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# EXCHANGE RATE RECONNECT


## Abstract

The failure to find fundamentals that co-move with exchange rates or forecasting models with even mild predictive power – facts broadly referred to as "exchange rate disconnect" – stands among the most disappointing, but robust, facts in all of international macroeconomics. In this paper, we demonstrate that U.S. purchases of foreign bonds, which did not co-move with exchange rates prior to 2007, have provided significant in-sample, and even some out-of-sample, explanatory power for currencies since then. We show that several proxies for global risk factors also start to co-move strongly with the dollar and with U.S. purchases of foreign bonds around 2007, suggesting that risk plays a key role in this finding. We use security-level data on U.S. portfolios to demonstrate that the reconnect of U.S. foreign bond purchases to exchange rates is largely driven by investment in dollar-denominated assets rather than by foreign currency exposure alone. Our results support the narrative emerging from an active recent literature that the US dollar's role as an international and safe-haven currency has surged since the global financial crisis.



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# Exchange Rate Reconnect*

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December 2019

**Abstract**

It is surprisingly difficult to find economic variables that strongly co-move with exchange rates, a phenomenon codified in a large literature on "exchange rate disconnect." We demonstrate that a variety of common proxies for global risk appetite, which did not co-move with exchange rates prior to 2007, have provided significant in-sample explanatory power for currencies since then. Furthermore, during the global financial crisis and its aftermath, U.S. purchases of foreign bonds were highly correlated with these risk measures as well as with exchange rates. Changes in this type of capital flow statistically explain as much as half of the quarterly variation in the US dollar during 2007-2012. We use security-level data on U.S. portfolios to demonstrate that this connection of U.S. foreign bond purchases to exchange rates is largely driven by investment in dollar-denominated assets rather than by foreign currency exposure alone. Our results support the narrative emerging from an active recent literature that the US dollar's role as an international and safe-haven currency has surged since the global financial crisis.

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# 1 Introduction

Starting with the influential contribution by Meese and Rogoff (1983), a long literature has demonstrated the difficulty in finding economic variables that co-move with exchange rates, a phenomenon known as "exchange rate disconnect." The paucity of robust empirical relationships between exchange rates and other aggregates offers little guidance for researchers and policy-makers on which macroeconomic models to use. While progress has certainly been made, the proverbial glass remains – at the very most – half full.

It is against this backdrop that we uncover a surprising pattern that emerged with the global financial crisis: exchange rates, and in particular the broad US dollar, have co-moved closely with global risk appetite and with U.S. foreign bond purchases. Since 2007, during months when proxies for global risk appetite decrease, the dollar contemporaneously appreciates. When risk appetite increases, the dollar depreciates. Whereas risk measures had little or no explanatory power for exchange rates prior to the crisis, the risk measures statistically explain a meaningful share of all subsequent exchange rate variation. Furthermore, during 2007-2012, U.S. purchases of foreign bonds rose and fell with these measures of global risk appetite, and so these capital flows also co-moved with the broad US dollar. In quarters when U.S. residents increased their holdings of external debt, the dollar contemporaneously depreciated. When U.S. residents decreased these foreign bond holdings, the dollar appreciated.

We dub the emergence of the relationships of global risk proxies and U.S. foreign bond purchases with the exchange rate as "exchange rate reconnect." It is difficult to reach definitive conclusions from such short time series as the 2013-2018 period, but it appears that the risk measures remain reconnected with exchange rates even at the end of our sample. U.S. foreign bond purchases, however, appear to have again disconnected with the broad US dollar.

We start our analysis by examining the connection between exchange rates and common proxies of global risk appetite, including credit spreads, financial intermediary returns, the S&P 500 returns and their implied volatility in option markets, and the premium on U.S. Treasuries. Consistent with Lilley and Rinaldi (2018), who first showed that the S&P 500 and exchange rates began to co-move since the crisis, we demonstrate that all six risk proxies exhibit a structural break around 2007. We run rolling regressions of exchange rates on our risk proxies using monthly data spanning 10- and 5-years. We find negligible explanatory power before the crisis and large $R^2$'s – in some cases, surpassing 50 percent – since then. Even at the end of our sample, the estimated coefficients in these regressions generally remained significantly different from zero and above their pre-crisis values.

We decompose the explanatory power of these risk measures for the broad dollar into its bilateral exchange rate components. Intuitively, the co-movement of these risk measures and bilateral exchange rates between the dollar and other safe-haven currencies such as the Swiss franc and Japanese yen remains fairly muted, even after the crisis. Instead, the reconnect of global risk measures and the broad dollar is largely driven by the bilateral exchange rates between the US dollar and currencies conventionally thought of as riskier, such as the Australian dollar.

Next, we turn to publicly available data from the IMF Balance of Payments (BoP) and International Investment Positions (IIP) to construct quarterly measures of U.S. capital flows. In rolling 10-year and 5-year regressions using these data, quarterly changes in U.S. gross foreign bond flows (as a share of the stock of U.S. foreign bond positions) had near-zero explanatory power for changes in the broad US dollar exchange rate prior to 2007. At the time of the crisis, the correlation between these objects increased and the $R^2$ on the regressions climbed sharply. The $R^2$ of the 5-year regressions, after peaking above 50 percent for the period corresponding to 2007-2012, returns to a near-zero level for 2013-2018. We conclude that the connection of U.S. gross foreign bond flows to exchange rates lasted for a number of years when markets were in a heightened state of turmoil.

When we repeat the identical exercise for other countries and for other flow measures (including outflows, inflows, and net flows of bonds, equity, and direct investment), we do not find similarly compelling evidence of reconnect. Since other flows likely interact similarly to U.S. foreign bond flows in terms of the pressure they exert on currency markets and their interaction with various market frictions, and given the continued reconnect of risk measures and exchange rates, we do not view the relationship between U.S. foreign bond flows and the dollar as causal. Rather, we believe fluctuations in global risk appetite simultaneously influenced both exchange rates and U.S. foreign bond flows during the crisis and several years of its aftermath. In this sense, the reconnect carries something of a special role for the United States.

While we find strong evidence for a reconnect between risk, capital flows, and exchange rates, we show that exchange rate disconnect largely remains for macro fundamentals. In particular, we find that macroeconomic variables such as interest rate, inflation, and growth rate differentials, remain only weakly correlated with exchange rate movements, even during and after the global crisis.

Having demonstrated the strong in-sample explanatory power of U.S. purchases of foreign bonds for the broad US dollar, at least during 2007-2012, we turn to a novel micro dataset capable of elaborating on the mechanics of this reconnect. We use data assembled by Maggiori, Neiman and Schreger (2019a) on mutual fund holdings from Morningstar that covers \$32 trillion of assets from individual security-level positions. These proprietary data do not extend backward enough in time to capture the change that occurs around 2007, but they do offer a number of benefits relative to BoP and IIP data.

First, the mutual fund holdings decompose the market value of positions into prices and quantities. As such, we can use them to isolate changes in foreign bond positions that come from purchases of additional securities and not from movements in prices or exchange rates. This ensures that reconnect does not reflect the direct or mechanical influence of the exchange rate on the value of foreign bond purchases. Indeed, even with this conservative notion of flows, U.S. foreign bond flows in the Morningstar data do have a similarly high explanatory power for the broad dollar as we found in the public macro data from 2007 onward.

Second, U.S. purchases of foreign bonds in the Maggiori et al. (2019a) dataset can be separated by issuing country, sector (corporate or government), and currency of denomination. Further, the data can be used to explore these purchases across different kinds of investors, including large versus small mutual funds or those that specialize in international investment versus those that do not. In doing so, we find that the explanatory power of U.S. portfolio flows is driven as much by U.S. net purchases of dollar-denominated bonds as by U.S. purchases of foreign-currency-denominated bonds. This further corroborates that the explanatory power is indeed coming from the relationship between these flows and changes in a global risk factor, rather than from the direct effect of a sale of US dollars and purchase of foreign currencies. In addition, in contrast to BoP data, the Morningstar data allow us to see which securities investors are buying domestically. Consistent with the idea that flows are picking up changes in investors' risk appetite, we see that when U.S. investors buy less U.S. Treasuries or more domestic corporate debt, the dollar depreciates.

Third, we sort the open-end and exchange-traded funds in Maggiori et al. (2019a) according to their size, the degree to which they specialize in foreign investment or foreign currency investment, and the degree to which they follow a passive investment strategy. We find that the aggregate results are driven by large actively-managed funds that are not specialists in foreign currency or foreign issuers. The fund-level analysis therefore also supports the view that U.S. foreign bond flows largely pick up the risk appetite of sizable dollar-centric discretionary U.S. investors.

In summary, we identify the emergence of a close relationship between various global risk measures and the broad US dollar that emerged with the global financial crisis. Further, we identify a particular quantity, U.S. foreign bond purchases, that has strongly comoved with these risk measures and the broad US dollar during the crisis and several years of its aftermath, even though this relationship no longer appears to hold at the end of our data. In the context of the voluminous literature on exchange rate disconnect which offers few comparably successful covariates, we consider this progress even if the post-crisis time series is short and we do not establish a causal mechanism. Going forward, anyone analyzing the relationship between exchange rates and risk should pay close attention to the large structural break that we document over the last 10 years.

Our documentation that exchange rate reconnect started around 2007 relates to the finding in Du, Tepper and Verdelhan (2017) of large covered interest rate parity deviations (CIP) over this same period, which Avdjiev, Du, Koch and Shin (2019b) show are systematically related to the dollar exchange rate. More generally, a number of papers have made progress on the exchange rate disconnect puzzle. Gourinchas and Rey (2007) show predictability over medium term horizons using the cyclical component of net external balances, and Kremens and Martin (2018) have success forecasting exchange rates with S&P 500 options-implied risk premia. Measures of the convenience yield on treasuries have been shown to covary with the broad dollar exchange rate in Jiang et al. (2018) and Engel and Wu (2018). Adrian and Xie (2019) find a higher share of US dollar loans in the portfolio of non-U.S. banks forecasts a dollar depreciation.

Finally, the crisis seems to have further cemented the role of the US dollar as the primary global safe asset. Maggiori et al. (2019a,b) document a broad and persistent portfolio shift into dollar-denominated bonds (and away from euro-denominated bonds) since the financial crisis. These latter two developments suggest an increase in the role of risk premia in driving the broad dollar. Our results support an emerging narrative that the US dollar's role as an international and safe-haven currency has surged since the global financial crisis, such as Bruno and Shin (2015) and Jiang et al. (2019).

# 2 Exchange Rate Disconnect and Reconnect

Figures 1a and 1b reproduce the well-known disconnect between the exchange rate and two fundamentals – the interest rate differential and inflation differential between the United States and other G10 countries – for the period 1977-2006. For example, Figure 1a relates quarterly log-changes in the broad dollar, defined as an equally-weighted basket of nine currencies (the G10, excluding the United States) against the US dollar, with the average quarterly interest differential between the United States and the other nine countries.[1] Uncovered interest parity implies a strong relationship between these variables. Fitting these data with a linear regression, however, yields a small and imprecise point estimate, with the interest differential explaining only 5 percent of the variation in the exchange rate. Figure 1b similarly relates changes in observed inflation differentials with the exchange rate and, at odds with many standard models, exhibits an even weaker relationship, with an $R^2$ value of less than 1 percent. Given this exchange rate disconnect holds in-sample for realized outcomes, it is not surprising that interest rates and inflation differentials also offer no out-of-sample forecasting power.[2]

Figure 1c relates changes in the broad dollar to changes in a measure of global risk appetite, the U.S. corporate bond credit spread, or "GZ Spread", taken from Gilchrist and Zakrajšek (2012).

[1] The broad dollar is defined such that an increase corresponds to a dollar depreciation, and the interest differential is defined such than an increase corresponds to higher U.S. rates. Aloosh and Bekaert (2019) term such equal-weighted measures "currency baskets" and demonstrate how they can be used to capture systematic exchange rate variation.

[2] These two variables constitute only a small subset of the many fundamentals that, at odds with standard models, have been shown to be disconnected from the exchange rate.

Figure 1d relates changes in the broad dollar to changes in U.S. holdings of foreign bonds, constructed as the quarterly flow of U.S. residents into foreign debt securities (from BoP) divided by the value of U.S. foreign debt holdings at the start of the quarter (from IIP). Similar to the two fundamentals in Figures 1a and 1b, both the GZ Spread and U.S. holdings of foreign bonds also did not co-move with the US dollar during the same 1977-2006 period. While the disconnect of interest and inflation differentials persists, we show below that the GZ Spread (and other risk measures) and this particular component of U.S. capital flows both started to closely track the exchange rate during the global financial crisis, a phenomenon we refer to as exchange rate reconnect.

## 2.1 Reconnect with Global Risk Appetite

The reconnect of exchange rates to global risk appetite can be clearly seen in Figure 2, which plots the $R^2$ values of rolling univariate regressions run in monthly data of the broad dollar exchange rate on a constant and the contemporaneous change in six global risk proxies. These proxies include (i) the "GZ Spread", (ii) the "VXO", calculated as the monthly change in the log implied volatility on the S&P100 stock index, (iii) the log total return on the "S&P500", (iv) the "Treasury Premium" constructed as the average one-year covered interest parity deviation between developed country government bonds and U.S. Treasuries taken from Du et al. (2018), (v) the "Global Factor" in world asset prices constructed by Miranda-Agrippino and Rey (2018), and (vi) the "Intermediary Returns" from a value-weighted portfolio of holding companies of New York Federal Reserve primary dealers taken from He et al. (2017).[3] Figure 2a shows regressions estimated on 10-year rolling windows, and Figure 2b considers 5-year windows, starting in January of 1977 and ending in December of 2018.

During 1977-2006, most of the rolling regressions in Figure 2a have $R^2$s that average only a few percentage points and peak at about 5-10 percent. Around 2007, however, there is an abrupt but sustained increase in the explanatory power of most of these risk proxies for the broad dollar. The measures subsequently have $R^2$ values ranging from 10 to 60 percent, with most finishing the sample with $R^2$ values above 20 percent, large values that stand out in the exchange rate disconnect literature. Even after the steep one-quarter declines in the $R^2$s at the very end of the sample, which arise from dropping the second quarter of 2009 from the rolling regressions, all of the 10-year regressions in Figure 2a have $R^2$s well above their pre-crisis peak values. The 5-year regressions in Figure 2b similarly have $R^2$ values that peak between 30-70 percent, though these $R^2$s also sharply decline toward the end of our sample, suggesting that the explanatory power of global risk

[3] We showed exchange rate disconnect in Figure 1 using quarterly data since that's the highest frequency with which most macro fundamentals are measured. We compare risk proxies and exchange rates at a monthly horizon in Figure 2 and below as it gives us more power. If we instead plotted a version of Figure 1c using monthly data, we would still have demonstrated a disconnect between credit spreads and the exchange rate prior to 2007.

measures for the exchange rate was greater during 2007-2012 than during 2013-2018. Nonetheless, four of the six measures, even in this final five-year period of our sample, offer more explanatory power than they did at any point prior to the crisis.

The break from historical experience in the relationship between these risk measures and the broad dollar can be additionally seen by examining the regression coefficients underlying the $R^2$ values shown in Figure 2b. For each of the six risk proxies, we plot in Figure 3 the point estimates from the rolling regressions along with their 95 percent confidence intervals. In the regressions, a positive coefficient indicates that a depreciation of the broad dollar is associated with a decline in the risk premium (or an increase in risk appetite) captured by our proxies. We plot the estimates after normalizing them as z-scores, so they give the percent depreciation of the broad dollar in response to a one-standard-deviation increase in each measure of risk appetite. For example, the value in Figure 3b corresponding to the GZ Spread ends our sample at 0.0125, implying that when corporate credit spreads drop by one standard deviation, the dollar depreciates by 1.25 percent. In all six cases, the coefficients rise dramatically from their typical pre-crisis values to their post-crisis peaks near 2012, all of which are statistically greater than zero. In four of the six cases, the estimates remain statistically greater than zero, even by the last quarter of 2018, the last observation for these risk measures in our data.

### 2.1.1 Bilateral Exchange Rates

We can further unpack the exchange rate reconnect of global risk appetite by studying how the risk proxies correlate differently with different bilateral exchange rates. We find that when our measures of the risk premium decrease, the dollar depreciates most strongly against currencies conventionally described as "riskier" and less strongly or not at all against currencies conventionally considered to be "safe havens". Figure 4 reports the coefficients from regressions of changes in each bilateral exchange rate against the dollar on changes in the GZ Spread using monthly data from 2007 to 2018. The coefficients are sorted in ascending order. While safe-haven currencies such as the Yen and Swiss Franc hold steady or even depreciate vis-a-vis the US dollar when credit spreads are low (i.e. when risk appetite is high), the emerging market currencies and the New Zealand and Australian dollars appreciate.

In fact, given the different degrees of comovement across bilateral pairs with the US dollar, in the post-crisis period, fluctuations in global risk appetite explain significant shares of variation in all bilateral exchange rates. Table 1 reports the $R^2$s from univariate regressions of changes in each G10 bilateral exchange rate, including pairs that do not involve the US dollar, on the GZ Spread. Note that the Australian Dollar to Japanese Yen exchange rate pair is among the most explainable, with an $R^2$ of 34 percent, even higher than that of the broad US dollar.[4] The bottom row of Table 1 reports the simple mean of the $R^2$s across all bilaterals for each country. The fact that these values are highest for the Japanese yen and US dollar, and is third-highest for the Swiss franc, is consistent with the idea that all three safe-haven currencies have similar loadings on a global risk appetite that is proxied by our various measures. We generated these results using the GZ Spread but note that the results are qualitatively unchanged when we use any of the other five risk proxies.

### 2.1.2 Out-of-Sample Forecasting

Next, we follow the tradition established by Meese and Rogoff (1983) in evaluating the "out-of-sample" fit of a model while giving the model the realized values of the regressors. We provide full details about how the forecast is computed in Appendix A.1. To compare the out-of-sample forecasting power of our six risk proxies to that of a random walk model, we use two metrics. First, we divide the Root Mean Square Error (RMSE) of our forecasts' RMSE by the RMSE of the random walk. We call this the "RMSE Ratio", and a number lower than 1 implies the forecasts using our risk proxies outperform the random walk by this measure. Second, we formalize this forecast-error comparison using the Diebold-Mariano test statistic (Diebold and Mariano (2002)). This test compares the mean squared errors of the two forecasts and reports a p-value corresponding to the percent chance that a conclusion of outperformance versus the random walk reflects random error or noise. We then plot these two metrics in Figure 5a for each 120-month forecast evaluation period, and in Figure 5b for each 60-month forecast evaluation period, for each of our six risk proxies. The evaluation periods are selected to start at the beginning of each calendar year, with the first evaluation period covering 1987-1996 and the next starting and ending a year later, and so each test period overlaps. The "x" markers represent evaluation periods that are entirely prior to 2007, the hollow dots represent evaluation periods that include months before and after 2007, and the solid dots represent evaluation periods where all forecast periods occur after 2007.

Prior to 2007, we find the standard result: the RMSE ratio of all model forecasts performs worse, or on par at best, with that of a random walk. Yet for the last decade, we find that all of these models outperform the "no-change" benchmark. Moreover, we find two instances of model forecasts passing the Diebold-Mariano test even at the 5 percent significance threshold; changes in the Global Factor do so for both the last 5 and 10 years, while the log return on the S&P500 does so for the last 10 years, but loses statistical significance at the shorter horizon.

[4] Appendix Table A.1 is the equivalent of Table 1 but for the period before the crisis. Nearly all $R^2$s are close to zero.

## 2.2 Reconnect with U.S. Foreign Bond Purchases

The post-crisis reconnect between global risk measures and exchange rates is strong, appears long-lived, and complements a small number of recent successes in the exchange rate forecasting literature that use other price-based variables. The finding of reconnect between quantity-based macroeconomic aggregates and exchange rates, however, has been even more elusive. In this section we demonstrate that U.S. purchases of foreign bonds, a type of U.S. capital flow, strongly comoved with these risk measures and, therefore, strongly moved with the broad dollar during 2007-2012.

We start by constructing U.S. purchases of foreign bonds as the quarterly flow of U.S. funds into foreign debt securities (from BoP) divided by the value of U.S. foreign debt holdings at the start of the quarter (from IIP). We then demonstrate that during 2007-2012, in a clear break from the pre-crisis relationship, these U.S. purchases of foreign bonds moved closely together with each of the six risk measures. Figures 6a and 6b report the $R^2$ of rolling 10-year and 5-year univariate regressions of quarterly changes in U.S. holdings of foreign bonds on the six risk measures.[5] All series jump starting in 2007, though the $R^2$'s from the 5-year regressions all also sharply decline after 2013.

Does the comovement of this U.S. capital flow and our risk measures imply that U.S. foreign bond purchases also reconnected with the broad dollar? Figure 7 shows the $R^2$ of 10- and 5-year rolling regressions of the broad US dollar and U.S. foreign bond purchases and demonstrates that the answer is yes. The series estimated with rolling 10-year windows, plotted in a solid black line, shows that the explanatory power of changes in these bond flows for changes in the broad dollar jumps from near-zero to about 15 percent with the onset of the crisis and peaks near 40 percent shortly thereafter. The removal of the first post-crisis quarter from the estimation window causes a steep decline for the last plotted value, but the level even at the end of our series remains clearly elevated relative to pre-crisis values. The 5-year series, plotted with a red dashed line, shows an even greater surge in the explanatory power of these bond flows for the broad dollar during the period from 2007-2012, though the $R^2$ values return by the end of the sample to negligible levels. We do not wish to draw definitive conclusions based on 5-year windows, but the results do suggest that the reconnect of U.S. foreign bond purchases and the broad dollar did not persist through the end of our sample.

Much of the stark change in Figure 7 is driven by the particularly large appreciation of the US dollar and particularly large reduction in U.S. foreign bond holdings during the third and fourth quarters of 2008. The confluence of reconnect of this capital flow and the global financial crisis is important and intriguing. We emphasize, however, that the large movements during 2007-2009 are not wholly responsible for reconnect. To give a better sense for how evenly distributed reconnect

[5]We switch our analysis here of changes in the risk measures from monthly to quarterly frequency as that is the highest frequency with which the bond holding and purchase measures are reported.

is across the post-crisis period, Figure 8 reproduces Figure 1d but for 2007:Q1-2019:Q2.

The solid black best-fit line has a positive slope of 0.85 that indicates that greater U.S. purchases of foreign bonds are associated with larger depreciations of the US dollar. The $R^2$ on this relationship between the broad dollar and U.S. purchases of foreign bonds jumps from less than one percent in Figure 1d, capturing the pre-crisis period, to 32 percent in these subsequent quarters plotted in Figure 8.[6] The red dashed line in Figure 8 demonstrates that the best-fit slope relating these two variables is nearly identical if we exclude 2007:Q1 to 2009:Q2, the key quarters of the global crisis.

### 2.2.1 Other U.S. Capital Flows?

Interestingly, other types of U.S. capital flows have not exhibited a post-crisis reconnect with global risk measures nor with the broad dollar.[7] Appendix Table A.2 reports regression estimates for gross foreign purchases, gross foreign sales, and net foreign purchases by the United States of bonds and of equities. Of these six types of U.S. capital flows, only U.S. gross foreign purchases of debt securities and U.S. gross sales of equities exhibit a meaningful post-crisis change in their explanatory power for the broad dollar, with the change for U.S. foreign bond purchases being the largest by far.[8]

### 2.2.2 Other Macroeconomic Fundamentals

In Figure 9 we analyze whether there has been a reconnect of other macroeconomic fundamentals to exchange rates. We run 40-quarter and 20-quarter rolling-window regressions using the fundamentals that are related to exchange rates in several standard models in international economics, analogous to what we did with global risk measures in Figure 2. Guided by the excellent review of exchange rate predictability in Rossi (2013), the models that we test include the UIP model, the monetary model, the Taylor-rule model, and the Backus-Smith model.[9] Figure 9 plots the rolling $R^2$ values from these models, together with the series from Figure 7 using U.S. purchases of for-

[6] Appendix Figures A.1 and A.2 confirm that the same patterns in Figures 1d and 8 hold when focusing on yearly (i.e. 4-quarter) changes rather than quarterly changes.

[7] We do not offer a theory of why some flows have reconnected while others have not. We hope our empirical results might offer further guidance on the source of these shocks. For example, recent models such as Farhi and Werning (2014) and Itskhoki and Mukhin (2017) have introduced financial shocks in the Euler equations for foreign currency bonds.

[8] The importance of the distinction between gross and net capital flows has been documented empirically by Forbes and Warnock (2012), Broner et al. (2013), and Avdjiev et al. (2018), and has been examined theoretically by Caballero and Simsek (2016). An interesting literature studies the relationship between bank credit and exchange rates, including Avdjiev et al. (2019b,a), Miranda-Agrippino and Rey (2018), and Niepmann and Schmidt-Eisenlohr (2019)).

[9] Appendix A.2 provides details about the implementation of each model. Recent contributions of this literature include Engel and West (2005), Chen et al. (2010), Eichenbaum et al. (2017), Schmitt-Grohé and Uribe (2018), and Calomiris and Mamaysky (2019).

eign bonds, for comparison. Table 2 reports the in-sample performance for the pre- and post-crisis periods.

Figure 9 and Table 2 remind us that while most models perform relatively poorly, it is not unusual to find short spans of data over which a particular model "works well". For example, both the UIP and Taylor-rule models have large $R^2$s in the mid-to-late 2000s, and most models have a mild uptick in performance in the post-crisis period. In fact, the recent upticks suggest the interesting possibility that we might soon also observe a clearer reconnect of exchange rates to macro fundamentals.[10] For now, however, we focus on the sharper and more persistant relationship with U.S. foreign bond purchases during 2007-2012 and note that the instability in some of the lines in Figure 9 reiterate the general need for caution in reaching too strong conclusions from analyses of short time series.

In sum, before the global financial crisis of 2007-2008, exchange rates rarely comoved with other economic aggregates. We demonstrate, however, that several common proxies for global risk appetite, and even more surprisingly, U.S. purchases of foreign bonds, strongly reconnected with the broad dollar starting around 2007. Reconnect remains even after excluding the quarters of the global financial crisis, though it has significantly attenuated in recent years. The short time series cautions against definitive conclusions, but at the end of our sample, risk-based reconnect appears to continue while we no longer see evidence for capital-flow-based reconnect.[11]

# 3 Elaborating Reconnect with Micro Data

One key benefit of our finding that a type of U.S. capital flow began to co-move with the broad dollar is that it offers a natural pathway to explore reconnect further. In particular, we can disagregate those capital flows using the security-level holdings details assembled by Maggiori et al. (2019a) using Morningstar data on open-end mutual fund positions.[12] These data cover \$32 trillion of assets and allow us to make two distinct contributions. First, our micro data allow us to directly disentangle security purchases from changes in security prices, whereas BoP or IIP data necessarily conflate the two to some degree when calculating changes in positions. This means

[10]Appendix Figure A.3 shows results from the equivalent out-of-sample tests as were reported in Figure 5, but using U.S. foreign bond purchases and these other macroeconomic fundamentals. We find the only factor that consistently outperforms the random walk consistently is that of U.S. foreign bond purchases. It outperforms the random walk for every ten year evaluation window that includes the post-crisis period, though this outperformance usually is not statistically significant at the 5 percent level.

[11]All results presented in this section can be easily replicated using the code and datasets posted to http://www.globalcapitalallocation.com.

[12]We refer the reader to Maggiori et al. (2019a) and its Online Appendix for an extensive study of the representativeness of this type of flows for the BoP. Here, we only note that the measured changes in U.S. holdings of foreign bonds in the two sources have a correlation of 0.64. Appendix Figure A.4 plots the two time series from 2005:Q1 to 2017:Q4, the maximum span we can study in the micro data.

that we can corroborate that our finding of flows that correlate with exchange rates is not a simple reflection of the use of exchange rates to impute these flows. Second, the micro data allow us to study reconnect using various subsets of the data, distinguishing flows by currency, asset class, and investor type, for example.[13]

In this final section of the paper, therefore, we use these micro data to unpack the reconnect of exchange rates with U.S. foreign bond purchases. We remind the reader, however, that this elaboration may only be informative for the period 2007-2012, when the connection between the broad dollar and U.S. foreign bond purchases was strongest, and may not teach us much about the end of our sample, when this flows-based reconnect appears to have ended.

## 3.1 Reconnect after Separating Purchases from Price Changes

Our previous analyses defined flows as quarterly purchases of foreign securities during a quarter divided by the stock of holdings of such securities at the start of the quarter. Aggregated data on these purchases, however, do not allow us to completely separate the quantity of securities purchased and the price at which they were purchased. The flow measures might therefore contain information about the exchange rate, since it may be an important driver of the security's price (particularly if the security is not dollar-denominated). For claims such as ours, that a macroeconomic variable co-moves with the exchange rate, this limitation is critical.

We circumvent this issue in this section by building a measure of flows that keeps all prices and exchange rates constant at their beginning-of-quarter levels, which we are able to do using the dataset assembled by Maggiori et al. (2019a). These data capture the detailed holdings of all U.S. mutual funds and allow us to separately track for each position $s$ at the end of each quarter $t$ the number of securities $N_t(s)$ and the price per security $P_t(s)$. The total start-of-quarter value of the position is then simply the product of the two at the end of the prior quarter: $Q_{t-1}(s) = P_{t-1}(s) \times N_{t-1}(s)$, while the flow is the change in the number of securities during the current quarter times the start-of-quarter price: $F_t(s) = (N_t(s) - N_{t-1}(s)) \times P_{t-1}(s)$. We can then aggregate the flows across all positions $s$ within some category $S$ (such as corporate or government bonds, denominated in dollars or otherwise), $F_{t,S} = \sum_{s \in S} F_t(s)$, and divide the total by the aggregated start-of-quarter positions, $Q_{t-1,S} = \sum_{s \in S} Q_{t-1}(s)$, to construct a measure equivalent to what we studied using aggregated data above, $F_{t,S}/Q_{t-1,S}$.[14]

In Table 3, we confirm that U.S. foreign bond purchases constructed from these micro data connect with the broad US dollar to a similar extent as did these purchases when taken from the

[13] We follow the procedure in Coppola et al. (2019) to classify positions based on nationality of the ultimate parent and not residency of the immediate issuer. The BoP and IIP are instead based on residency. Therefore, another advantage of the micro data is the focus on truly foreign positions of U.S. resident funds.

[14] We provide a more exhaustive description of this procedure in Appendix Section A.3.2.

macro data.[15] While the coefficients are slightly different, the $R^2$s are similar: 33 percent for the BoP and 39 percent for the Morningstar data. Our results using the aggregate BoP data were not driven by the implicit influence of the exchange rate on bond prices.

## 3.2 Which Flows Matter?

As discussed above, we believe the post-crisis era has been characterized by a reconnect between the exchange rate and proxies for global risk appetite. U.S. purchases of foreign bonds appear to have themselves started to comove with these risk proxies, which brought about our capital-flow-based reconnect. We can use the micro data to confirm the importance of this single global factor by comparing, for each individual bilateral exchange rate against the US dollar, the explanatory power that comes from U.S. purchases of bonds in that particular corresponding foreign country with that coming from all other U.S. foreign bond purchases. For example, the analysis in Table 4 asks whether U.S. purchases of Australian bonds have more explanatory power for the bilateral exchange rate between the US and Australian dollar than do U.S. purchases of foreign bonds excluding those issued by Australia. The results show that for the vast majority of countries, including the flows to that country adds little to the $R^2$ for their currency relative the inclusion of all other foreign flows. The average $R^2$, for example, increases from 23 to 26 percent, as seen in the bottom row of the table. The notable exception is the Euro, for which only the flow to the Euro area is significant at the 5 percent level. These results stand in contrast with much of the previous literature on exchange rate disconnect which focused on bilateral differences in fundamentals (such as bilateral capital flows) to explain bilateral exchange rate changes and instead highlights the power of global variables for explaining the cross-section of bilateral exchange rate changes.

One might find it natural that bonds are more connected to exchange rates than equities since bonds are promises to pay units of a particular currency and equities are claims on real assets. Therefore, one might conjecture that the connection between U.S. foreign bond flows and the broad dollar occurs because U.S. residents are changing their positions in foreign-currency bonds, thus directly and causally affecting the exchange rate.[16] Table 5 shows that this is not the case. Much of the information about the exchange rate contained in U.S. purchases of foreign bonds is contained in U.S. purchases of foreign, but US dollar-denominated, bonds. The table separately investigates the explanatory power for the broad dollar of flows by U.S. residents in corporates and sovereigns and dollar- and non-dollar-denominated bonds. Flows to corporate bonds denominated

[15]In Appendix Figure A.4, we show the purchase of foreign bonds by U.S. mutual funds in the microdata is highly correlated with the U.S. BoP bond flow.

[16]Models of portfolio balance such as Kouri (1976) and Gabaix and Maggiori (2015) connect foreign currency risk taking to exchange rates via imperfect substitutability of the assets. A growing empirical literature has focused on portfolio rebalancing of foreign currency exposures and its connection to exchange rates, including Hau and Rey (2006), Camanho et al. (2017), and Bergant and Schmitz (2018).

in US dollars has the most explanatory power for the US dollar, while flows to sovereigns in foreign currency are statistically significant, though weaker.

These results are consistent with the narrative that when U.S. residents have more risk-bearing capacity, they use it to purchase foreign bonds in all currencies and at the same time require a lower risk premium, which causes the world's primary safe-haven currency to depreciate. This logic suggests a similar relationship in domestic portfolio allocations, which unlike the BoP data, are included in our micro dataset. We explore this in Table 6, which examine the co-movement between the broad dollar and changes in U.S. mutual fund investment in overall domestic bonds, corporate bonds, and domestic sovereign bonds (Treasuries), the safest asset class. Column one shows that overall flows into domestic bonds by U.S. residents covaries negatively with the broad dollar. This means that during times when U.S. mutual funds are increasing their flows into domestic debt, the broad dollar tends to appreciate. This is the opposite of what we saw for U.S. foreign bond flows. Interestingly, we find strong effects with opposite signs for domestic investment in corporate versus sovereign bonds. When U.S. funds purchase the riskier corporate bonds or sell the safer sovereign bonds, the dollar contemporaneously depreciates.

This duality between domestic risky and foreign bond investments can be further confirmed by focusing on which type of funds drive the aggregate results. We sort U.S.-domiciled funds on four characteristics: total size of the fund, fraction of the fund that is invested in foreign assets, fraction of the fund that is invested in foreign currency, and how close a fund is to being a passive investor. We split funds into quintiles for each characteristic and report coefficient estimates and $R^2$ from univariate regressions of changes in the broad dollar on foreign bond flows for each of these subgroups in Figure 10.

The key driver of the aggregate results are the large active funds that are not specialized in foreign investment. Indeed, the upper left panels of Figures 10a and 10b show that that the degree to which a fund specializes in foreign currency investments does not have a strong effect on the results. The upper right hand panels show that funds that have the least percentage of asset under management invested abroad have the strongest covariation and explanatory power for the exchange rate. The lower left panels show that it is the largest funds that drive the overall results. Finally, the bottom right panels show that the most passive funds have no explanatory power for the exchange rate. Therefore, we see that the aggregate explanatory power is driven by active funds who do not specialize in foreign investment. The fact that the results are driven by the purchases or sales of non-specialists supports the idea that the key driver of the aggregate results is the risk-bearing capacity of large U.S.-based investors, rather than the flows themselves causing exchange rate changes.

# 4 Conclusion

This paper documents a correlation between global risk proxies, U.S. foreign bond purchases, and exchange rates that emerged starting with the global financial crisis. The US dollar, a safe-haven currency, depreciates when risk-appetite is high and when these flows out of the United States increase. And since currencies load heterogeneously on this global risk factor, these relationships explain more than just the broad US dollar, they also explain variation in bilateral currency pairs where one currency is considered "safe" and the other is considered "risky". The reconnect of the global risk proxies has clearly weakened relative to the 2007-2012 period, but appears to remain intact at the end of our sample. The reconnect of the U.S. capital flows, however, appears to have ended by 2018.

While we do not offer a theory of the reconnect nor do we establish a causal link between global risk proxies and U.S. foreign bond purchases, we offer here one possible view of the facts uncovered in this paper. Perhaps currencies began to strongly covary with measures of global risk at the time of the global crisis because of a drastic reduction in global financial intermediation capacity compared to global flows and a repricing of currency risk. This is consistent with the evidence in Du et al. (2017) that persistent CIP deviations have emerged after the crisis. Perhaps U.S. foreign bond purchases became connected with measures of global risk around the same time because that is the unique component of global capital flows whose direction alone reveals whether investors are shifting their portfolio towards riskier foreign securities compared to the ultimate safety of domestic government bonds. This is consistent with the idea that the US dollar's role as a safe asset and international currency has sharply increased since the financial crisis.[17]

Maggiori et al. (2019a,b), for example, provide direct evidence that the dollar's use in several roles, including to denominate corporate bonds and bank loans, has surged since 2008. Such a change would help explain why the factors highlighted in this paper have become relatively more important drivers of the dollar's value after the crisis than they were previously.

[17]The role of the dollar as a safe asset has received much theoretical and empirical attention in the literature on the international monetary system. See for example Caballero et al. (2008), Gourinchas et al. (2011), Maggiori (2017), and Farhi and Maggiori (2018).

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# Tables

Table 1: G10 Bilateral Exchange Rates and Change in GZ Spreads, 2007-2018

| $R^2$ | AUD | CAD | CHF | EUR | GBP | JPY | NOK | NZD | SEK | USD |
|---|---|---|---|---|---|---|---|---|---|---|
| AUD | | 2 | 24 | 17 | 5 | 34 | 1 | 4 | 7 | 23 |
| CAD | 2 | | 14 | 9 | 2 | 36 | 0 | 0 | 2 | 30 |
| CHF | 24 | 14 | | 4 | 7 | 12 | 20 | 11 | 10 | 1 |
| EUR | 17 | 9 | 4 | | 2 | 19 | 17 | 5 | 6 | 7 |
| GBP | 5 | 2 | 7 | 2 | | 25 | 3 | 1 | 0 | 20 |
| JPY | 34 | 36 | 12 | 19 | 25 | | 35 | 22 | 26 | 9 |
| NOK | 1 | 0 | 20 | 17 | 3 | 35 | | 1 | 5 | 24 |
| NZD | 4 | 0 | 11 | 5 | 1 | 22 | 1 | | 1 | 12 |
| SEK | 7 | 2 | 10 | 6 | 0 | 26 | 5 | 1 | | 13 |
| USD | 23 | 30 | 1 | 7 | 20 | 9 | 24 | 12 | 13 | |
| **Mean** | 13 | 10 | 11 | 10 | 7 | 24 | 12 | 6 | 8 | 16 |

Notes: This table reports the $R^2$ of regressions of the form $\Delta e_{i,j,t} = \alpha + \beta f_t + \varepsilon_t$, where $\Delta e_{i,j,t}$ is the monthly change in the bilateral exchange rate of the currency in row $i$ and column $j$, and $f_t$ is the change in U.S. corporate bond spreads, taken from Gilchrist and Zakrajšek (2012). Exchange rate data are from Thomson Reuters Datastream and bond position data are from the IMF Balance of Payments database. Data is measured monthly from 2007-2018.

Table 2: Broad Dollar, Capital Flows, and Macro Fundamentals

| | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ |
|---|---|---|---|---|---|
| Model | | UIP | Backus-Smith | Monetary | Taylor Rule |
| Panel A: 1977-2006 | | | | | |
| U.S. Flows | 0.086 | | | | |
| | (0.14) | | | | |
| $i^{US}_{t-1} - \bar{i}_{t-1}$ | | -0.53** | | | |
| | | (0.22) | | | |
| $\pi^{US}_t - \bar{\pi}_t$ | | | -2.5* | -0.32 | -0.48 |
| | | | (1.3) | (0.80) | (0.71) |
| $\Delta c^{US}_t - \overline{\Delta c_t}$ | | | 1.1 | | |
| | | | (1.3) | | |
| $\Delta y^{US}_t - \overline{\Delta y_t}$ | | | | 0.25 | |
| | | | | (0.47) | |
| $\tilde{y}^{US}_t - \bar{\tilde{y}}_t$ | | | | | 0.83** |
| | | | | | (0.33) |
| Obs. | 108 | 108 | 47 | 108 | 108 |
| $R^2$ | 0.00 | 0.07 | 0.10 | 0.00 | 0.08 |
| Panel B: 2007Q1-2019Q2 | | | | | |
| U.S. Flows | 0.85*** | | | | |
| | (0.16) | | | | |
| $i^{US}_{t-1} - \bar{i}_{t-1}$ | | 1.3** | | | |
| | | (0.61) | | | |
| $\pi^{US}_t - \bar{\pi}_t$ | | | 2.5*** | 2.8*** | 2.9*** |
| | | | (0.65) | (0.57) | (0.54) |
| $\Delta c^{US}_t - \overline{\Delta c_t}$ | | | -0.75 | | |
| | | | (1.28) | | |
| $\Delta y^{US}_t - \overline{\Delta y_t}$ | | | | 0.50 | |
| | | | | (1.17) | |
| $\tilde{y}^{US}_t - \bar{\tilde{y}}_t$ | | | | | 0.0063 |
| | | | | | (0.099) |
| Obs. | 50 | 50 | 50 | 50 | 50 |
| $R^2$ | 0.32 | 0.08 | 0.15 | 0.15 | 0.15 |

Notes: This table reports regressions results of the form $\Delta e^B_{USD,t} = \alpha + \beta X_t + \varepsilon_t$, where $\Delta e^B_{USD,t}$ is the quarterly change in the broad US dollar and $X_t$ captures various macroeconomic variables. For our baseline regressions, $X_t$ is "U.S. Flows," net purchases of foreign bonds by the United States, normalized as a percentage of the value of the United States' foreign bond investment at the end of the prior quarter. For the "UIP" model, $X_t$ is the lagged interest rate spread between the United States and the average of the other G10 countries. For the "Monetary" model, $X_t$ contains two variables, the mean inflation difference between the United States and the other G10 countries and the mean growth difference between the United States and the other G10 countries. For "Taylor Rule", $X_t$ contains the (relative value of) the two variables in a Taylor Rule, the mean inflation difference between the United States and the other G10 countries and the mean output gap differential between the United States and the other G10 countries. All macroeconomic variables are computed as the difference between the quarterly observation for the United States versus the average of all other G10 countries. Panel (A) reports regression results from 1977:Q1-2006:Q4 and Panel (B) reports regression results from 2007:Q1-2019:Q2. Exchange rate data are from Thomson Reuters Datastream, international investment data are from the IMF Balance of Payments, and macroeconomic data are from the IMF International Financial Statistics Database.

Table 3: Broad US Dollar and U.S. Purchases of Foreign Bonds

| | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ |
|---|---|---|---|
| | 1977-2006 | 2007-2017 | 2007-2017 |
| | BoP | BoP | Morningstar |
| U.S. Purchases of Foreign Bonds | 0.091 | 0.86*** | 0.50*** |
| | (0.13) | (0.16) | (0.08) |
| Constant | -0.0016 | -0.013** | -0.014** |
| | (0.0045) | (0.0060) | (0.0055) |
| Observations | 120 | 44 | 44 |
| $R^2$ | 0.00 | 0.33 | 0.39 |

Notes: This table reports regressions results of the form $\Delta e^B_{USD,t} = \alpha + \beta f_t + \varepsilon_t$, where $\Delta e^B_{USD,t}$ is the quarterly change in the broad US dollar and $f_t$ is a particular measure of capital flows listed in the first column of the table. Purchases of bonds are normalized by the stock of holdings of that asset at the end of the previous quarter. The BoP measure is defined as net purchases of foreign bonds by the United States, where transactions are recorded at their current value during the quarter, normalized as a percentage of the United States' value of foreign bond investment at the end of the prior quarter. The Morningstar measure defines net purchases of foreign bonds as the change in the quantity of each foreign bond held multiplied by the prior quarter's end of period price, normalized as a percentage of the value of mutual fund foreign bond investment at the end of the prior quarter.

Table 4: Bilateral Exchange Rates with the US Dollar, Global and Idiosyncratic Factors

| | Restricted Regression | | Unrestricted Regression | | | |
|---|---|---|---|---|---|---|
| Currencies | US to all ex. Country i | $R^2$ | US to all ex. Country i | US to Country i | $R^2$ | Partial-$R^2$ |
| AUD | -0.82*** | 0.44 | -0.55*** | -0.31** | 0.53 | 0.09 |
| BRL | -0.85*** | 0.29 | -0.88*** | 0.081 | 0.30 | 0.01 |
| CAD | -0.47*** | 0.31 | -0.46*** | -0.03 | 0.31 | 0.00 |
| CHF | -0.26* | 0.09 | -0.28** | 0.12** | 0.17 | 0.08 |
| COP | -0.71*** | 0.29 | -0.55*** | -0.26** | 0.34 | 0.05 |
| CZK | -0.57*** | 0.20 | -0.58*** | -0.0068*** | 0.29 | 0.09 |
| DKK | -0.38*** | 0.16 | -0.37*** | -0.0036 | 0.16 | 0.00 |
| EUR | -0.32* | 0.09 | -0.062 | -0.22* | 0.19 | 0.10 |
| GBP | -0.58*** | 0.36 | -0.52** | -0.08 | 0.37 | 0.01 |
| IDR | -0.35** | 0.16 | -0.34* | -0.1 | 0.18 | 0.02 |
| ILS | -0.31*** | 0.13 | -0.31*** | 0.0037 | 0.13 | 0.00 |
| INR | -0.42*** | 0.31 | -0.42*** | -0.017 | 0.32 | 0.01 |
| JPY | 0.042 | 0.00 | 0.039 | 0.0098 | 0.00 | 0.00 |
| KRW | -0.60*** | 0.40 | -0.61*** | 0.021 | 0.41 | 0.01 |
| MXN | -0.54*** | 0.24 | -0.55*** | 0.01 | 0.24 | 0.00 |
| MYR | -0.27*** | 0.12 | -0.26*** | -0.0066 | 0.12 | 0.00 |
| NOK | -0.69*** | 0.34 | -0.58*** | -0.11*** | 0.41 | 0.07 |
| NZD | -0.66*** | 0.36 | -0.64*** | -0.015 | 0.36 | 0.00 |
| PLN | -0.81*** | 0.28 | -0.69*** | -0.046* | 0.30 | 0.02 |
| RUB | -0.70*** | 0.17 | -0.68*** | -0.076 | 0.18 | 0.01 |
| SEK | -0.63*** | 0.33 | -0.46*** | -0.12** | 0.38 | 0.05 |
| SGD | -0.24*** | 0.20 | -0.25*** | 0.0044 | 0.20 | 0.00 |
| TRY | -0.52** | 0.19 | -0.48** | -0.17** | 0.24 | 0.05 |
| ZAR | -0.54*** | 0.18 | -0.28 | -0.20*** | 0.37 | 0.19 |
| Average | | 0.23 | | | 0.26 | 0.04 |

Notes: The dependent variable of each regression in the left panel is the log change in each foreign currency against the US dollar, defined such that a negative value corresponds to an appreciation of the non-US dollar currency. The average $R^2$ is the mean $R^2$ from separate regressions for each currency. The regressor titled "U.S. to All ex. Country i" is the percentage increase in foreign bond investment in all countries which are not the natural issuer of the currency, while the regressor titled "US to Country i" is the percentage increase in foreign bond investment in all countries which are the natural issuer of the currency. A negative coefficient for "U.S. to All ex. Country i" indicates that the listed currency appreciates against the US dollar when the United States is purchasing foreign bonds. A negative coefficient for "U.S. to Country i" indicates that the listed currency appreciates against the US dollar when the United States is purchasing that country's bonds. Units are defined as percentage changes, as described in section A.3.2. All regressions are conducted at a quarterly frequency. The sample period for all regressions is from 2007:Q1 to 2017:Q4. Standard errors are calculated allowing for heteroskedasticity. *p< 0:1; **p< 0:05; ***p< 0:01. Exchange rate data are from Thomson Reuters Datastream and bond position data are from Morningstar.

Table 5: US Dollar and Subcomponents of U.S. Outflows

| | | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ |
|---|---|---|---|---|---|---|
| Corporates | USD | 0.36*** | 0.43*** | | | |
| | | (0.072) | (0.069) | | | |
| | NonUSD | -0.034 | | 0.085 | | |
| | | (0.068) | | (0.065) | | |
| Sovereigns | USD | -0.0024 | | | 0.15 | |
| | | (0.12) | | | (0.12) | |
| | NonUSD | 0.16** | | | | 0.24*** |
| | | (0.069) | | | | (0.066) |
| Observations | | 44 | 44 | 44 | 44 | 44 |
| $R^2$ | | 0.42 | 0.35 | 0.03 | 0.04 | 0.22 |

Notes: This table reports regressions results of the form $\Delta e^B_{USD} = \alpha + \beta f_t + \varepsilon_t$, where $\Delta e^B_{USD,t}$ is the quarterly change in the broad dollar and $f_t$ is a particular measure of capital flows. All variables are defined as U.S. purchases of foreign securities belonging to a particular category, scaled by U.S. holdings of bonds belonging to that category at the end of the previous quarter. "Corporates" refers to corporate debt, "Sovereigns" refers to sovereign debt, "USD" indicates that the bond is denominated in US dollars, and "NonUSD" indicates that the bond is denominated in a currency other than the US dollar. Each row refers to a bond in the relevant category, a bond included in Corporates, USD indicates U.S. purchases of corporate debt issued by a non-US firm denominated in a currency other than the US dollar. All other variables are defined equivalently. The sample period for all regressions is from 2007:Q1 to 2017:Q4. Standard errors are calculated allowing for heteroskedasticity. *p< 0:1; **p< 0:05; ***p< 0:01. Exchange rate data are from Thomson Reuters Datastream and bond position data are from Morningstar.

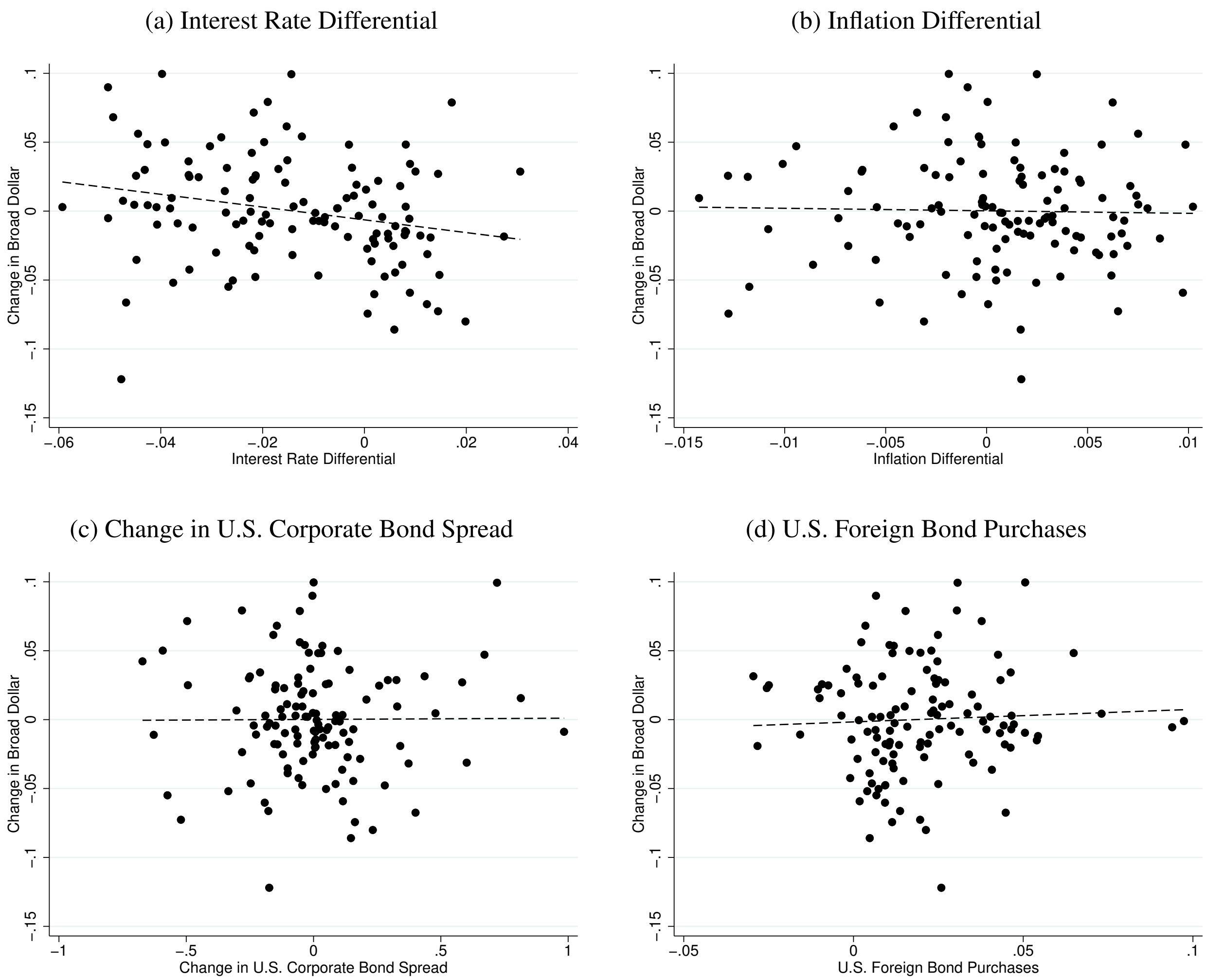
Table 6: The Broad Dollar and U.S. Domestic Investment

| | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ | $\Delta e^B_{USD}$ |
|---|---|---|---|---|
| All U.S. Bonds | -0.51** | | | |
| | (0.24) | | | |
| U.S. Sovereign Bonds | | -0.27*** | | -0.18* |
| | | (0.082) | | (0.088) |
| U.S. Corporate Bonds | | | 0.76** | 0.51* |
| | | | (0.25) | (0.28) |
| Constant | 0.0078 | 0.0075 | -0.020** | -0.0080 |
| | (0.0065) | (0.0060) | (0.0081) | (0.0087) |
| Observations | 44 | 44 | 44 | 44 |
| $R^2$ | 0.10 | 0.20 | 0.21 | 0.27 |

Notes: This table reports regressions results of the form $\Delta e^B_{USD} = \alpha + \beta f_t + \varepsilon_t$, where $\Delta e^B_{USD,t}$ is the quarterly change in the broad dollar and $f_t$ is a particular measure of capital flows. "All United States Bonds" refers to U.S. domiciled mutual fund purchases of U.S. debt, scaled by the value all holdings of U.S. bonds by U.S. mutual funds at the end of the previous quarter. "Sovereign Bonds" and "Corporate Bonds" are defined equivalently, restricting the sample to the universe of debt issued by the U.S. Federal Government and U.S. corporations, respectively. Exchange rate data are from Thomson Reuters Datastream and bond position data are from Morningstar.

# Figures

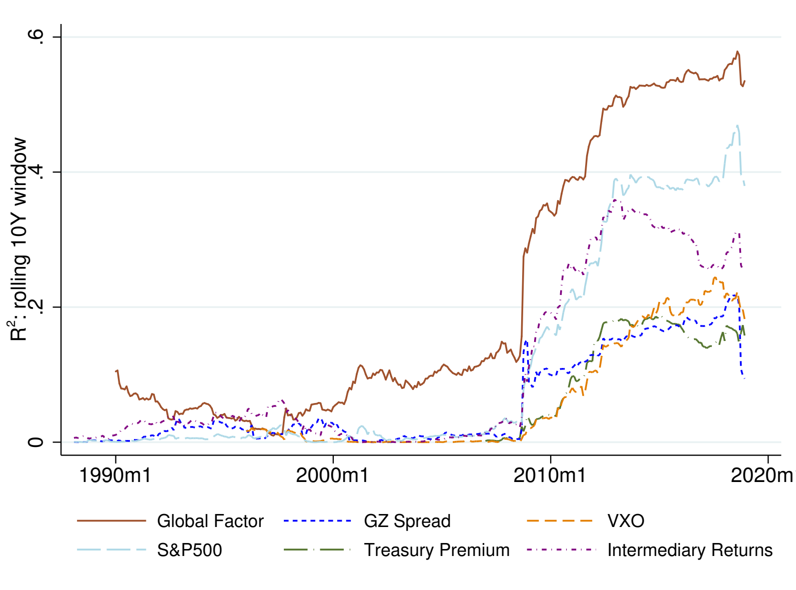
Figure 1: Exchange Rate Disconnect, 1977-2006



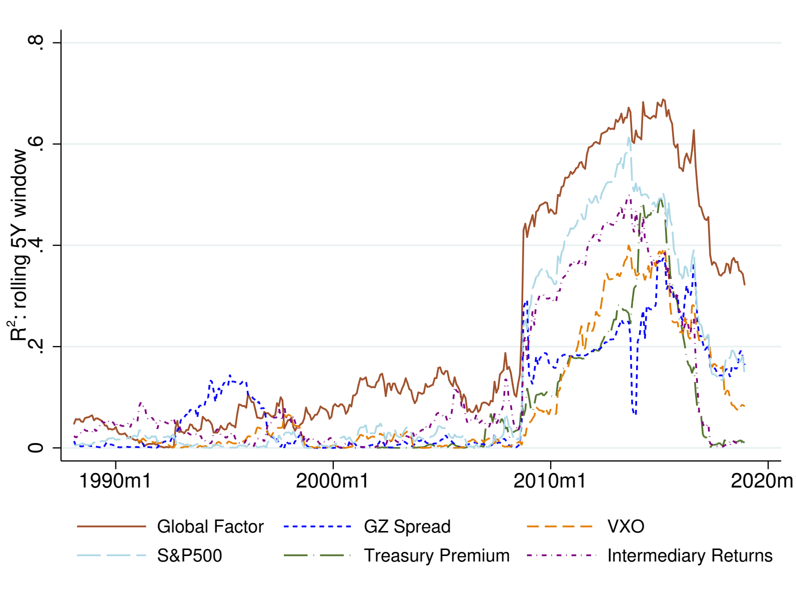

Notes: This figure plots the relationship between various macroeconomic variables and quarterly changes in the broad dollar exchange rate from 1977-2006. Changes in the broad dollar are reported on the y-axis and the relevant macroeconomic quantity is reported on the x-axis. A positive change in the broad dollar indicates dollar depreciation, and a rightward move in the x-axis corresponds to a higher level for the United States minus the G10 countries. Panel A tests the UIP model, using the average lagged interest rate differential in the United States relative to the mean of the other G10 economies. Panel B looks at the equivalent in the U.S. inflation rate relative to the inflation rate of the other G10 economies. Panel C uses the change in U.S. corporate bond spreads, taken from Gilchrist and Zakrajšek (2012). Panel D looks at U.S. purchases of foreign bonds by the United States, normalized as a percentage of the United States' value of foreign bond investment at the end of the prior quarters. The $R^2$s of these regressions are 0.06, 0.00, 0.00 and 0.00 respectively. Exchange rate data are from Thomson Reuters Datastream and macroeconomic data are from the IMF International Financial Statistics Database.

Figure 2: Reconnect of The Broad Dollar and Risk Measures: $R^2$s

(a) 10-Year Rolling Window

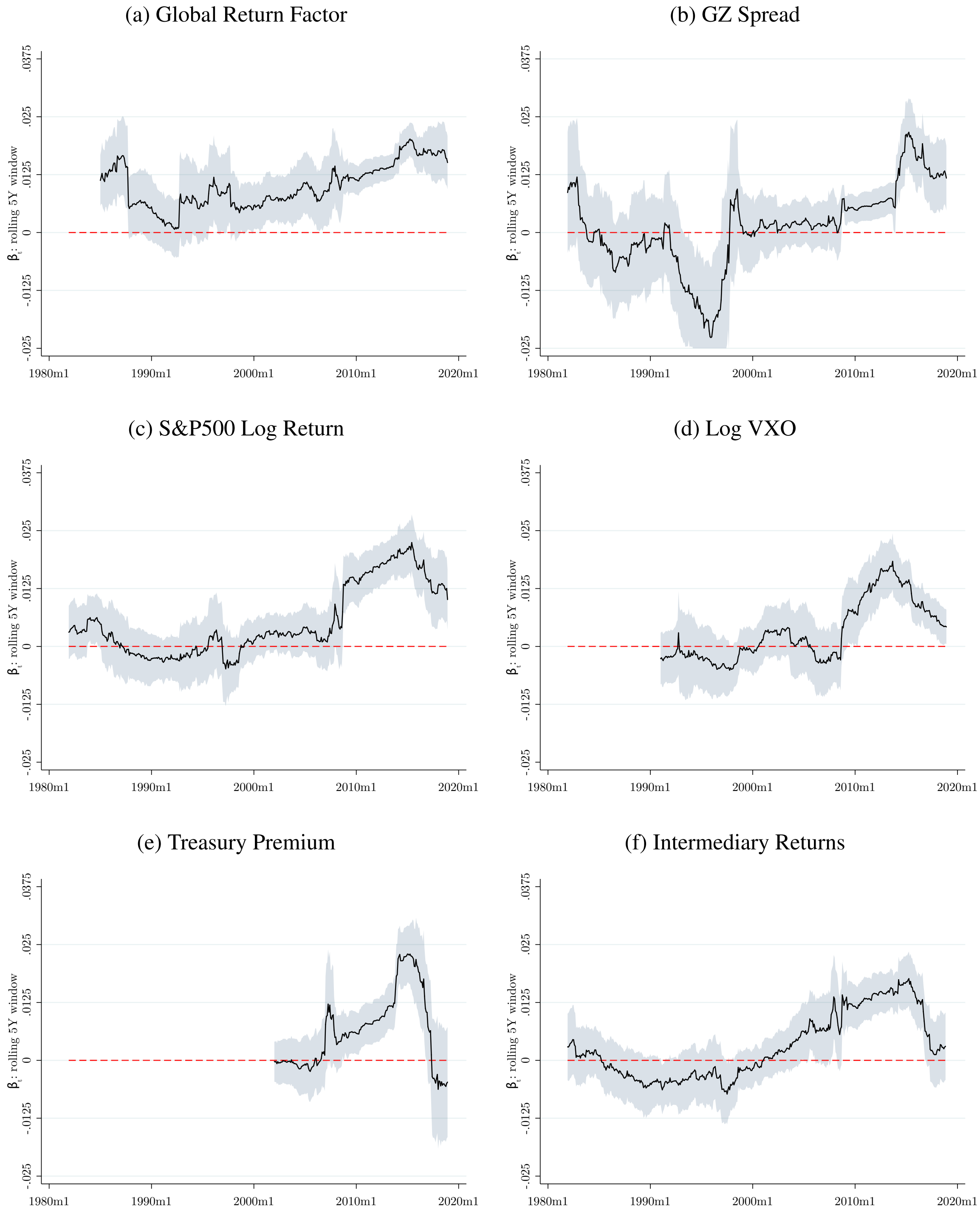



(b) 5-Year Rolling Window



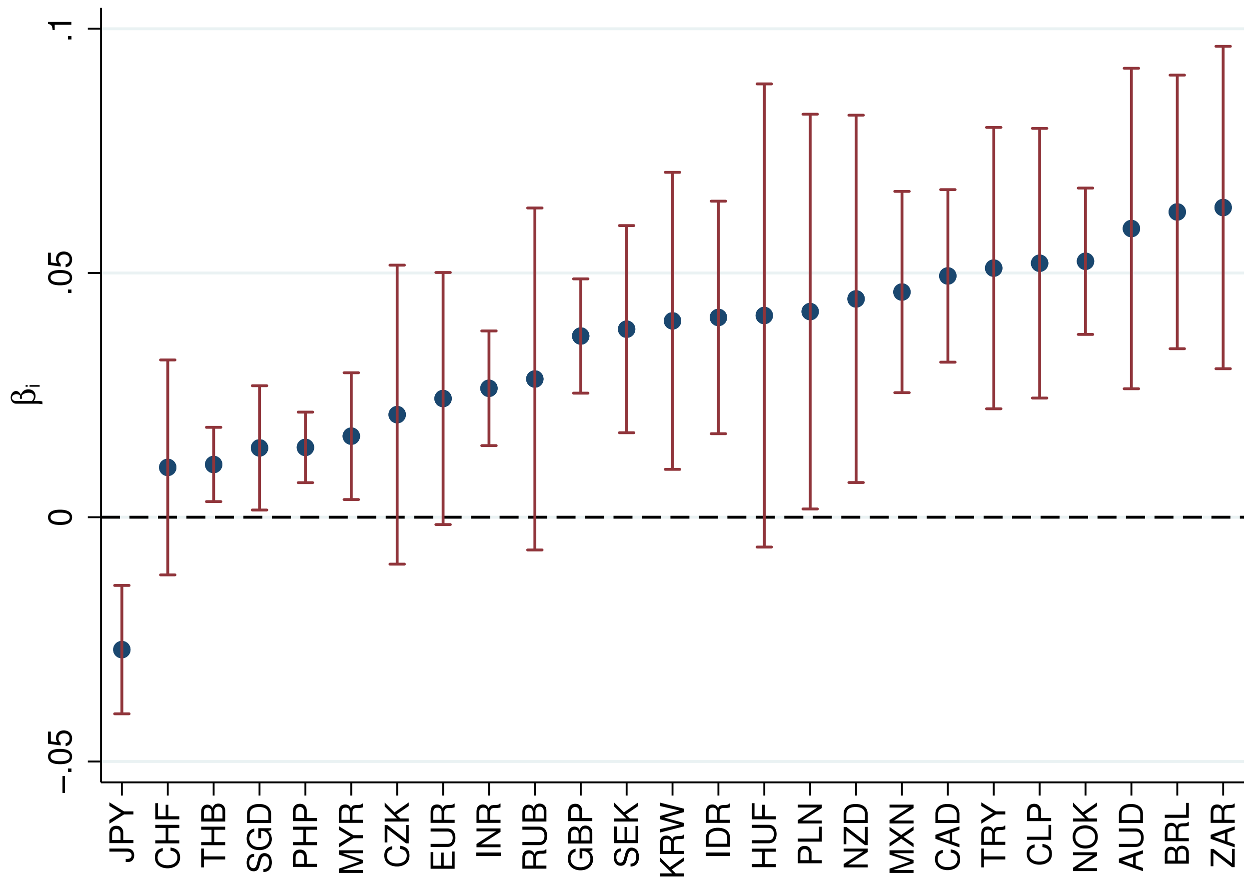

Notes: The figures show the 120- and 60- month rolling $R^2$ for regressions of the average log change in the US dollar versus the other G10 currencies against various indicators of risk. The regression specification is $\Delta e^B_{USD,t} = \alpha + \beta X_t + \varepsilon_t$, where $X_t$ corresponds to different variables depending on the model in question. For "VXO," $X_t$ is the monthly change in the log transformation of an index of implied volatility on the stocks in the S&P100, from the CBOE. For "S&P500," $X_t$ is the log total return on the S&P500 index. For "Treasury Premium," $X_t$ is the change in the one-year Treasury Premium, the average one-year tenor CIP deviation between developed country government bonds and U.S. Treasuries from Du et al. (2018). For "GZ Spread," $X_t$ is the U.S. corporate bond credit spread, taken from Gilchrist and Zakrajšek (2012). For "Intermediaries," $X_t$ is the value-weighted return on a portfolio of NY Fed primary dealers' holding companies and is taken from He et al. (2017). For "Global Return Factor," $X_t$ is the global factor in world asset prices constructed by Miranda-Agrippino and Rey (2018).

Figure 3: Reconnect of The Broad Dollar and Risk Measures: $\beta$s




Notes: The figure shows the 60 month rolling $\beta$ for regressions of the average log change in the US dollar versus the other G10 currencies against various indicators of risk, normalized as z-scores. The regression specification is $\Delta e^{B}_{USD,t} = \alpha + \beta X_t + \varepsilon_t$, where $X_t$ corresponds to different variables depending on the model in question. For "VXO," $X_t$ is the quarterly change in the log transformation of an index of implied volatility on the stocks in the S&P100, from the CBOE. For "S&P500," $X_t$ is the log total return on the S&P500 index. For "GZ Spread," $X_t$ is the U.S. corporate bond credit spread, taken from Gilchrist and Zakrajšek (2012). For "Global Factor," $X_t$ is the global factor in world asset prices constructed by Miranda-Agrippino and Rey (2018). The shaded errors correspond to 95% confidence intervals, calculated using heteroskedasticity robust standard errors.

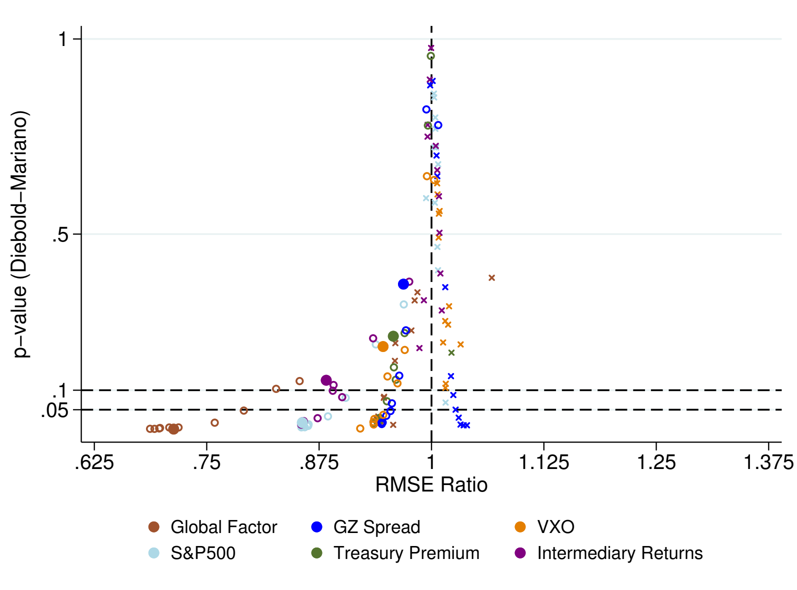
Figure 4: Reconnect of Bilateral Exchange Rates and GZ Spread, $\beta$s for 2007-2018



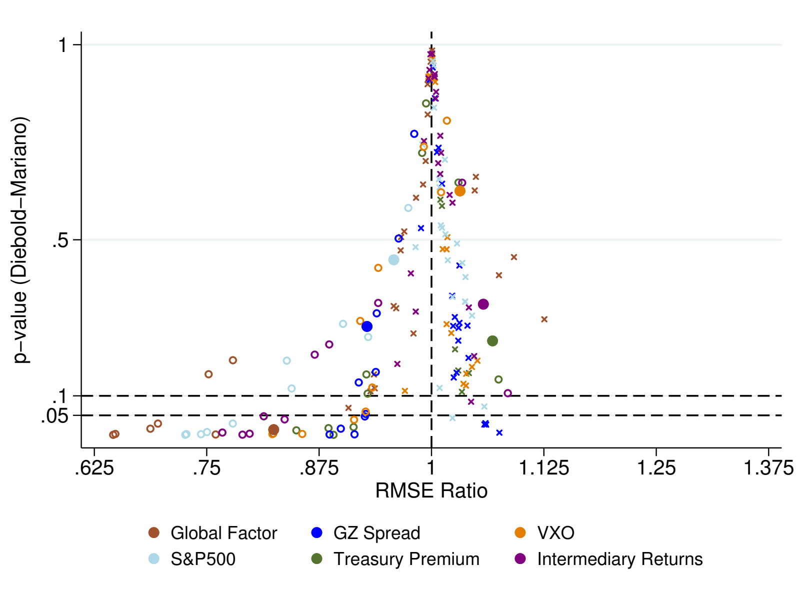

Notes: This figure reports the coefficient estimate of the following regression specification: $\Delta e^{\$}_{i,t} = \alpha_i + \beta_i f_t + \varepsilon_t$, where $\Delta e^{\$}_{i,t}$ is the monthly change in the log bilateral exchange rate against the US dollar and $f_t$ is the change in U.S. corporate bond spreads, as measured by the "GZ Spread" taken from Gilchrist and Zakrajšek (2012). The blue dots indicate the coefficient point estimates, $\beta_i$, and the red bars indicate two standard error bands. A positive coefficient indicates that the listed currency depreciates bilaterally against the US dollar when U.S. corporate bond spreads rise.

Figure 5: Reconnect of Risk Measures: Out-Of-Sample Forecasting

(a) 10-Year Evaluation Periods



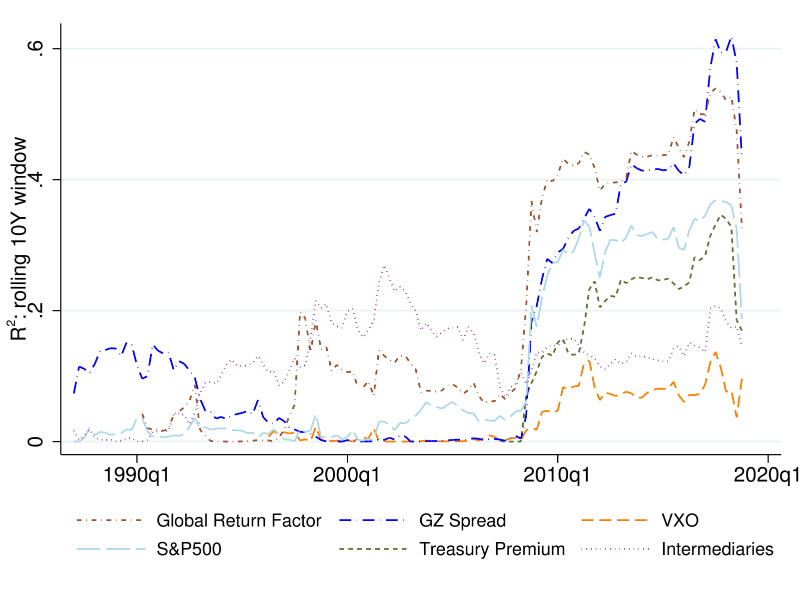

(b) 5-Year Evaluation Periods



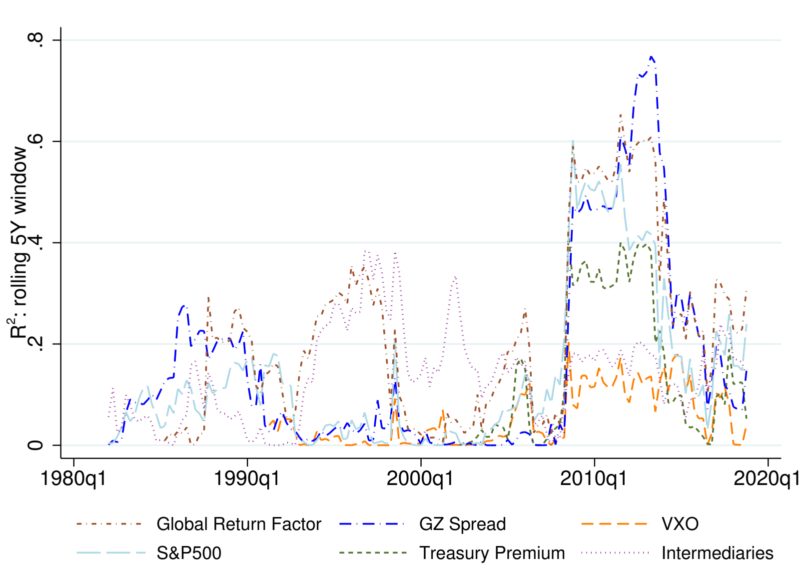

Notes: This figure reports the performance of exchange rate forecasts using each of our six risk proxies relative to a random walk over different sample periods. Each marker reports the p-value of a Diebold-Mariano test for the performance of the model relative to a random walk (y-axis) and the ratio of the model's root mean squared forecast error relative to a random walk. Each observation represents a 120- or 60-month model evaluation period, using a 120- or 60-month rolling estimation windows, as described in Appendix Section A.1. The "x" markers represent windows where all forecasts are for periods prior to 2007, the hollow dots represent windows where the forecasts mix periods before and after 2007, and the solid dots represent windows where all forecast periods occur after 2007.

Figure 6: Comovement of U.S. Foreign Bond Purchases and Risk Measures

(a) 10-Year Rolling Window

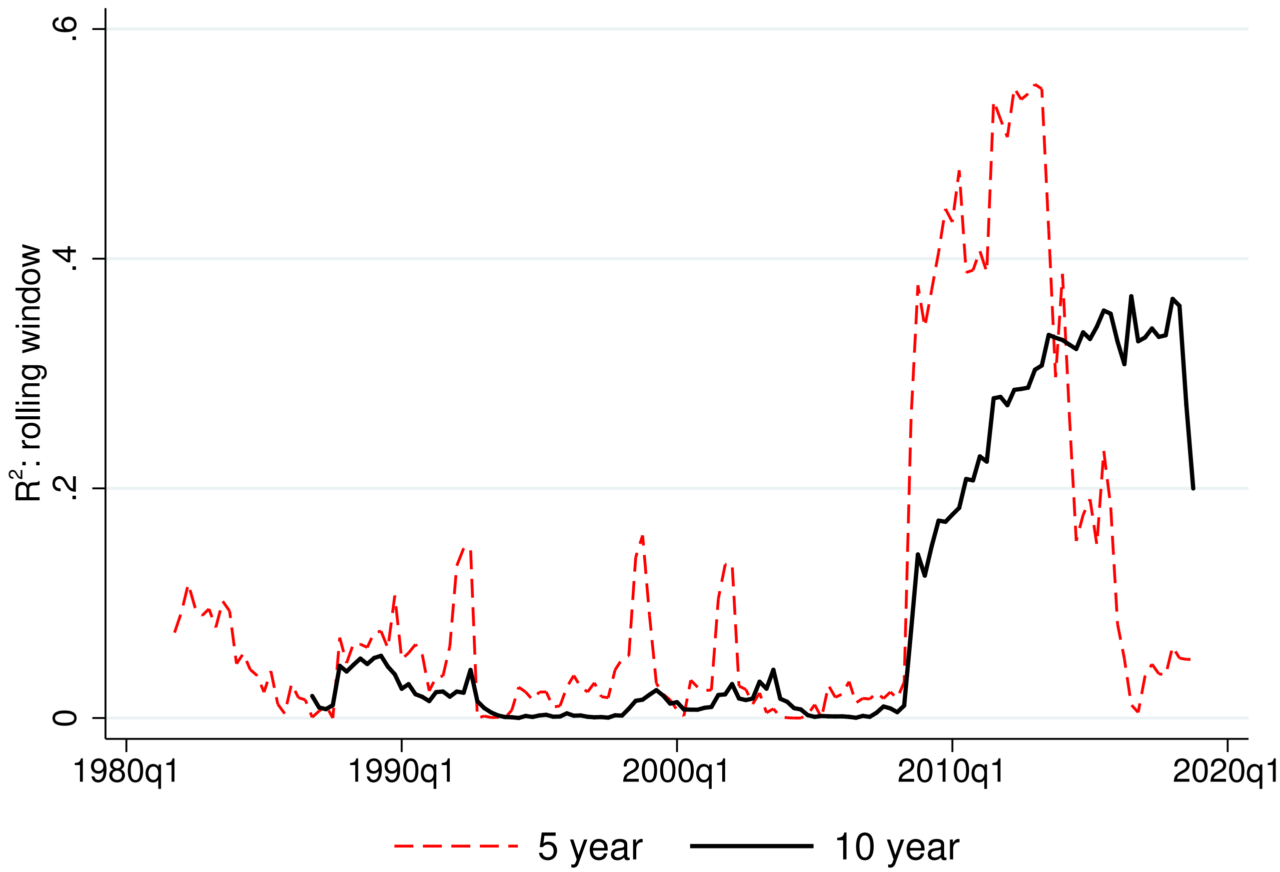



(b) 5-Year Rolling Window



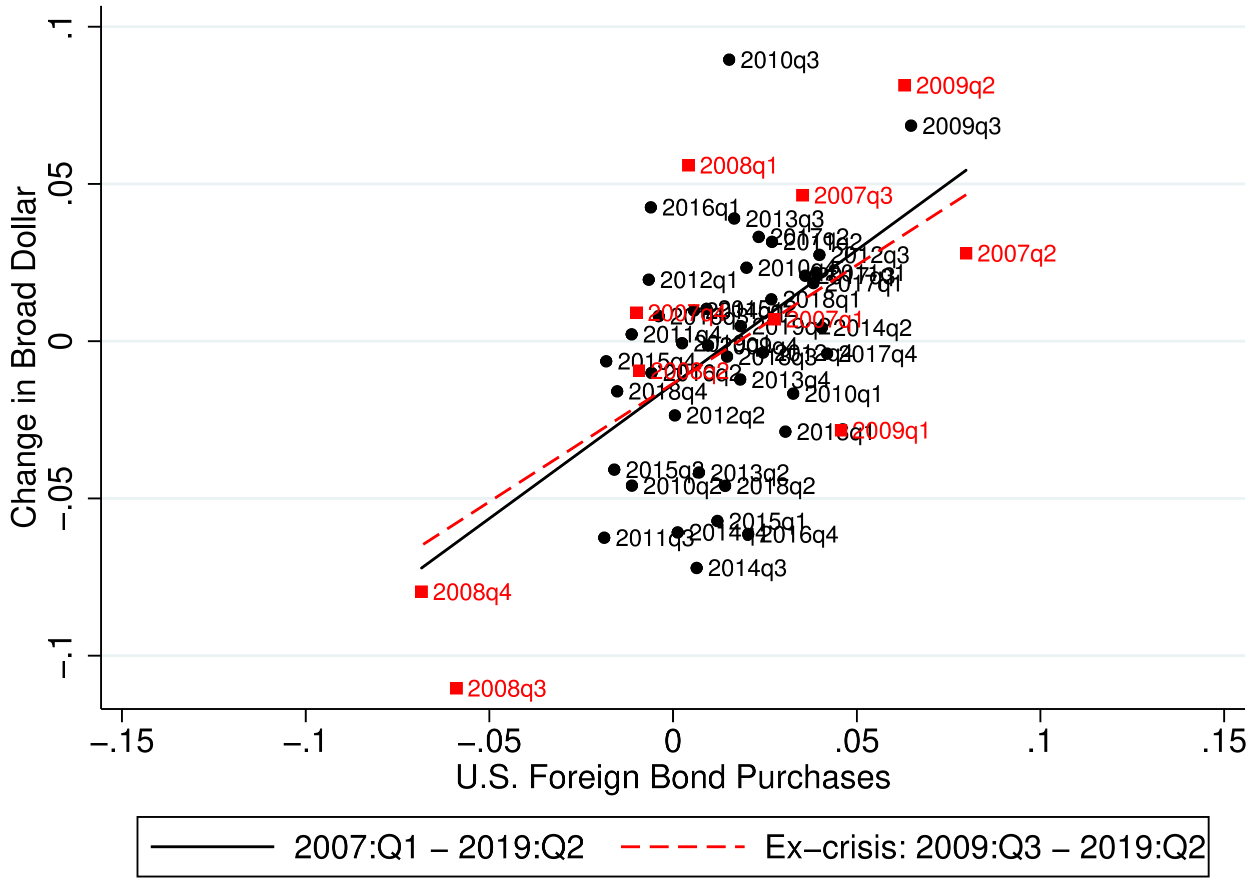

Notes: The figures show the $R^2$ from 40-quarter and 20-quarter rolling regressions of U.S. Foreign Bond Purchases against various indicators of risk. The regression specification is $f_t = \alpha + \beta X_t + \varepsilon_t$, where $f_t$ refers to the net purchases of foreign bonds by the United States, normalized as a percentage of the value of U.S. foreign bond holdings at the end of the prior quarter. $X_t$ corresponds to different variables depending on the model in question.For "VXO," $X_t$ is the quarterly change in the log transformation of an index of implied volatility on the stocks in the S&P100, from the CBOE. For "S&P500," $X_t$ is the log total return on the S&P500 index. For "Treasury Premium," $X_t$ is the change in the one-year Treasury Premium, the average one-year tenor CIP deviation between developed country government bonds and U.S. Treasuries from Du et al. (2018). For "GZ Spread," $X_t$ is the U.S. corporate bond credit spread, taken from Gilchrist and Zakrajšek (2012). For "Intermediaries," $X_t$ is the value-weighted return on a portfolio of NY Fed primary dealers' holding companies and is taken from He et al. (2017). For "Global Return Factor," $X_t$ is the global factor in world asset prices constructed by Miranda-Agrippino and Rey (2018).

Figure 7: Reconnect of The Broad Dollar and U.S. Foreign Bond Purchases: $R^2$s




The y-axis corresponds to the $R^2$ of a 20- and 40-quarter rolling regression of the following specification: $\Delta e^B_{USD,t} = \alpha + \beta X_t + \varepsilon_t$, where $\Delta e^B_{USD,t}$ is the average log appreciation of the US dollar against all other G10 currencies and $X_t$ is the U.S. net purchases of foreign bonds, normalized as a percentage of the U.S. value of foreign bond investment at the end of the prior quarter. Exchange rate data is from Thomson Reuters Datastream and bond purchase data is from the IMF Balance of Payments Database.

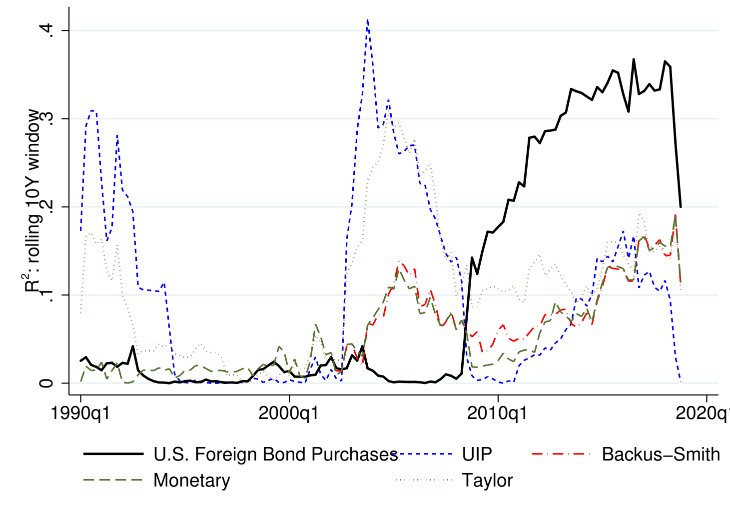
Figure 8: Exchange Rate Reconnect, 2007:Q1-2019:Q2



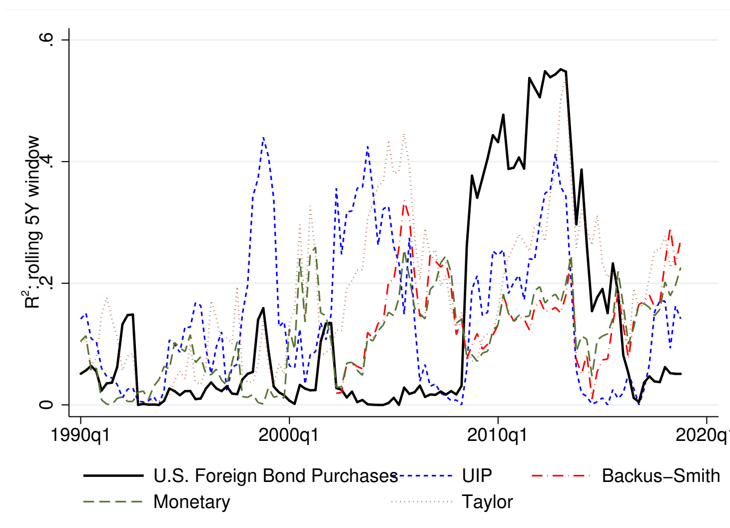

The y-axis corresponds to the quarterly average change in the US dollar against all other G10 currencies, defined such that a positive value corresponds to a depreciation. The x-axis shows the purchases of foreign bonds by the United States in the contemporaneous quarter, normalized as a percentage of the United States' value of foreign bond investment at the end of the prior quarter. Regression lines are estimated using the full sample (2007:Q1 to 2019:Q2) and excluding the crisis (2009:Q3 to 2019:Q2). Exchange rate data are from Thomson Reuters Datastream and bond purchase data are from the IMF Balance of Payments Database.

Figure 9: In-Sample Explanatory Power of Capital Flows and Other Fundamentals

(a) 10-Year Rolling Window




(b) 5-Year Rolling Window

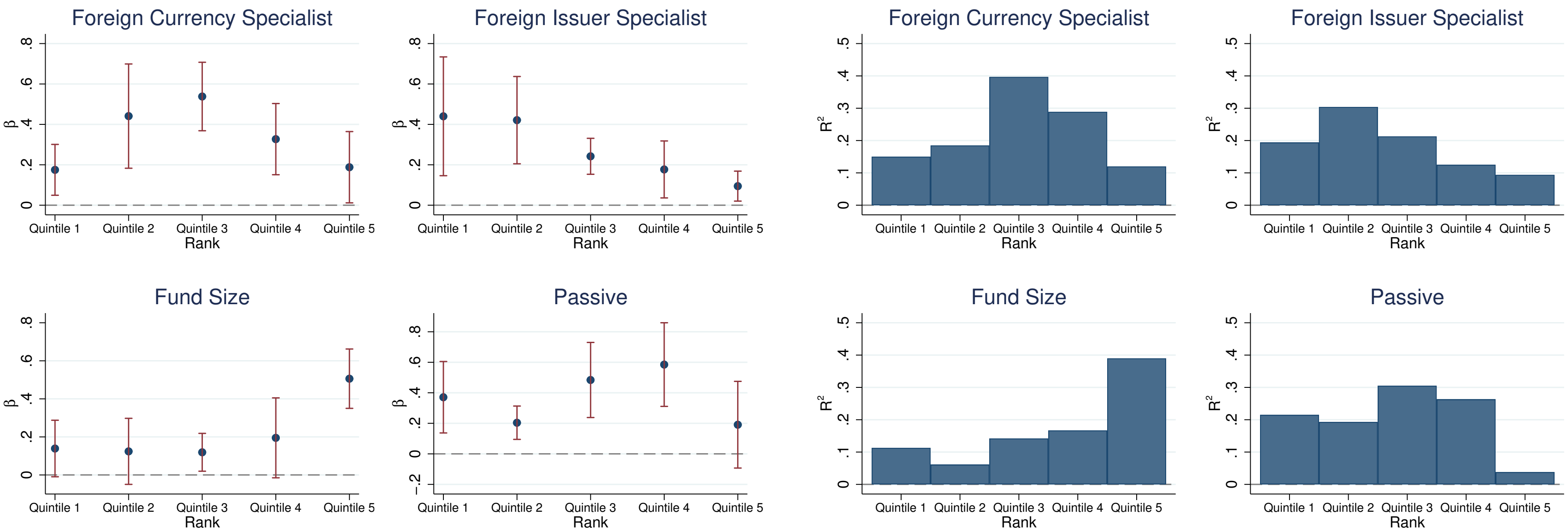



Notes: The figure shows the rolling $R^2$ for regressions of the form $\Delta e^B_{USD,t} = \alpha + \beta X_t + \varepsilon_t$ where $\Delta e_{USD,t^B}$ is the quarterly average log change in the US dollar versus the other G10 currencies against various models. $X_t$ corresponds to different variables depending on the model in question. For "U.S. Foreign Bond Purchases," $X_t$ is net purchases of foreign bonds by the United States, normalized as a percentage of the United States' value of foreign bond investment at the end of the prior quarter. For the "UIP" model, $X_t$ is the lagged interest rate spread between the United States and the average of the other G10 countries. For the "Monetary" model, $X_t$ contains two variables, the mean inflation difference between the United States and the other G10 countries and the mean growth difference between the United States and the other G10 countries. For "Taylor", $X_t$ contains the (relative value of) the two variables in a Taylor Rule, the mean inflation difference between the United States and the other G10 countries and the mean output gap differential between the United States and the other G10 countries. All macroeconomic variables are computed as the difference between the quarterly observation for the United States versus the average of all other G10 countries. Interest rate differentials are computed from the series "Deposit Rates" from the IFS where available, and from "Treasury Bills, 3 month" otherwise. Growth is measured as the log change in real Gross Domestic Product and the output gap is calculated using the cyclical component of the same logarithmic series from a detrended HP filter with l = 1600. Exchange rate data are from Thomson Reuters Datastream, international investment data are from the IMF Balance of Payments, and macroeconomic data are from the IMF International Financial Statistics Database.

Figure 10: Broad US Dollar and U.S. Foreign Bond Purchases by Subsets of Mutual Funds

(a) Coefficients by Fund Characteristics

(b) $R^2$s by Fund Characteristics




Notes: This figure reports the coefficient estimate (Panel A), and $R^2$ (Panel B) of the following regression specification: $\Delta e^{\$}_{i,t} = \alpha_i + \beta_q f^q_t + \varepsilon_t$, where $\Delta e^{\$}_{i,t}$ is the change in average log change in the US dollar versus the other G10 currencies against $f^q_t$ which is U.S. mutual funds' foreign bond purchases, normalized as a percentage of the same mutual funds' value of foreign bond investment at the end of the prior quarter, subsetted into fund quantiles $q$. In each panel, we separately construct the flow measure for some quintile of the mutual fund universe. We first explain this process for fund size (the AUM in US dollar). For each quarter from 2007:Q1 to 2019:Q2, we sort each fund $i$ by AUM separately within 10 fund categories (e.g. Fixed Income, Equity, Money Market) as defined by Morningstar and measure their percentile ranking within each category for that quarter, $R_{i,t}$. We then average that percentile ranking for each fund over all $t$, to yield an average ranking $\bar{R}_i$. We then sort each category by $\bar{R}_i$ into 5 quintiles of an equal number of funds. Then we aggregate the positions of each quintile and construct the flow in the usual way. The characteristic "foreign currency specialist" is defined by the percentage of bonds the fund holds in currencies other than the US dollar. The characteristic "foreign issuer specialist" is defined by the percentage of bonds the fund holds which were issued by a foreign parent, using the parent match procedure described in (Coppola et al., 2019). The characteristic "passive" is defined by the $R^2$ of the fund's monthly returns with the monthly returns of any bond or equity index (we compare their returns with the returns of the 500 most popular indices and take the maximum). Quintile 5 corresponds to largest AUM, highest proportion of foreign currency bonds (by AUM), highest proportion of foreign country issuers (by AUM), highest $R^2$ with a published index for fund size, foreign issuer specialist, foreign currency specialist, and passive respectively.