_{t+1}) + \frac{1}{2} var_t\left(m_{t+1} + \Delta q_{t+1}\right) = \log(1 + \kappa_t(\theta_t + \rho_t)) \,, \qquad (5)$$

using lower case letters for logarithms. This yields the following expressions for the expected log exchange rate change and risk premium (expected excess currency return):

$$E_t(\Delta q_{t+1}) = r_{f,t} - r^*_{f,t} - cov_t(m_{t+1}, \Delta q_{t+1}) - \frac{1}{2} var_t(\Delta q_{t+1}) + \log(1 + \kappa_t(\theta_t + \rho_t)) \,, \qquad (6)$$

$$E_t(rx_{t+1}) = -cov_t(m_{t+1}, \Delta q_{t+1}) - \frac{1}{2} var_t(\Delta q_{t+1}) + \log(1 + \kappa_t(\theta_t + \rho_t)) \,, \qquad (7)$$

using that $r_{f,t} = -E_t(m_{t+1}) - \frac{1}{2} var_t(m_{t+1})$ in (6). When the leverage (risk) constraint (3) is binding, κ_t is strictly positive, so the currency risk premium (7) increases with the hedging state ρ_t. In economic terms, the currency risk premium is larger when the exchange rate amplifies risk ($\rho_t > 0$), compared to scenarios in which the exchange rate hedges risk ($\rho_t < 0$).

In this brief exposition, we have considered the perspective of a domestic intermediary. Alternatively, we could have taken the perspective of a foreign intermediary. In that case, ρ_t would have the opposite sign in the risk contraint, implying that the currency risk premium would again be increasing in ρ_t when expressed against the domestic currency.

2.2. Model discussion

In the above sketch, we draw on the DSGE model of Fang and Liu (2021). We could, alternatively, derive the same insights from the gamma model proposed in Gabaix and Maggiori (2015). In their model, domestic intermediaries absorb currency imbalances between savings from debtor and creditor countries. For absorbing imbalances, they require compensation through the currency risk premium, which varies inversely with risk-bearing capacity. The latter is directly a function of the foreign position's variance denominated in domestic currency, involving the variance of the foreign investment in local currency, the variance of the currency exposure, and their covariance. Therefore, this framework generates the same hypothesis about the hedging state of the exchange rate and the currency risk premium. In the following, we show that the hedging state of the US dollar (whether the exchange rate hedges or amplifies international equity risk) is indeed time-varying, and significantly predicts future currency excess returns.

3. Data and variable construction

This section describes our main data sources for international equity returns, foreign exchange rates, and international bond returns. Our main results are based on the G10 currencies, which represent the most traded and liquid currencies in FX markets (BIS, 2022).

3.1. International equity returns

For international equity returns, we consider the MSCI country indices for the underlying countries in G10, i.e., Australia, Canada, Japan, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, Germany, and the U.S. We source the data from Thomson Reuter's Eikon. Since our goal is to measure whether the exchange rate amplifies or hedges international equity risk, we consider equity returns denominated in local currency. To estimate the hedging state of the US dollar against international equity risk, we rely on daily data. As data become available at daily frequency from 2001, we take this as starting point for our main predictability analysis. We furthermore collect monthly data back to January 1996, which we use to construct financial risk measures for the currencies. To construct excess returns, we substract the local risk-free rate which we proxy by a 3-month yield obtained from Bloomberg (Randl, Simion, and Zechner, 2024) as Bloomberg does not have a 1-month yield available. Table 1 shows the average equity returns across the countries.

[Insert Table 1 About Here]

The equity returns range from 0.22% per month for the UK to 0.66% per month for Norway. In unreported results, we find that the international equity returns have a large common component, as the correlation across countries is high. The first PCA component explains roughly 70% of the variation in the equity returns. To construct an international equity factor, $\overline{RX}_t^{equity}$, we simply consider the equal-weighted cross-sectional average across countries.

3.2. Currency excess returns

We source end-of-month spot and one-month forward exchange rates from January 1996 to December 2020 from Barclay's and Thomson Reuters for the G10 currencies: the Australian dollar (AUD), Canadian Dollar (CAD), Swiss Franc (CHF), the Euro (EUR), Japanese Yen (JPY), Norwegian Krone (NOK), Swedish Krona (SEK), New Zealand Dollar (NZD), British Pound (GBP), and the US Dollar (USD). We use the Deutsche Mark (DEM) instead of EUR prior to the introduction of the Euro in 1999. Even though our main results are based on the G10 currencies, we show that the results are similar when using a broader cross-section of currencies.

We define $S_{i,t}$ and $F_{i,t}$ as the spot and one-month forward exchange rates for currency i at time t, in US dollar (USD) prices per unit of foreign currency. An increase in the exchange rate corresponds to an appreciation of the foreign currency. The excess return from buying foreign currency i in the forward market at time t and selling it in the spot market at time $t+1$ is

$$RX_{i,t+1} = \frac{S_{i,t+1} - F_{i,t}}{S_{i,t}}. \tag{8}$$

Under covered interest parity (CIP), the forward premium equals the interest rate differential, so the excess return can equivalently be defined as the spot exchange rate return plus the interest rate differential (forward discount). We follow the standard practice in the literature and use forward exchange rates to construct currency excess returns.

Table 1 presents descriptive statistics for currency excess returns for our sample. All currencies except Japan have postive average excess returns, ranging from -0.08% (Japan) to 0.49% (New Zealand). This relation is flipped when focusing on volatility, for which Japan has the lowest (2.63) and New Zealand the highest (3.78). The majority of the currencies exhibit negative skewness, except Sweden and Switzerland.

From this set of currencies, we also construct the dollar and carry factors (Lustig, Roussanov, and Verdelhan, 2011). We follow Verdelhan (2018) and construct the dollar factor, $\overline{RX}_t$, as the cross-sectional average of excess currency returns across the G10 currencies. To construct the carry factor, we sort our cross-section in five equal-weighted portfolios based on the currencies' forward discounts. The carry factor is then long in the high interest rate (forward discount) portfolio and short in the low interest rate portfolio. We use the Lustig et al. (2011) two factor model (which relies on the dollar and carry factors) to risk adjust portfolio returns. Further, we construct a larger set of currency factors to use as controls. This set consists of the dollar factor (Verdelhan, 2018), carry (Lustig et al., 2011, Menkhoff et al., 2012a), short- and long-term momentum (Menkhoff, Sarno, Schmeling, and Schrimpf, 2012b), currency value (Asness, Moskowitz, and Pedersen, 2013, Menkhoff, Sarno, Schmeling, and Schrimpf, 2017), global imbalances (Della Corte et al., 2016), term spreads (Bekaert, Wei, and Xing, 2007, Lustig, Stathopoulos, and Verdelhan, 2019), long-term yields (Ang and Chen, 2010), and output gaps (Colacito, Riddiough, and Sarno, 2020).

Due to non-synchronous returns, we skip the first trading day of each month in all our predictive regressions, to avoid any lookahead bias.[1]

3.3. International bond returns

We obtain daily bond yields for the countries from Bloomberg. To construct returns, we interpolate the yields between the fixed year maturities using a linear interpolation. We calculate the holding period return from buying a τ maturity bond and take an equal weighted average across maturities between two and five years, following literature standards (Cochrane and Piazzesi, 2005, Ludvigson and Ng, 2009). To construct the excess returns, we use the 3-month yield for the risk-free rate, as for international equity excess returns:

$$RX_{i,t}^{bond} = \left(\frac{1}{4} \sum_{\tau=2,\ldots,5} \frac{P_{i,t+1}^{\tau-1}}{P_{i,t}^{\tau}} - 1 \right) - \frac{y_{k,t}^{3}}{N}\,, \tag{9}$$

where $P_{i,t}^{\tau}$ is the price of a maturity τ zero-coupon bond at time t for country i, i.e., $P_{i,t}^{\tau} = \exp\left(-\frac{\tau}{N} y_{i,t}^{\tau}\right)$, with $y_{i,t}^{\tau}$ the annualized yield of a zero-coupon maturity τ bond for country i, and N the number of observations per year, meaning that $\frac{y_{i,t}^{3}}{N}$ is the three month yield for $N = 12$.

As for the equity factor, we construct an international bond factor, $\overline{RX}_t^{bond}$, as the cross-sectional average across countries. The last column in Table 1 shows the average excess bond returns for the countries. They range from 0.05% per month for Japan to 0.17% for Canada.

4. The hedging ability of the US dollar and currency risk premia

This section examines whether the time-varying hedging ability of the US dollar influences currency risk premia. First, we confirm the average hedging ability of the US dollar against international equity market risk. Second, we document substantial time variation

[1] For example, the US market is not closed at the WMR noon fixing which happens at 4 pm UK time or at noon EST.

in this hedging ability, challenging the conventional view of the dollar as a consistent safe haven. Third, we show that the hedging state of the US dollar significantly predicts future currency excess returns, consistent with our theoretical sketch.

4.1. Do currencies consistently hedge international equity risk?

The literature has traditionally viewed the US dollar as a safe-haven currency that serves as a hedge against international equity market risk (Jiang et al., 2018, 2021, 2023, 2024) when taking an unconditional perspective. To rigorously examine this perspective, we start by analyzing the relation between currency returns and international equity returns while controlling for international bond exposure across G10 currencies in an unconditional setting using the following regression:

$$\overline{RX}_t = b_0 + \beta_{equity}\overline{RX}_t^{equity} + \beta_{bond}\overline{RX}_t^{bond} + \eta_t \,. \tag{10}$$

We include international bond returns as controls to isolate the relation with equity-specific risk, because exchange rates exhibit strong connections to interest rate differentials (Hofmann, Shim, and Shin, 2020), and leaving this out potentially introduces an omitted variable bias (indeed, we show below that the international bond factor significantly explains some of the variation in the dollar factor). Table 2 presents the results.

[Insert Table 2 About Here]

While seven out of nine G10 currencies show significantly positive coefficients against international equity risk, the Swiss Franc (CHF) and Japanese Yen (JPY) exhibit negative coefficients. This is consistent with Ranaldo and Söderlind (2010), who find that these currencies are characteristized as safe-havens. When aggregating the currencies into a dollar factor (Verdelhan, 2018) (computed as the cross-sectional average of the currency basket), we find a highly significant coefficient of 0.18 (t-statistic = 12.76), confirming the US dollar's unconditional safe-haven attribute: it hedges international equity risk.

To investigate time variation in the US dollar's hedging ability, each month, t, we regress the dollar factor on the international equity factor across the days, j, within month

t, again controlling for global bond returns:

$$\overline{RX}_{t,j} = b_{0,t} + \beta_{equity,t}\overline{RX}^{equity}_{t,j} + \beta_{bond,t}\overline{RX}^{bond}_{t,j} + \tilde{\eta}_{t,j} \ , \quad (11)$$

where the bar denotes the cross-sectional averages across the G10 countries/currencies. From the regression, we obtain a time series of $\beta_{equity,t}$ coefficients, which captures time variation in the dollar's hedging ability against international equity risk. When estimating equation (11), there is a trade-off between capturing time variation and presicion in the estimates. Following, among others, Pástor and Stambaugh (2003), Ang, Hodrick, Xing, and Zhang (2006), Lewellen and Nagel (2006), and Chang, Christoffersen, and Jacobs (2013), we choose to focus on a non-overlapping 1-month rolling window. We show in Section 7 that the results are qualitatively similar when considering two and three months to estimate the exposures. For longer horizons, the time variation in the US dollar's hedging ability disappears, implying that the predictability we document later also disappears.

We focus on the hedging ability towards equity risk because exchange rate hedging is less prevalent for equities than for fixed income assets (Liao and Zhang, 2024). The hedging ability of towards equity risk should, thereby, have a stronger impact on the risk-bearing capacity than bonds.[2]

From the estimates, we measure the US dollar's hedging state, ρ_t, as the sign of $\beta_{t,equity}$ in period t:

$$\rho_t = \begin{cases} 1 & if \quad \hat{\beta}_{equity,t} > 0 \\ -1 & otherwise \end{cases} \quad (12)$$

This implies that the US dollar's hedging state, ρ_t, is 1 when the US dollar hedges international equity-specific risk, and -1 when the US dollar amplifies international equity-specific risk.

[Insert Table 3 About Here]

Table 3 presents descriptive statistics of the estimates, the global equity factor, the

[2]Consistent with this, the US dollar's hedging ability against international bond risk does not predict currency risk premia.

global bond factor, and the traditional currency factors: dollar and carry. In addition, Panel B shows the correlations of the estimates with the different financial factors.

Our estimates reveal several important features of the dollar's hedging ability. While the average effect is positive, consistent with the dollar's unconditional safe-haven status, we find that the US dollar acts as a hedge ($\beta_{equity,t} > 0$) in only 56% of the months in our sample. The hedging ability exhibits strong persistence, with an AR(1) coefficient of 0.47 for the raw $\beta_{equity,t}$ estimates, and 0.32 for the US dollar's hedging state ρ_t.[3] Moreover, the hedging ability has little correlation (0.08 or less) with the international equity and bond factors, and with the traditional currency factors, dollar and carry (Lustig et al., 2011).

[Insert Figure 1 About Here]

To gain some economic insights about the variation, Figure 1 illustrates this time variation, revealing several notable episodes during which the dollar's hedging ability broke down, including: summer 2008 (pre-Lehman collapse), November 2016 (U.S. presidential election), and early 2020 (onset of the COVID pandemic). The time series reaches its maximum in October 2010, and its minimum in October 2017.

These findings challenge the conventional view of the US dollar as a consistent safe-haven currency. While the dollar does hedge international equity risk on average, this hedging ability exhibits significant and persistent time variation. In the following sections, we formally test whether this time-varying hedging ability helps explain currency risk premia.

4.2. The US dollar's hedging stategy and currency risk premia

Having established time variation and, in particular, persistence in the US dollar's hedging ability against international equity-specific risk, we now examine whether the hedging state has predictive power for excess currency returns and, thereby, helps explain currency risk premia. This analysis provides a direct test of our theoretical hypothesis, which

[3] The persistence probabilities of the two-level hedging state ρ_t are $P(\rho_t = 1|\rho_{t-1} = 1) = 0.72$ and $P(\rho_t = -1|\rho_{t-1} = -1) = 0.60$. Thus, hedging ability (risk reduction) is slightly more persistent than risk amplification.

suggests that changes in the dollar's hedging properties should affect investors' required compensation for currency risk. To test this, we run the following predictive regression:

$$RX_{i,t+1} = b_0 + b\rho_t + \varepsilon_{i,t+1}\,. \tag{13}$$

This specification allows us to capture the economic intuition that investors' required risk compensation should depend on whether the currency exposure acts as a hedge or amplifies the risk of stock portfolios. Table 4 presents the findings, both for the dollar factor and the individual G10 currencies.

[Insert Table 4 About Here]

The results reveal a strong link between the dollar's hedging properties and future excess currency returns. For the dollar factor, we find that the US dollar's hedging state significantly predicts next month's excess return, with a coefficient of 0.42% per month (t-stat of 2.82) and a R^2 of 3.09%. To put some economic perspectives to the numbers: following months where the US dollar hedges international equity-specific risk, the expected dollar factor excess return is 0.51% per month. Conversely, following months where the US dollar amplifies international equity-specific risk, the expected dollar return is -0.35% per month. This corresponds to a significant difference of nearly 90 basis point in expected returns to the dollar factor depending on the hedging state of the US dollar.

The analysis of bilateral exchange rates reveals notable cross-sectional heterogeneity in this predictability. The effect ranges from 0.16% per month for Japan (t-statistic = 0.98, R^2 = 0.38%) to 0.86% for New Zealand (t-statistic = 3.61, R^2 = 5.04%). While all currencies show positive coefficients, suggesting a consistent direction in the effect, only four of the nine currencies exhibit statistically significant predictability. Notably, the strength of this predictability appears to correlate with the currencies' unconditional exposure to the international equity factor (documented in Table 2). Risky currencies, such as Australian and New Zealand, show stronger predictability compared to traditional safe-haven currencies like Japan and Switzerland (Ranaldo and Söderlind, 2010). This cross-sectional pattern indicates an interaction between a currency's international equity exposure and the predictive ability of the dollar's hedging ability.

In the following section, we further explore this cross-sectional heterogeneity by formally examining how a currency's international equity exposure influences the strength of predictability. We then discuss the implications of our findings for the pricing of international equity risk in currency markets, and demonstrate the economic significance of this predictability through a portfolio timing exercise.

5. The cross-section of currency risk and predictability

While our previous results establish that the US dollar's hedging state predicts excess currency returns, a pattern emerges: this predictability seems to vary systematically with the currencies' riskiness. This section demonstrates that the economic magnitude of return predictability increases with currency risk, measured by international equity exposure. Furthermore, we show that the US dollar's hedging state fundamentally alters how financial risk is priced in currency markets - the risk price associated with financial risk actually switches sign depending on the US dollar's hedging state. We end the section by showing that the relation between riskiness and predictability carries over to a range of financial risk measures.

5.1. Currency international stock market exposure and predictability

We begin by examining how a currency's exposure to international stock markets influences the strength of predictability. The results for bilateral currencies indicate some relation between the currencies' international stock market exposures and predictability, with with higher sensitivity to global stock markets corresponding to significantly stronger predictability from the dollar's hedging state. To formally investigate this relation, we construct currency portfolios based on their time-varying exposure to international equity markets. Specifically, we estimate each currency's international stock market beta using rolling 60-month regressions using data on a monthly frequency:

$$RX_{i,t} = \alpha_i + \beta_i \overline{RX}_t^{equity} + \epsilon_{i,t} \,, \tag{14}$$

where $RX_{i,t}$ represents currency excess returns, and $\overline{RX}_t^{equity}$ is the international equity factor. Using these beta estimates, we sort currencies into five equal-weighted portfolios each month, with P1 containing currencies least exposed to international equity risk (the low-beta portfolio) and P5 containing the most exposed currencies (the high-beta portfolio). We then run the predictive regression in equation (13) for each portfolio. Table 5, Panel A presents the regression results.

[Insert Table 5 About Here]

The results presents a clear story: both the economic magnitude of predictability and its statistical significance increase, more or less, monotonically with currency international equity exposure. The low-beta portfolio (P1) shows only modest predictability, with an insignificant positive coefficient of 0.14 (t-stat of 0.98) with an R^2 of 0.40%. In contrast, the high-beta portfolio (P5) exhibits a strong degree of predictability, with a highly significant positive coefficient of 0.79 (t-stat of 3.73) and an R^2 of 5.51%. This spread in predictability implies that the high-minus-low beta portfolio (P5-P1) also has a strong degree of predictability, with a significant coefficient of 0.65 (t-stat of 3.44) and an R^2 of 4.62%. All intercepts are insignificant and for the high-minus-low portfolios (P5-P1) economically very close to zero. In sum, the findings suggest that the dollar's hedging properties matter most for currencies that are themselves more exposed to global equity risk: Currencies that typically amplify rather than hedge equity risk are particularly sensitive to changes in the dollar's hedging properties.

5.2. The unconditional risk price of international equity risk

We next examine the implication of the predictability on the risk price of international equity exposure in currency markets. We begin this analysis by examining the unconditional risk price of international equity risk. Panel B of Table 5 reveals a nuanced relation between currency returns and international equity exposures. Sorting currencies by their international equity factor betas produces a distinctive U-shaped pattern in average returns. While high-beta currencies (P5) generate the highest excess returns, 5.00% per annum, and low-beta currencies (P1) produce moderate positive returns, intermediate-beta currencies (P3) actually lose value, with average returns of −2.95% per annum. A traditional long-short portfolio that buys high-beta currencies and shorts low-beta currencies earns a modest 2.40% per annum (t-statistic = 1.03), translating to a Sharpe ratio of just 0.23. Moreover, this strategy inherits the crash risk typically associated with currency investing, exhibiting substantial negative skewness (−0.56), comparable to the well-documented carry trade. This evidence suggests that international equity risk exposure alone does not command a significant risk premium in currency markets, and confirms the findings of Cenedese et al. (2016), who find that currency returns are unrelated to stock markets.

5.3. The conditional risk price of international stock risk

International stock exposure does not carry a risk price, and predictability of the US dollar's hedging state is increasing in the currencies' international equity beta. We now combine these two findings and demonstrate the role of the US dollar's hedging state for the risk price of international equity exposure. We do so by constructing simple timing strategies that condition on the dollar's hedging state: taking long positions in each portfolio when the dollar hedges equity risk and short positions when it amplifies equity risk. Panel C of Table 5 presents the results.

The economic magnitude of these timing strategies maps directly to our previous predictability results. The timing strategy for the low-beta portfolio (P1) generates the lowest return, 2.13% annualized (t-statistic 1.22), which is worse than a static long position in the portfolio. Hence, there is no gain in timing the portfolio using the hedging state of the US dollar as timing variable. The story is, however, completely different for the high-beta portfolio (P5). For this portfolio, the timing strategy more than doubles the return, to 10.13% (t-stat of 4.01) per annum. These findings carry over to the high-minus-low portfolio (P5-P1), for which the timing strategy generates a significant average return of 8.00% annualized (t-stat of 3.61). This demonstrates that the dollar's hedging state not only predicts returns, but also the sign of the risk price of international equity exposure in currency markets, and therefore can be utilized for timing the risk price.

These timing strategies also dramatically improve the risk-return relationship. For portfolio P3, P4, P5, and P5-P1, the timing gains come with a reduction in volatility of the strategy. The combination of the increase in average return and reduction in volatility implies that timing strategies improve substantially in terms of Sharpe ratios. The Sharpe ratio for the timed P5 portfolio more than doubles, from 0.43 to 0.90, while the timed high-minus-low portfolio (P5-P1) achieves a more an three-fold increase in Sharpe ratio, to 0.79 (compared to 0.23 for the static version).

The timing strategies even transform the return distribution itself: whereas the static portfolios exhibit substantial crash risk (skewness of −0.11 for P5 and −0.56 for P5-P1), the timed portfolios show positive skewness (0.46 for P5 and 0.66 for P5-P1) and lower kurtosis. Thus, conditioning on the dollar's hedging state not only enhances average returns, but fundamentally changes the risk characteristics of the currency strategies. Further, the high average returns for the timed P5 and timed P5-P1 cannot be explained by the two factor model (the dollar and carry factors) of Lustig et al. (2011), as the model's pricing error remains significant. In fact, the timing strategies' alpha survives controlling for nine common currency factors in a Barillas and Shanken (2017)-type test.[4]

Figure 2 shows the cumulative excess returns to the high-minus-low beta portfolio (P5-P1), and the timed high-minus-low portfolio (P5-P1) over time.

[Insert Figure 2 About Here]

The figure corroborates the conclusion from the summary statistics: the timed P5–P1 portfolio exhibits substantial timing gains and does not experience the severe drawdowns that characterize the untimed long-short portfolio. The untimed P5–P1 suffers pronounced losses during the Global Financial Crisis, the 2013 Taper Tantrum episode, and the period preceding the COVID-19 outbreak, whereas the timed strategy appreciates during these same intervals. The figure also shows that a large share of the timing gains arises during

[4]More precisely, we control for the dollar factor (Verdelhan, 2018), carry (Lustig et al., 2011, Menkhoff et al., 2012a), short- and long-term momentum (Menkhoff et al., 2012b), currency value (Asness et al., 2013, Menkhoff et al., 2017), global imbalances (Della Corte et al., 2016), term spreads (Bekaert et al., 2007, Lustig et al., 2019), long-term yields (Ang and Chen, 2010), and output gaps (Colacito et al., 2020).

and after the Global Financial Crisis, a pattern consistent with the tighter post-crisis regulatory environment for financial intermediaries.

These findings reveal that the price of international equity risk in currency markets is fundamentally state-dependent, switching sign based on the dollar's hedging state. Below, we show that this relation holds more broadly for a long list of different measures of financial risk.

5.4. The conditional risk price of financial risk in general

Our previous findings suggest that the dollar's hedging state might play a broader role in determining how financial risks are priced in currency markets. To investigate this hypothesis systematically, we now examine how the predictive power of the dollar's hedging state varies across currencies sorted on a range of different financial risk measures. Our analysis considers both systematic risk exposures and currency-specific risk characteristics, revealing a fundamental link between the dollar's hedging properties and the conditional pricing of financial risk.

We first examine currencies sorted on their exposures to various systematic risk factors: Innovations in FX market volatility (Menkhoff et al., 2012a), changes in the VIX index, dollar factor (Verdelhan, 2018), changes in macroeconomic uncertainty (Jurado, Ludvigson, and Ng, 2015), changes in financial uncertainty (Jurado et al., 2015), and the intermediate capital risk factor (He et al., 2017). For each risk measure, we follow the procedure for international stock beta analysis and construct portfolios using 60-month rolling windows to estimate risk exposures. In addition, we complement these systematic risk measures with currency-specific characteristics (also estimated using a 60 month rolling window, or 1250 trading days in case of daily frequency): Value-at-Risk (5% level based on daily frequency), expected Shortfall (5% level), skewness (daily frequency), realized variance (daily frequency), forward discount (Lustig et al., 2011, Menkhoff et al., 2012a), and Coskewness with international stock returns (based on data of monthly frequency to minimize the effect of non-synchoneous trading). Table 6 presents the predictive coefficients and t-statistics for the different portfolios, in addition to the high-minus-low portfolio.

[Insert Table 6 About Here]

Across all risk measures, the predictive power of the dollar's hedging state increases in riskiness of the currency, with significant predictive coefficients for the high-minus-low strategies. The sign, of course, depends on whether riskiness is increasing or decreasing in the characteristics. In all cases, the signs of the predictive coefficients align with intuition: the expected returns of risky currencies are significantly higher when the US dollar hedges international stock risk.

Taking a closer look at the individual risk measures, predictability of the high-minus-low portfolios is stronger for exposures closer linked to the risk-bearing capacity of intermediaries, such as FX volatility, VIX changes, and the intermediate risk factor. When the dollar serves as an international stock market hedge, investors require higher compensation for holding risky foreign currency positions. The relation is similar among country-specific characteristics, for which predictability is strongest for expected shortfall, volatility, and coskewness. This pattern suggests that the dollar's hedging state particularly affects currencies that are themselves more vulnerable to extreme market movements, or that tend to amplify international equity risk.

Our results suggest that the US dollar's hedging state serves as a key state variable for currency markets, fundamentally altering whether financial risk has a positive or negative risk price in currency markets.

6. Economic determinants of the dollar's hedging properties

Our analysis thus far has established that the dollar's hedging state significantly predicts currency returns, with particularly strong effects for currencies highly exposed to financial risk. In this section, we explore the economic drivers of the hedging ability of the US dollar. While our earlier analysis (Table 3) showed that the dollar's hedging state exhibits low correlation with traditional financial factors - including stock returns, bond returns, and common currency factors like the dollar and carry factors - the literature suggests several potential determinants.

The traditional safe-haven view of the US dollar suggests that its hedging properties should strengthen during periods of market turbulence (Jiang et al., 2018, 2021, 2024). To measure market turbulence, we consider intra-monthly realized variance of international stock returns and spot rate changes of the dollar factor. Recent work by Kremens (2020) documents that a currency's equity market exposure varies systematically with hedge fund positioning in currency futures markets, suggesting that speculative activity might influence the dollar's hedging properties. We measure this using the average net position of "Leveraged Funds" in the currency futures market. We obtain the data from the "Traders in Financial Markets" dataset. The frequency of the data is weekly, so we consider the last observation during the month as the end-of-month observation.

To empirically investigate these potential channels, we examine how innovations in the dollar's hedging state relate to market conditions and institutional positioning. We regress AR(1) innovations of $\beta_{equity,t}$ on the volatility measures and the institutional positioning. We do this for both the continuous measure of the dollar's hedging ability ($\beta_{equity,t}$) and the US dollar's hedging state (ρ_t). Panel A of Table 7 presents the results.

[Insert Table 7 About Here]

The empirical analysis reveals support for both the safe-haven hypothesis and the role of institutional positioning in determining the dollar's hedging properties. Specifically, we find that the US dollar's hedging ability strengthens with increases in market volatility, consistent with the dollar's role as a safe asset during turbulent periods. Similarly, higher net hedge fund positioning in FX futures predicts a stronger hedging relationship between the dollar and international equity markets, suggesting that institutional trading patterns help shape the dollar's risk properties. However, the relation between market conditions and the dollar's hedging ability becomes more nuanced when we examine different volatility measures simultaneously. When including both equity and FX market volatility in our specifications, their individual explanatory powers diminish, and neither measure remains statistically significant. This pattern suggests that it is the common component of market stress, rather than asset-class-specific volatility, that drives the dollar's hedging properties.

While these economic factors help explain variations in the dollar's hedging ability and hedging state, they cannot fully account for its predictive power on currency returns. In Table 7, Panel B, we find that the dollar's hedging state remains significant even after controlling for market volatility and institutional positioning, which are both insignificant. In unreported results, we show that both types of volatility and institutional positioning are insignificant in predicting excess currency returns. The results suggest that the dollar's hedging properties capture a distinct aspect of currency market conditions.

Overall, our findings suggest that the dollar's hedging properties respond to both market conditions and institutional trading behavior. Nevertheless, the component of the hedging properties that is related to currency risk premia appears to stem from different sources.

7. Additional results and robustness

This section presents some additional results and demonstrates robustness of the results presented so far. First, we show that the hedging ability of the US dollar contains distinct predictive information on currency risk premia not contained in a set of predictors from the literature. Second, we show that the results carry over when including emerging market currencies. Third, we show that increasing the estimation horizon for the US dollar's hedging state reduces predictability. Thus, changes in the hedging state are short-lived, and by increasing the estimation period, the measure does not capture the time-varying nature of the series. Finally, we show that our results are robust to changing the estimation window for the individual currencies' international equity betas when constructing portfolios.

7.1. Other currency predictors

To establish that the hedging state of the US dollar represents a novel source of predictability, we now demonstrate its robustness to known predictors of currency returns. We augment our baseline predictive regression with an extensive set of established predictors:

$$RX_{i,t+1} = b_0 + b\rho_t + \gamma' Z_t + \varepsilon_{i,t+1}\,, \tag{15}$$

where Z_t contains predictors previously shown to capture time variation in currency risk premia. These include the average forward discount (AFD) of Lustig et al. (2014), which captures global interest rate differentials, the US variance risk premium (VP_{US}), the currency variance risk premium (XVP) from Londono and Zhou (2017), and the year-over-year growth in financial commercial papers (CP) from Fang and Liu (2021), which proxies for financial intermediary constraints. For the XVP measure, we follow Londono and Zhou (2017) and compute the difference between 6-month implied volatility and realized variance estimated over six months, averaged across their currency set.[5]

[Insert Table 8 About Here]

Table 8 demonstrates the incremental predictive power of the dollar's hedging state. Panel A shows results for the dollar factor, while Panel B presents findings for the high-minus-low international stock beta portfolio. The dollar's hedging state maintains both its economic and statistical significance across all specifications. For the dollar factor, the coefficient ranges from 0.38% to 0.45% per month (t-statistics between 2.36 and 2.91), virtually unchanged from our baseline estimates. Similarly, for the high-minus-low beta portfolio, the coefficient remains stable between 0.58% and 0.68% per month (t-statistics between 3.01 and 3.54), even when controlling for all predictors simultaneously. The stability of these coefficients suggests that the dollar's hedging state captures a distinct source of time variation in currency risk premia, independent of previously documented predictors.

[5]While our data come from Thomson Reuters, our XVP measure shows nearly perfect correlation with Londono and Zhou (2017)'s during overlapping sample periods. We thank the authors for making their data available.

7.2. Including emerging market currencies

While our main analysis focuses on G10 currencies, which represent the most liquid segment of the FX market, we now examine whether our findings generalize to a broader cross-section including emerging market currencies. We employ the standard 48 currency cross-section also examined in, among others, Menkhoff et al. (2012a), Menkhoff et al. (2012b), and Menkhoff et al. (2017), with the exception that the Euro is introduced for our sample. Table 9 shows the results of the predictive regressions in equation (14) in which the dollar factor and international equity beta sorted portfolios are based on this wider cross-section.

[Insert Table 9 About Here]

Our main findings carry over to this broader sample, both in economic and statistical terms. For the dollar factor, the coefficient on the US dollar's hedging state is 0.34 (t-statistic = 2.77), compared to 0.42 in our G10 sample. For the beta-sorted portfolios, we find that predictability is still monotonically increasing in international stock market beta, although the results are slightly weaker. The predictive coefficient of the high-minus-low beta portfolio is 0.47% per month (t-statistic = 2.75), lower than the 0.65% coefficient in our G10 sample, but still economically meaningful.

7.3. Estimation period for the US dollar's hedging state

To assess the robustness of our baseline specification, we extend the estimation window for measuring the US dollar's hedging state against international equity-specific risk beyond the one-month horizon. Table 10 reports predictive regression results using 2-, 3-, 6-, 9-, and 12-month estimation windows for the regression in equation (11) for the dollar factor (Panel A) and the high-minus-low portfolio sorted on stock market exposure (Panel B).

[Insert Table 10 About Here]

The predictive ability of the US dollar's hedging state decreases as the estimation window increases. This is the case both for the dollar factor and the high-low portfolio. For estimation windows longer than three months, all coefficients are insignificant.

The declining predictability likely stems from the time-variation in the dollar's hedging properties. Longer estimation windows hide this temporal variation. Consistent with this, we find that the frequency of non-hedging states for the US dollar monotonically decreases with the estimation window length. Nevertheless, the predictive relationship remains economically and statistically significant at the two- and three-month horizons, showing that our findings are not specific to the one-month baseline specification

Panel C of Table 10 evaluates how the estimation window affects the performance of our timing strategy. The results parallel the predictability patterns: investment performance monotonically declines with the estimation window length, from an annualized return of 8.00% using the one-month window to 1.67% with the nine-month window. Notably, the strategy continues to generate significant returns with positive skewness when implemented using two- and three-month estimation windows.

These findings demonstrate that while our results are robust to moderate extensions of the estimation window, both predictability and performance of the timing strategy diminish with longer estimation window. This pattern aligns with the time variation in the US dollar's hedging properties — longer estimation windows appear to hide the time variation that drives both the predictability and the economic value of the timing strategy.

7.4. Estimation period for individual international stock beta

While our main analysis uses a 60-month rolling window, which balances the trade-off between estimation precision and timely updating of betas, we now demonstrate the robustness of our findings to alternative estimation windows.

To investigate the robustness, we shorten the estimation window in two ways. First, we examine monthly estimates using windows ranging from 12 to 48 months, still using data of monthly frequency, which helps assess whether our results are sensitive to the length of the estimation period. Second, we utilize higher-frequency daily returns over horizons from 1 to 12 months, which potentially allows for more precise beta estimation at the cost of higher noise in daily returns.

[Insert Table 11 About Here]

Both sets of analyses confirm the robustness of our main findings. For both data frequencies, predictability and timing performance strengthen monotonically in the length of the estimation window. Using alternative monthly windows, the predictive coefficients between high and low beta portfolios are significant for all specifications with an estimation window above 12 months. Similarly, daily beta estimates generate comparable results Notably, while the point estimates show some variation across specifications, the economic message remains consistent: the predictive ability of the US dollar's hedging state is increasing in international stock market exposure.

8. Concluding remarks

The relation between the US dollar and international stock risk reveals a time-varying pattern that carries significant implications for international asset pricing. Our analysis demonstrates that the US dollar's hedging state serves as a crucial predictor of excess currency returns, with the direction of this relationship contingent on whether the dollar hedges or amplifies stock risk: the currency risk premium is positive when the dollar acts as a hedge, but negative when it amplifies risk. We document that the effect is increasing in the currencies' riskiness in terms of a wide range of measures of financial risk. Our results help reconcile the historically puzzling weak relation between stock and currency risk premia by revealing that the sign of the risk price is time-varying.

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Table 1: Descriptive statistics

This table presents descriptive statistics for monthly individual G10 currency, stock, and government bond returns from January 2001 to December 2020. Foreign exchange data are from Thomson Reuters, Stock returns are from MSCI (sourced from Thomson Reuters), and government bonds are from Bloomberg. For each currency, the table reports means, annualized standard deviations, skewness, and kurtosis for currency excess returns.

	Excess currency returns				Excess equity returns	Excess bond returns
	Mean	Std.dev.	Skewness	Kurtosis	Mean	Mean
Australia	0.38	3.60	-0.39	4.72	0.43	0.11
Canada	0.12	2.62	-0.45	5.36	0.41	0.17
Japan	-0.08	2.63	-0.15	3.76	0.41	0.05
New Zealand	0.49	3.78	-0.22	4.36	0.46	0.13
Norway	0.14	3.39	-0.15	3.50	0.66	0.14
Sweden	0.09	3.22	0.05	3.40	0.61	0.16
Switzerland	0.17	2.90	0.35	5.54	0.41	0.13
United Kingdom	0.03	2.54	-0.30	4.20	0.22	0.15
Euro/Germany	0.10	2.75	-0.13	4.29	0.42	0.15
Dollar factor/U.S.	0.16	2.37	-0.09	3.80	0.59	0.19

Table 2: Contemporaneous regressions

This table reports the regression output from regressing the dollar factor (Panel A) and the bilateral exchange rate excess returns (Panel B) on the cross sectional average of stock returns and bond returns. The regressions are based on daily data spanning from January 2001 to December 2020. Newey and West (1987) t-statistics are provided in brackets using the Andrews (1991) algorithm to select the lag length.

	Constant	$\bar{RX}^{equity}$	$\bar{RX}^{bond}$	R^2
		Panel A: Dollar factor		
Dollar factor	-0.01	0.18	2.40	7.95
	[-0.92]	[12.76]	[5.37]	
		Panel B: Bilateral exchange rates		
Australia	-0.00	0.40	1.19	18.72
	[-0.43]	[15.70]	[1.93]	
Canada	-0.00	0.25	0.19	14.78
	[-0.27]	[13.22]	[0.45]	
Japan	-0.02	-0.13	6.81	17.49
	[-2.27]	[-7.96]	[14.81]	
New Zealand	-0.00	0.35	1.78	12.74
	[-0.20]	[14.44]	[2.89]	
Norway	-0.01	0.28	2.50	8.86
	[-1.18]	[12.40]	[3.70]	
Sweden	-0.01	0.25	1.96	7.94
	[-0.82]	[12.13]	[3.07]	
Switzerland	-0.00	-0.00	4.21	3.13
	[-0.15]	[-0.26]	[7.41]	
United Kingdom	-0.01	0.15	0.76	4.17
	[-0.74]	[8.15]	[1.55]	
Euro	-0.00	0.09	2.15	1.66
	[-0.39]	[5.34]	[3.90]	

Table 3: Summary statistics for estimates and factors

The table presents summary statistics for the dollar factor's international stock exposure estimated intra-monthly, the US dollar's hedging state (ρ_t), the international equity factor ($\overline{RX}^{equity}$), the international bond factor ($\overline{RX}^{bond}$), and common currency factors: the dollar factor (DOL) and the carry factor (CAR). Panel A shows mean, standard deviation, skewness, kurtosis, and first order autocorrelation. Panel B shows the correlation between the dollar factor's international stock exposure and its sign against the currency, stock, and bond factors. The sample period is January 2001 to December 2020.

	β_{equity}	ρ	$\bar{RX}^{equity}$	$\bar{RX}^{bond}$	DOL	CAR
			Summary statistics			
Mean	0.09	0.18	0.46	0.14	0.16	0.40
Std	0.28	0.99	3.95	0.52	2.37	2.90
Skew	0.12	-0.37	-0.86	0.29	-0.09	-0.40
Kurt	3.20	1.14	4.73	3.28	3.80	4.38
AR	0.53	0.34	0.19	0.28	0.06	0.05
	8.42	4.57	2.76	3.01	0.81	0.65
			Panel B: Correlation matrix			
β_{stock}	1.00	0.77	0.08	0.08	0.05	0.06
ρ		1.00	0.05	0.02	0.05	0.07

Table 4: Predictive regressions

This table reports the regression output from regressing future dollar factor (Panel A) and future bilateral exchange rate excess returns (Panel B) on the US dollar's hedging state (ρ_t). The predictive regressions are based on monthly data spanning from February 2001 to December 2020. Newey and West (1987) t-statistics are provided in brackets using the Andrews (1991) algorithm to select the lag length.

	Intercept	ρ	R^2
Dollar factor	0.05	0.42	3.09
	[0.30]	[2.82]	
Australia	0.15	0.83	5.20
	[0.69]	[3.68]	
Canada	-0.03	0.42	2.74
	[-0.21]	[2.84]	
Japan	-0.09	0.16	0.38
	[-0.54]	[0.98]	
New Zealand	0.22	0.86	5.04
	[0.95]	[3.61]	
Norway	-0.02	0.51	2.36
	[-0.10]	[2.44]	
Sweden	-0.03	0.31	0.95
	[-0.13]	[1.56]	
Switzerland	0.13	0.31	1.10
	[0.77]	[1.78]	
UK	0.03	0.12	0.24
	[0.16]	[0.75]	
Euro	0.04	0.24	0.76
	[0.23]	[1.39]	

Table 5: Predictability and international equity betas

In Panel A, this table reports the regression output from regressing future returns of five equal-weighted portfolios sorted on international equity exposure and the high-minus-low portfolio on the US dollar's hedging state, ρ_t. The regressions are based on monthly data spanning from February 2001 to December 2020. Panel B shows descriptive statististics for the five portfolios and the high-minus-low portfolio, while Panel C shows descriptive statistics for timing strategies: long in the portfolios when the US dollar hedges international equity risk and short otherwise. The last two rows of the table shows the timing strategies' pricing error when adjusting for the Lustig et al. (2011) 2 factor model (LV) and when adjusting for a set of nine common currency factors from the literature. Newey and West (1987) t-statistics are provided in brackets using the Andrews (1991) algorithm to select the lag length.

	P1	P2	P3	P4	P5	P5-P1
			Panel A: Predictive regressions			
Intercept	0.19	0.08	-0.31	-0.04	0.27	0.08
	[1.31]	[0.50]	[-1.64]	[-0.25]	[1.28]	[0.43]
ρ	0.14	0.39	0.33	0.52	0.79	0.65
	[0.98]	[2.31]	[1.77]	[2.98]	[3.73]	[3.44]
R^2	0.40	2.35	1.29	3.36	5.51	4.62
			Panel B: Portfolio characteristics			
Average return	2.60	1.84	-2.95	0.59	5.00	2.40
	[1.49]	[0.94]	[-1.34]	[0.28]	[1.93]	[1.03]
Std. dev	7.77	8.65	9.97	9.65	11.56	10.36
Sharpe ratio	0.33	0.21	-0.30	0.06	0.43	0.23
Skewness	0.40	-0.14	-0.32	-0.36	-0.11	-0.56
Kurtosis	3.91	3.77	4.83	4.21	5.29	6.79
			Panel C: Timed-portfolio characteristics			
Average return	2.13	4.84	3.32	6.13	10.13	8.00
	[1.22]	[2.53]	[1.51]	[2.99]	[4.01]	[3.61]
Std. dev	7.78	8.55	9.96	9.49	11.28	10.12
Sharpe ratio	0.27	0.57	0.33	0.65	0.90	0.79
Skewness	0.14	-0.05	0.35	0.15	0.46	0.66
Kurtosis	4.02	3.80	4.81	4.16	5.00	6.39
LV α	2.12	4.58	2.74	5.48	9.20	7.08
	[1.20]	[2.15]	[1.12]	[2.30]	[3.30]	[2.88]
α_9	2.25	4.10	2.11	5.46	8.63	6.39
	[1.26]	[2.20]	[0.94]	[2.69]	[3.57]	[3.14]

Table 6: Predictability and financial risk

This table presents estimated predictive slope coefficients of the US dollar's hedging state, ρ_t, for equal-weighted portfolios sorted on exposure towards a number of risk metrics (Panel A), and currency-specific risk metrics (Panel B). The regressions are based on monthly data spanning from February 2001 to December 2020. Newey and West (1987) t-statistics are provided in brackets using the Andrews (1991) algorithm to select the lag length.

	P1	P2	P3	P4	P5	P5-P1
			Panel A: Currency exposures			
ΔFX vol	0.81	0.45	0.40	0.32	0.23	-0.59
	[4.11]	[2.39]	[1.97]	[1.80]	[1.55]	[-3.19]
ΔVIX	0.81	0.51	0.31	0.37	0.14	-0.67
	[3.76]	[2.82]	[1.73]	[2.10]	[0.99]	[-3.39]
Dollar beta	0.18	0.39	0.62	0.45	0.68	0.51
	[1.48]	[2.36]	[3.14]	[2.36]	[2.91]	[2.62]
ΔMU	0.65	0.45	0.30	0.51	0.23	-0.43
	[3.07]	[2.29]	[1.64]	[3.26]	[1.52]	[-2.45]
ΔFU	0.76	0.57	0.33	0.30	0.20	-0.57
	[3.63]	[3.10]	[1.85]	[1.77]	[1.28]	[-2.96]
Intermediate risk factor	0.15	0.34	0.43	0.61	0.72	0.57
	[1.05]	[2.01]	[2.28]	[3.46]	[3.42]	[3.17]
			Panel B: Currency-specific characteristics			
VaR (5%)	0.79	0.47	0.48	0.21	0.25	-0.54
	[3.63]	[2.36]	[2.75]	[1.41]	[1.64]	[-3.55]
ES (5%)	0.86	0.40	0.45	0.19	0.28	-0.58
	[3.90]	[2.10]	[2.46]	[1.35]	[1.83]	[-3.96]
Skewness	0 0.72	0.56	0.22	0.35	0.21	-0.51
	[3.62]	[2.56]	[1.08]	[1.95]	[1.50]	[-2.93]
Realized variance	0.28	0.26	0.37	0.49	0.83	0.55
	[1.85]	[1.76]	[2.13]	[2.51]	[3.81]	[4.09]
Forward Discounts	0.30	0.23	0.39	0.53	0.73	0.43
	[2.03]	[1.45]	[1.91]	[2.83]	[3.19]	[2.28]
Coskewness	0.70	0.55	0.42	0.42	0.07	-0.62
	[4.07]	[2.83]	[2.04]	[2.30]	[0.48]	[-4.02]

Table 7: Drivers of the hedging ability

This table shows the regressional results from regressing future hedging ability innovations on FX volatility, stock volatility, and a proxy for hedge fund speculation in the FX futures market. Both volatility measures are estimated on the intra-monthly realized variance. The regressions are based on monthly data spanning from July 2006 to December 2020. Newey and West (1987) t-statistics are provided in brackets using the Andrews (1991) algorithm to select the lag length.

	$\beta_{DOL,equity}$				ρ_t			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.01	0.01	-0.00	0.02	0.03	0.02	0.08	-0.01
	[0.41]	[0.33]	[0.88]	[-0.20]	[0.33]	[0.22]	[1.15]	[-0.15]
FX vol	8.96			12.41	42.02			32.42
	[3.29]			[1.44]	[4.40]			[1.38]
Stock vol		6.19		-1.64		30.56		10.16
		[3.36]		[-0.30]		[4.09]		[0.58]
Hegde fund speculation			0.30	0.33			0.80	0.91
			[2.49]	[2.88]			[2.07]	[2.36]
R^2	2.01	1.86	3.29	5.91	3.34	3.43	1.73	5.69
	The dollar factor				HML beta portfolio (P5-P1)			
Intercept	-0.15	-0.21	-0.19	-0.23	0.	-0.02	-0.10	-0.03
	[-0.88]	[-1.18]	[-1.02]	[-1.31]	[0.02]	[-0.07]	[-0.37]	[-0.13]
ρ	0.74	0.72	0.71	0.72	0.86	0.85	0.80	0.84
	[3.80]	[3.65]	[3.58]	[3.36]	[3.19]	[3.16]	[3.11]	[2.98]
FX vol	-24.12			-240.2	-65.3			-168.1
	[-0.36]			[-1.69]	[-0.78]			[-1.06]
Stock vol		6.34		166.87		-32.84		79.65
		[0.15]		[1.74]		[-0.52]		[0.67]
Hegde fund speculation			0.03	0.02			0.06	0.04
			[0.22]	[0.14]			[0.34]	[0.25]
R^2	7.99	7.87	7.87	9.75	6.50	6.20	5.94	6.75

Table 8: The hedging ability and existing currency predictors

This table reports the regression output from regressing future dollar factor (Panel A) and the high-minus-low international equity exposure portfolio (Panel B) on the hedging state of the US dollar when controlling for traditional currency time-series predictors. These are the currency variance risk premium (Londono and Zhou, 2017), the US variance risk premium (Londono and Zhou, 2017), the average forward discount (Lustig et al., 2014), and the year-on-year growth in financial commercial papers (Fang and Liu, 2021). The predictive regressions are based on monthly data spanning from February 2001 to December 2020. Newey and West (1987) t-statistics are provided in brackets using the Andrews (1991) algorithm to select the lag length.

	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Dollar factor			
Intercept	0.08	0.14	0.03	0.05	0.13	0.11
	[0.52]	[0.92]	[0.18]	[0.34]	[0.80]	[0.63]
ρ	0.43	0.41	0.45	0.43	0.38	0.39
	[2.80]	[2.70]	[2.91]	[2.79]	[2.39]	[2.36]
XVP		-0.01				-0.01
		[-1.65]				[-1.29]
VP_{US}			0.00			0.00
			[0.93]			[0.85]
AFD				1.62		1.04
				[1.22]		[0.72]
CP					-0.02	-0.01
					[-1.77]	[-1.07]
R^2	3.30	4.99	4.80	3.81	4.18	6.92
			Panel B: High-minus-low beta portfolio (P5-P1)			
Constant	0.08	0.19	0.01	0.05	0.11	0.11
	[0.44]	[1.04]	[0.03]	[0.29]	[0.54]	[0.50]
ρ	0.65	0.61	0.68	0.65	0.58	0.59
	[3.47]	[3.40]	[3.54]	[3.47]	[3.04]	[3.01]
XVP		-0.01				-0.01
		[-2.03]				[-2.05]
VP_{US}			0.00			0.00
			[1.01]			[0.93]
AFD				1.54		1.08
				[1.02]		[0.69]
CP					-0.02	-0.01
					[-1.32]	[-0.55]
R^2	4.62	7.81	6.68	4.90	5.04	10.24

Table 9: Predictability when Including emerging market currencies

This table reports the regression output from regressing future dollar factor (Panel A), five portfolios sorted on international equity exposure portfolio and the high-minus-low portfolio (Panel B) on the hedging state of the US dollar. All portfolios are constructed using a broader basket of currencies. The predictive regressions are based on monthly data spanning from February 2001 to December 2020. Newey and West (1987) t-statistics are provided in brackets using the Andrews (1991) algorithm to select the lag length.

	Intercept	ρ	R^2
Dollar factor	0.13	0.34	3.15
	[1.03]	[2.77]	
P1	0.18	0.14	0.69
	[1.41]	[1.14]	
P2	0.10	0.32	3.18
	[0.82]	[2.74]	
P3	-0.02	0.33	2.63
	[-0.18]	[2.66]	
P4	-0.02	0.33	3.32
	[-0.60]	[2.90]	
P5	0.13	0.61	4.02
	[0.66]	[3.20]	
P5-P1	-0.05	0.47	2.97
	[-0.33]	[2.75]	

Table 10: Estimating the hedging state using longer horizons

This table reports the regression output from regressing future dollar factor (Panel A), the high-minus-low international equity risk portfolio (Panel B) on the hedging state of the US dollar. Along the columns, we extend the measurement horizon for estimating the US dollar's hedging state from 1 month to 12 months. Panel C shows descriptive statistics of a timing strategy which is long in the high-minus-low international equity portfolio when the US dollar hedges international equity risk, and short otherwise. The predictive regressions are based on monthly data spanning from February 2001 to December 2020. Newey and West (1987) t-statistics are provided in brackets using the Andrews (1991) algorithm to select the lag length.

	1-month	2-month	3-month	6-month	9-month	12-month
			Panel A: Dollar factor predictability			
ρ	0.43	0.29	0.34	0.19	0.09	0.14
	[2.85]	[1.92]	[2.24]	[1.25]	[0.54]	[0.87]
R^2	3.30	1.54	2.10	0.59	0.13	0.32
			Panel B: P5-P1 predictability			
ρ	0.65	0.61	0.47	0.16	0.09	0.12
	[3.44]	[3.32]	[2.45]	[0.86]	[0.51]	[0.64]
R^2	4.62	4.12	2.38	0.26	0.09	0.15
			Panel C: Timing strategies			
Mean	8.00	7.53	5.83	2.34	1.67	1.99
	[3.61]	[3.43]	[2.59]	[1.01]	[0.72]	[0.84]
SR	0.79	0.74	0.57	0.23	0.16	0.19
Skewness	0.66	0.71	0.72	-0.57	-0.56	-0.59
Kurtosis	6.39	6.34	6.33	6.79	6.72	6.76

Table 11:
Estimating the currencies' international equity exposure using shorter horizons

This table reports the predictive slope coefficient from regressing the high-minus-low international equity risk portfolio on the hedging state of the US dollar. In addition to descriptive statistics of timing strategies that are long in the high-minus-low international equity portfolio when the US dollar hedges international equity risk, and short otherwise. Along the columns, we extend the measurement horizon for estimating the currencies' international equity exposure from 12 months to 60 months (1 month to 12 months) in Panel A (Panel B). In Panel A we use monthly data to estimate the exposures, while we use daily data to estimate the exposures in Panel B. The predictive regressions are based on monthly data spanning from February 2001 to December 2020. Newey and West (1987) t-statistics are provided in brackets using the Andrews (1991) algorithm to select the lag length.

	12 months	24 months	36 months	48 months	60 months
	Panel A: P5-P1 predictability				
ρ	0.33	0.56	0.60	0.61	0.65
	[1.68]	[2.95]	[3.16]	[3.25]	[3.44]
R^2	1.14	3.39	3.82	4.24	4.62
Mean	4.06	6.90	7.35	7.46	8.00
	[1.74]	[3.10]	[3.28]	[3.46]	[3.61]
SR	0.39	0.69	0.73	0.77	0.81
Skewness	0.67	0.67	0.66	0.55	0.66
Kurtosis	5.96	6.53	6.23	5.94	6.39
	1 month	2 months	3 months	6 months	12 months
	Panel B: P5-P1 predictability - beta based on daily observations				
ρ	0.41	0.39	0.45	0.50	0.61
	[2.17]	[2.09]	[2.30]	[2.48]	[3.04]
R^2	1.87	1.60	1.99	2.42	3.66
Mean	5.15	4.58	5.21	5.94	7.11
	[2.25]	[2.04]	[2.25]	[2.46]	[2.96]
SR	0.50	0.46	0.50	0.55	0.66
Skewness	0.63	0.53	0.48	0.47	0.41
Kurtosis	7.08	6.93	6.44	6.05	6.32

Figure 1: The hedging ability of the US dollar over time

This figure shows the evolution of the $\beta_{DOL,equity}$ coefficient from Eq. (11) over time. The coefficient in each month is estimated intra-monthly. The sample ranges from January 2001 to December 2020. NBER recessions are shown in shaded areas.

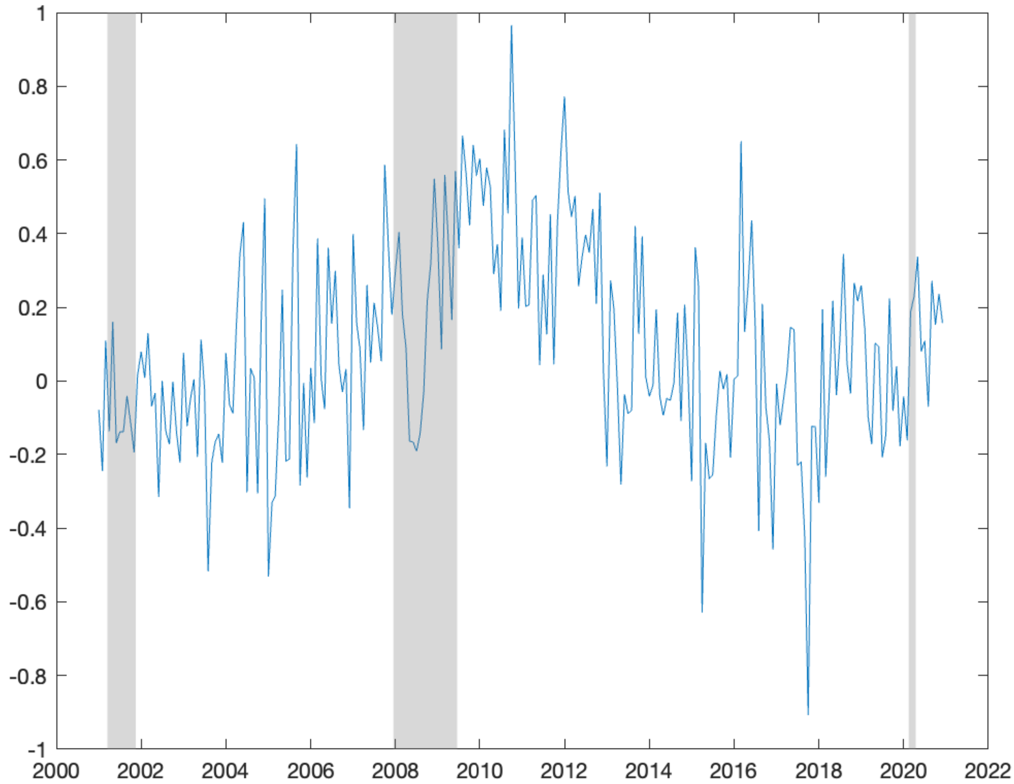

Figure 2: Cumulative portfolio returns

This figure shows the cumulative net exces returns to the high-minus-low international equity portfolio (blue line), and a timing strategy (red line)which is long in the high-minus-low international equity portfolio when the US dollar hedges international equity risk, and short otherwise. The high-minus-low international equity portfolios is constructed using five equal-weighted portfolios sorted on the bilateral currencies' exposure towards an international equity factor, i.e., the cross-sectional average of equity returns across G10 currencies. The sample ranges from February 2001 to December 2020.