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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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1 Introduction

Starting with the influential contribution by Meese and Rogoff (1983), a long literature has established two empirical findings. First, macroeconomic fundamentals are largely disconnected from exchange rates, even when the analysis is carried out in sample and contemporaneously. Second, models offer so little guidance about future exchange rates that they commonly perform worse than a simple forecast of “no change”. The exchange rate disconnect and the failure of macroeconomic models to forecast exchange rates are among the most disappointing and enduring problems in international economics (Obstfeld and Rogoff (2000)).

These failures are particularly troubling as the exchange rate is one of the most important prices in any economy. Its value and dynamics are critical for real-world concerns such as a country’s purchasing power of both goods and assets. Further, the absence of robust empirical relationships between exchange rates and other aggregates leave models used by researchers, which deeply embed such relationships, on unstable ground. It comes as no surprise then that much effort, by the private sector as well as by policymakers and academics, has been devoted to overturning these negative empirical results. 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 has emerged since the global financial crisis: exchange rates, and in particular the broad US dollar, appear to have reconnected to U.S. purchases of foreign bonds. When U.S. residents increase their holdings of external debt, the dollar contemporaneously depreciates, and when U.S. residents reduce their holdings of external debt, the dollar contemporaneously appreciates. We dub the emergence of this relationship “exchange rate reconnect" and and demonstrate its strength using readily-available public data. In some specifications, reconnect is so strong as to pass the very high bar for out-of-sample forecasting introduced by Meese and Rogoff.

We start our analysis using IMF Balance of Payments (BoP) and International Investment Positions (IIP) data to construct measures of capital flows into and out of countries around the world. In rolling 10-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, reaching 35 percent by 2017. The fact that the timing of this change coincides with the timing of the global crisis is intriguing, but the impact of the crisis on reconnect is not mechanical. When we exclude the quarters associated with the global crisis, the coefficient of co-movement between U.S. foreign bond flows and the dollar remains nearly unaffected, and while this attenuates the R^2 of the empirical exercise, it remains a clear break from historical experience.

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, we do not view the relationship between U.S. foreign bond flows and the dollar as causal. Rather, we interpret the reconnect as revealing that U.S. foreign bond flows contain information relevant for understanding exchange rates from 2007 onward. In this sense, the reconnect carries something of a special role for the United States.

It appears that fluctuations in U.S. holdings of foreign bonds relate to global investors' risk-bearing capacity. One clue that risk plays a central role comes from decomposing the predictability of the broad dollar into its bilateral exchange rate components. The co-movement of U.S. foreign bond flows and bilateral exchange rates between the dollar and safe-haven currencies such as the Swiss franc and Japanese yen remains fairly muted even after the crisis. Therefore, the reconnect of the broad dollar is largely driven by the bilateral exchange rates between the US dollar and riskier currencies such as the Australian dollar. In this sense, U.S. foreign bond flows explain the exchange rate variation in currency pairs that load differently on global risk.

Additional evidence for this risk-based story comes from directly examining the connection between U.S. foreign bond purchases and common proxies of global risk-bearing capacity, 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. Whereas U.S. foreign bond purchases were largely uncorrelated with these risk measures prior to 2007, they begin to strongly co-move starting with the crisis, a change not experienced by other types of capital flows. In fact, when we regress the broad dollar on these risk measures, we find similarly strong reconnect as what we find for U.S. foreign bond purchases.

While we find strong evidence for a reconnect between capital flows, risk, 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 motivated the uniquely strong in-sample explanatory power of U.S. purchases of foreign bonds for the broad US dollar, we turn to a novel micro dataset capable of elaborating on the mechanics of 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 risk-bearing capacity, rather than from the direct effect of a sale of U.S. 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-bearing capacity, 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-bearing capacity of sizable dollar-centric discretionary U.S. investors.

In summary, we identify a particular quantity, U.S. foreign bond purchases, that has strongly comoved with the broad US dollar starting with the global financial crisis and is closely related to measures of risk premia. In the context of the voluminous literature on exchange rate disconnect, which offers a number of deep insights but 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.

Our documentation that exchange rate reconnect started around 2007 relates to an active literature emphasizing two recent developments in currency markets. First, the crisis seems to have drastically and persistently reduced the financial intermediation capacity, leading to large covered interest rate parity deviations (CIP) documented by Du, Tepper and Verdelhan (2017). These deviations are systematically related to the dollar exchange rate and global credit in dollars by banks, as shown in Avdjiev, Du, Koch and Shin (2019b). Similarly, 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).

Second, 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 two developments together suggest an increase in the role of risk premia in driving the broad dollar consistent with the increased correlation between the dollar and equity market returns first documented by Lilley and Rinaldi (2018).

Our paper is also related to a literature aiming to connect portfolio positions to exchange rates. Models of portfolio balance connect foreign currency risk taking to exchange rates via imperfect substitutability of the assets (Kouri (1976); Gabaix and Maggiori (2015)). A growing empirical literature has focused on portfolio rebalancing of foreign currency exposures and its connection to exchange rates (Hau and Rey (2006); Camanho et al. (2017); Bergant and Schmitz (2018)). Our paper is consistent with the importance of these frictions for foreign currency assets, but our focus is different since we show that even purchases of foreign dollar-denominated bonds (and even forms of U.S. investment in domestic dollar-denominated bonds) are connected with the broad dollar. These flows account for the bulk of U.S. foreign bond positions but, being dollar denominated, do not mechanically generate foreign currency exposure. Our results most directly support the narrative emerging from an active literature that the US dollar's role as an international and safe-haven currency has surged since the global financial crisis (Rey (2015); Bruno and Shin (2015); Jiang et al. (2019)).

2 Exchange Rate Disconnect and Reconnect

Figure 1 reproduces the well-known disconnect between the exchange rate and a variety of fundamentals for the period 1977-2006. For example, Figure 1a relates quarterly log-changes in the broad dollar – an equally-weighted basket of nine currencies (the G10, excluding the U.S.) against the US dollar – with the average quarterly interest differential between the U.S. 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. Figures 1b and 1c similarly relate changes in observed inflation and GDP growth differentials with the exchange

[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.

rate and, at odds with many standard models, they exhibit even weaker relationships, with R^2 values less than 1 percent. Given this exchange rate disconnect holds in-sample for realized outcomes, it is not surprising that interest rates, inflation, and growth differentials also offer no out-of-sample forecasting power.[2]

Figure 1d relates the broad exchange rate to changes in U.S. holdings of foreign bonds, constructed 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). Consistent with an earlier literature that found exchange rate disconnect in most components of the balance of payments, and similar to the other three fundamentals in Figure 1, changes in U.S. foreign bond portfolios did not co-move with the US dollar during the same 1977-2006 period. While the disconnect of interest, inflation, and growth rate differentials persists, this particular component of U.S. capital flows has started closely tracking the exchange rate since the global financial crisis. Starting in 2007, U.S. foreign bond purchases offer significant explanatory power of the exchange rate, a phenomenon we refer to as exchange rate reconnect.

2.1 U.S. Purchases of Foreign Bonds

Reconnect is best seen in Figure 2, which plots with the solid black line the R^2 values of univariate regressions of the broad dollar exchange rate on a constant and the contemporaneous change in U.S. foreign bond holdings. We estimate these regressions on 10-year rolling windows of quarterly data starting in 1977Q1 and ending in 2017Q4. During 1977-2006, these rolling regressions have R^2s that average only a few percentage points and peak at about 5 percent. Around 2007, however, there is an abrupt but sustained increase in the explanatory power of this component of U.S. foreign asset flows. By 2010, the relationship has an R^2 of 20 percent, which rises to and stabilizes near 35 percent only a few years later.[3]

The timing of reconnect necessarily implies that much of the stark change in Figure 2 is driven by large and correlated changes in the US dollar and U.S. holdings of foreign bonds. Indeed, the largest appreciations of the US dollar as well as the largest reductions in U.S. foreign bond holdings occurred in the second half of 2008. The confluence of reconnect 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. The red-dashed line in Figure 2 reports R^2 values of rolling regressions that exclude the quarters from 2007Q1 to 2009Q2. Reconnect, though attenuated, is still clearly evident. The red-dashed line also displays a clear break from its pre-crisis history.

[2]These three 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.

[3]Appendix Figure A.3 demonstrates the robustness of this reconnect for alternative measures of the broad dollar exchange rate.

To give a better sense for how evenly distributed reconnect is across the post-crisis period, Figure 3 reproduces Figure 1d but for 2007-2017. The solid black best-fit line has a positive slope of 0.87 that indicates that greater U.S. purchases of foreign bonds are associated with larger depreciations of the US dollar. The R^2 jumps from about 5 percent in Figure 1d to 33 percent in Figure 3.[4] Figure 2 showed that the R^2 remains high even when excluding the quarters closest to the global financial crisis. The red-dashed line in Figure 3 demonstrates that the best-fit slope relating these two variables is nearly identical whether including or excluding key quarters of the global crisis.

2.2 Other U.S. Capital Flows

We focus on U.S. purchases of foreign bonds because, interestingly, reconnect is not visible in other types of U.S. flows. Figure 4a demonstrates this by separately repeating the rolling regressions from Figure 2 for U.S. purchases of foreign bonds, foreign purchases of U.S. bonds, and for U.S. net purchases of foreign bonds, which equals the difference between the two gross flows.[5] Only the solid black line, identical to that shown earlier, exhibits reconnect. Figure 4b repeats this exercise for equities. While foreign purchases of U.S. equities episodically exhibit high R^2s against the broad US dollar, none of the patterns suggest a scale or stability of relationship comparable to that of U.S. purchases of foreign bonds.

Table 1 reports regression estimates for the six types of U.S. capital flows in Figure 4 on the broad dollar and confirms that the relationship with the exchange rate is uniquely strong for U.S. holdings of foreign debt securities. The bottom row of Panel A reports the R^2s of regressions of the broad US dollar on each of the six types of flows during 1977-2006. All values are below 4 percent. By contrast, Panel B reports equivalent results for 2007-2017 and the third column, corresponding to U.S. purchases of foreign bonds, reports an R^2 of 33 percent, more than twice the next highest value.[6]

2.3 Capital Flows and Broad Exchange Rates in Other Countries

Our results thus far have focused on U.S. flows and the US dollar. To what extent are our findings unique to U.S. aggregates? We now repeat the identical analysis done above but looking at the

[4] Appendix Figures A.1 and A.2 confirm that the same patterns in Figures 1d and 3 hold when focusing on yearly (i.e. 4-quarter) changes rather than quarterly changes.

[5] 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).

[6] Appendix Table A.1 repeats our analyses using flows of FDI, bank loans, and other categories of the BoP. 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)).

relationship between foreign bond purchases and broad exchange rates for other countries.

Figure 5 and Appendix Figure A.4 show the R^2 of these regressions run for a number of developed and developing countries, respectively. For example, we regress changes in the broad British pound on changes in U.K. holdings of foreign (i.e. non-U.K.) bonds. The leftmost (solid blue) bar for each country reports the average R^2 across all available 40-quarter regressions for that country between 1977Q1 and 2006Q4, the middle (solid red) bar reports the same but for 40-quarter regressions run during 2007Q1 to 2017Q4, and the rightmost (hollow red) bar reports equivalent results for that period but excluding the crisis quarters of 2007Q1-2009Q2. Other than the United States, only Australia exhibits anything resemblant of reconnect.[7]

Finally, we summarize these relationships across all countries other than the United States by pooling their rolling R^2 coefficients and regressing them against time fixed effects, absorbing a country-specific fixed effect. We do this for gross outflows and inflows as well as the net flow for both bonds and equities. Figure 6 plots these time fixed effects, normalized such that their minimum value equals zero. The equity outflows line crossed the 10 percent R^2 threshold toward the end of the sample, but remains far below the level of variation of the US dollar explained by U.S. purchases of foreign bonds. And the other flows remain low throughout the sample.

In sum, we find U.S. purchases of foreign bonds reconnected with exchange rates starting around 2007, and the pattern remains even after excluding the quarters of the global financial crisis. We focus on this particular relationship as we find significantly less evidence of reconnect elsewhere, whether looking at flows into other assets, at net or gross inflows instead of gross outflows, or at countries other than the United States.

2.4 Macro Fundamentals

Has there been reconnect of other fundamentals to the broad US dollar? We run 40-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 U.S. foreign bond purchases 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.[8] Figure 7 plots the rolling R^2 values from these models, together with the series from Figure 2 using U.S. purchases of foreign bonds, for comparison. Table 2 reports the

[7] While Figure 5 focuses on the R^2 of these regressions, we note that the sign of the relationship between the broad Australian dollar and Australian holding of foreign bonds is the opposite of the U.S. one. When Australian residents purchase more foreign bonds, the Australian dollar appreciates. As we discuss in Section 3, this is consistent with the idea that changes in positions are coincident with changes in risk-bearing capacity (with Australian and U.S. purchases of foreign assets both indicating an increase in risk-bearing capacity), and with the US dollar being a safe currency and the Australian dollar a risky one.

[8] Appendix A.1 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), and Schmitt-Grohé and Uribe (2018).

in-sample performance for the pre- and post-crisis periods. Figure 7 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^2s 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.

For now, however, we focus on the much sharper relationship with U.S. foreign bond purchases and note that some of the unstable measures in Figure 7 caution against reaching too strong a conclusion from the benchmark result in this paper. The sample is short, and while the results are strong, we acknowledge that only time will tell whether the exchange rate reconnect that we document persists.

2.5 Out of Sample Forecasting

We turn next to out of sample forecasting performance. 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 the full details about how the forecast is computed in Appendix A.1, and in Figure 8, we plot the time series of realized broad-dollar changes and our regression-implied forecast. The figure shows that the forecasts generally track the realized exchange rate well, with the forecasts being less volatile than the actual series. Around the crisis period, the regression predicts the direction of the exchange rate change correctly but understates its magnitude.[9]

Next, we formally compare the out-of-sample forecasting power of U.S. foreign bond flows to that of a random walk model. For both our regression forecasts and the random walk forecast we compute the Root Mean Square Error (RMSE) as a measure of fit. An intuitive comparison is then obtained by dividing our forecasts’ RMSE by the RMSE of the random walk. We find that our forecasts have a RMSE ratio of 0.916, implying an 8 percent lower RMSE compared to the random walk. This forecast-error comparison can be made more formally using the Diebold-Mariano test statistic (Diebold and Mariano (2002)). This test compares the mean squared errors of the two forecasts and assesses whether they are statistically different while taking into account serial correlation of the errors. We find that our benchmark forecasts outperforms the random walk at the 10 percent significance level. When we exclude the crisis, the RMSE ratio increases to 0.967, which is still below 1 but is no longer statistically significant (and has a p-value of 33 percent).

[9] Given that we emphasize a structural break in the relationship between capital flows and exchange rates around the financial crisis, it is not obvious that we should expect the out-of-sample forecasts to work well for the crisis period itself, for example the exchange rate change in 2008Q3 is forecast using a coefficient estimate based on data from 1998Q2-2008Q2.

Given the relatively short sample over which we are evaluating the model's forecasting performance, a concern is that these results may be spurious. Therefore, to complement these statistical tests, in Figure 9 we plot the out-of-sample forecasting performance of U.S. foreign bond flows relative to other fundamentals-based models discussed above. This gives a sense of just how frequently results as strong as those we document for the post-crisis period have occurred in the full sample. In the figure, each dot indicates a different 10-year evaluation period for the forecasts. The 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. We also always indicate the period 2008Q1-2017Q4 with a solid dot to facilitate comparison with our benchmark results.

Across all models and time windows, we find only five instances of model forecasts passing the Diebold-Mariano test at the 10 percent significant threshold - U.S. foreign bond outflows and the Treasury Premium, both of which proxy changes in risk-bearing capacity. Each of these instances are within the three most recent sample windows of: 2006-2015, 2007-2016, and 2008-2017. These are also the five observations with the lowest RMSE ratio. By contrast, the vast majority of fundamentals-based forecasts have a RMSE ratio greater than one, meaning that their forecasting performance is worse than a random walk. In Appendix Figure A.5, we reproduce versions of Figure 9 for alternative estimation windows. While the statistical significance of the results do indeed vary across the specifications, we robustly find that the performance of capital flows and the Treasury Premium in the post-crisis windows are outliers in terms of forecasting performance compared to the alternative models.

3 Capital Flows, Risk Premia, and Exchange Rates

U.S. purchases of foreign bonds have comoved with the broad US dollar since the global financial crisis, but other macroeconomic fundamentals and aggregate quantities remain largely disconnected. Further, the fact that this reconnect appears unique to flows originating from the United States points to the likelihood that, rather than directly causing exchange rate movements, U.S. foreign bond purchases encode or proxy for some global factor that itself is what matters for exchange rates. In this section, we offer suggestive evidence that these flows are picking up changes in risk premia. In particular, we demonstrate that while there is no reconnection of macroeconomic fundamentals to the broad dollar, there is in fact a reconnection for a number of prices that are often used to proxy for risk-bearing capacity.

3.1 Reconnect with Risk Measures

An important clue that the explanatory power of U.S. purchases of foreign bonds is coming from a relationship with risk premia is that the correlation of these flows with traditional risk measures jumped from low levels before the crisis to high levels thereafter. Figure 10 reports the R^2 of rolling 10-year univariate regressions of changes in U.S. holdings of foreign bonds on the implied volatility of the S&P index (VXO), the return of the stock market (S&P 500), the credit spread constructed in Gilchrist and Zakrajšek (2012), the returns of financial intermediaries composed by He et al. (2017), and the Treasury Premium introduced in Du et al. (2018) and shown to covary with the broad dollar exchange rate in Jiang et al. (2018) and Engel and Wu (2018). Risk measures and U.S. bond flows are only mildly correlated prior to 2007. All five measures become much more correlated with these portfolio flows after the crisis.[10]

Given the jump in these correlations plotted in Figure 10, it is natural to ask, did these risk measures also experience reconnect with the US dollar after the crisis? Indeed, they did. Figure 11 reports the R^2 of rolling 10-year univariate regressions of the broad dollar on each of these risk measures as well as our baseline result using U.S. purchases of foreign bonds. Before the financial crisis the performance of risk measures is mixed and not that dissimilar to that of macro fundamentals. R^2s range from 0 to 20 percent, with most measures below 10 percent. After the financial crisis, all measures have a marked increase in their explanatory power for the broad dollar, with R^2 of similar magnitudes to U.S. foreign bond flows of about 30 percent.

Table 3 reports estimated regressions of the broad dollar on these risk proxies that lead to the same conclusion. The estimates in Panel A cover the period 1977-2006 and reveal that most measures of risk premia have an economically small and statistically insignificant relationship with the broad dollar.[11] Panel B reports estimates from 2007-2017 and shows that all measures have a strong relationship with the U.S. dollar in the post-crisis period. All coefficients are an order of magnitude bigger than in Panel A, have a sign consistent with the dollar being a safe-haven currency, and all have significantly larger R^2 values. Since the crisis, but not before, the dollar typically appreciates whenever volatility, the Treasury Premium, and credit spreads increase, or

[10] In unreported results we confirmed that U.S. flows that did not reconnect with the exchange rate, such as equity flows or foreign purchases of U.S. bonds, did not experience similarly large jumps in their correlation to these measures of risk premia. We do not offer a theory of why some flows have reconnected and not others. Recent theoretical developments have introduced financial shocks in the Euler equations for foreign currency bonds (Farhi and Werning (2014); Itskhoki and Mukhin (2017)) and our empirical results might offer further guidance on the source of these shocks.

[11] The VXO enters the regression as statistically significant but with the “wrong" sign from the perspective of this narrative: an increase in volatility is associated with a dollar depreciation. More generally, the weak unconditional relationship between measures of risk premia and the dollar in Panel A is typical of the pre-crisis literature. Over this period, a stronger association is typically found only when conditioning on periods of market downturns (Lettau et al. (2014)).

whenever returns of the stock market or intermediaries are lower.[12]

These post-crisis results are consistent with other recent papers that document a connection between the dollar and measures of risk and liquidity. Lilley and Rinaldi (2018) first documented the increase in correlation between exchange rates and the returns of the stock market following the financial crisis, providing an explanation based on the implications of the zero-lower bound constraint for exchange rates. Avdjiev et al. (2019b) focuses on Libor-based CIP deviations that emerged after the financial crisis and shows them to be related contemporaneously to the dollar. Jiang et al. (2018) and Engel and Wu (2018) document a covariation between the dollar and the convenience yield on U.S. Treasuries.

3.2 Decomposing Reconnect into Bilateral Exchange Rates

If U.S. foreign bond flows capture attitudes toward risk, then one would expect them to correlate more strongly with dollar depreciations against currencies perceived as riskier, such as those of emerging markets and Australia, than with dollar depreciations against other currencies that are also perceived as safe. Indeed, this is exactly the case. Figure 12 reports the coefficients of a regression of each bilateral exchange rate (against the dollar) on U.S. foreign bond purchases. The coefficients are sorted in descending order. While safe-haven currencies such as the Yen and Swiss Franc hold steady or even appreciate vis-a-vis the US dollar when the U.S. is buying foreign bonds, emerging market currencies and the Australian dollar depreciate.

In fact, the degree to which any bilateral exchange rate pair loads on U.S. foreign bond purchases depends squarely on their relative distance on the risk spectrum. To demonstrate this, Table 4 reports the R^2s from univariate regressions of each G10 bilateral exchange rate – including those not involving the USD – on U.S. foreign bond purchases. Note that the Australian Dollar to Japanese Yen exchange rate pair is among the most explainable, with an R^2 of 42 percent, higher than that of the broad US dollar.[13]

We have thus far focused on the broad dollar, but the evidence above that the yen and Swiss franc have similar loadings on U.S. foreign bond purchases opens up the possibility that our flow measure explains equally well the broad yen or broad Swiss franc as it does the broad dollar. After all, as shown in Figure 12, those are the only two currencies whose bilateral exchange rates with the US dollar had an estimated relationship with our flow measure that did not differ significantly from zero. To consider this, the bottom row of Table 4 reports the simple mean of the R^2s across all

[12] Appendix Table A.2 confirms that this is not simply due to the observations corresponding to the financial crisis. Excluding the period 2007Q1-2009Q2 from the regression leaves the conclusions largely unchanged with only the intermediary returns loosing their statistical significance.

[13] Appendix Figure A.7 replicates Figure 2 but focuses on bilateral exchange rates. The reconnect is strongest for currencies that are perceived to be risky. Appendix Table A.4 is the equivalent of Table 4 but for the period before the crisis. Nearly all R^2s are close to zero.

bilaterals for each country. The fact that these values are highest for the Japanese yen, US dollar, and Swiss franc is consistent with the idea that all three safe-haven currencies have similar loadings on a global risk factor that is proxied by U.S. foreign bond purchases. The U.S. is special in the sense that its foreign bond purchases appear uniquely informative about global risk. It's currency, however, may react to risk in a manner comparable to other safe havens.

4 Elaborating Reconnect with Micro Data

To make further progress in understanding exchange rate reconnect, we bring to bear the security-level holdings details assembled by Maggiori et al. (2019a) using Morningstar data on open-end mutual fund positions.[14] 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 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.[15]

4.1 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 comoves with and may even forecast 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

[14] 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.8 plots the two time series from 2005Q1 to 2017Q4, the maximum span we can study in the micro data.

[15] 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.

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, $F_{t,S}/Q_{t-1,S}$.[16]

In Appendix Table A.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 macro data. While the coefficients are slightly different, the R^2 are nearly identical: 33.4 percent for the BoP and 34.6 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.

4.2 Which Flows Matter?

Our focus on a single flow for explaining bilateral exchange rates, U.S. purchases of all foreign bonds, is perhaps surprising since our micro data allows us to condition these flows on their destination. The outsized importance of the single global factor is confirmed by comparing, for each individual bilateral dollar exchange rate, the explanatory power that comes from U.S. purchases of bonds in that particular foreign country with that coming from all other U.S. foreign bond purchases. The analysis in Table 5 asks, for example, 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 21 to 24 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 informative. 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. And they work against an interpretation where flows mechanically move the prices of currencies due to market frictions.

One might find it natural that bonds are more connected to exchange rates than equities since bonds are promises to pay units of money in 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

[16]We provide a more exhaustive description of this procedure in Appendix section A.1.

bonds, thus directly and causally affecting the exchange rate. Table 6 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, emerging markets and developed markets (G10), and dollar- and non-dollar-denominated bonds. Increases in U.S. residents' holdings of any of these bonds are associated with a weaker dollar, with the very small category of non-dollar emerging market corporate bonds as the exception. Sovereign dollar-denominated bonds, for both emerging and developed markets, have positive but statistically insignificant coefficients.

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 7, 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 13.

The key driver of the aggregate results are the active large funds that are not specialized in foreign investment. Indeed, the upper left panels of Figures 13a and 13b 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.

5 Conclusion

This paper documents a correlation between U.S. foreign bond purchases and exchange rates that emerges starting with the global financial crisis. At that time, these capital flows started moving together with global risk measures, which we also show reconnected with exchange rates. The US dollar, a safe-haven currency, depreciates when risk-appetite is high and when these flows out of the U.S. increase. And since currencies load heterogeneously on this global risk factor, U.S. foreign bond purchases 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".

While we do not offer a theory of the reconnect nor do we establish a causal link between U.S. foreign bond purchases and flows, we offer here one possible view of the facts uncovered in this paper. The primary takeaway of our paper is that, since the global financial crisis, there has been a broad reconnect of exchange rates with capital flows emanating from the U.S. and that these flows strongly co-move with U.S. investors' risk-bearing capacity. Why did currencies begin to covary so strongly with measures of global risk at the time of the global crisis? We think that this might have occurred 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.

Why did U.S. foreign bond purchases become so connected with measures of global risk around the crisis? U.S. portfolio debt investment may be unique among all the components of global capital flows because it is the only one 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

[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 and Rey (2007), Gourinchas et al. (2011), Maggiori (2017), and Farhi and Maggiori (2018).

highlighted in this paper have become relatively more important drivers of the dollar's value after the crisis than they were previously.

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Tables

Table 1: US Dollar and Gross and Net Capital Flows

Panel A: 1977-2006								
Purchaser	Issuer	Asset Class	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}
Net IIP (US - RoW)	Net IIP (US - RoW)	Bond	0.210**					
			(0.105)					
		Equity		-0.112				
				(0.163)				
U.S.	RoW	Bond			0.0908			
					(0.131)			
		Equity				-0.230		
						(0.175)		
RoW	U.S.	Bond					0.296*	
							(0.161)	
		Equity						-0.480*
								(0.281)
Observations			120	120	120	120	120	120
R^2			0.025	0.005	0.002	0.014	0.021	0.034
Panel B: 2007-2017								
Purchaser	Issuer	Asset Class	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}
Net IIP (US - RoW)	Net IIP (US - RoW)	Bond	-0.186					
			(0.373)					
		Equity		0.680**				
				(0.306)				
U.S.	RoW	Bond			0.873***			
					(0.163)			
		Equity				0.181		
						(0.798)		
RoW	U.S.	Bond					0.896*	
							(0.487)	
		Equity						1.229***
								(0.404)
Observations			44	44	44	44	44	44
R^2			0.007	0.062	0.334	0.002	0.067	0.159

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 US broad dollar and f_t is a particular measure of capital flows described in the first three columns of the table. Purchases of bonds and equities are normalized by the stock of holdings of that asset at the end of the previous quarter. Net positions are normalized by the sum of the stock of the U.S. position in foreign assets and the foreign position in U.S. assets for each type of security. Panel (A) reports regression results from 1977Q1-2006Q4 and Panel (B) reports regression results from 2007Q1-2017Q4. Exchange rate data is from Thomson Reuters Datastream and international investment position data is from the IMF Balance of Payments.

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

	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}
Model		UIP	Backus-Smith	Monetary	Taylor Rule
			Panel A: 1977-2006		
US Flows	0.210**				
	(0.105)				
$i^{US}_{t-1} - \bar{i}_{t-1}$		-0.679***			
		(0.256)			
$\pi^{US}_t - \bar{\pi}_t$			-2.492*	-0.253	-0.824
			(1.270)	(0.844)	(0.829)
$\Delta c^{US}_t - \overline{\Delta c}_t$			1.082		
			(1.318)		
$\Delta y^{US}_t - \overline{\Delta y}_t$				-0.125	
				(0.302)	
$\tilde{y}^{US}_t - \bar{\tilde{y}}_t$					0.556
					(0.432)
Obs.	120	108	47	108	108
R^2	0.025	0.084	0.101	0.003	0.021
			Panel B: 2007-2017		
US Flows	0.873***				
	(0.163)				
$i^{US}_{t-1} - \bar{i}_{t-1}$		2.060***			
		(0.736)			
$\pi^{US}_t - \bar{\pi}_t$			2.541***	2.890***	2.951***
			(0.713)	(0.601)	(0.573)
$\Delta c^{US}_t - \overline{\Delta c}_t$			-0.758		
			(1.526)		
$\Delta y^{US}_t - \overline{\Delta y}_t$				0.604	
				(1.245)	
$\tilde{y}^{US}_t - \bar{\tilde{y}}_t$					-1.096
					(1.658)
Obs.	44	43	44	44	44
R^2	0.334	0.127	0.157	0.157	0.163

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 US broad dollar and X_t captures various macroeconomic variables. For our baseline regressions, X_t is "US 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 US and the average of the other G10 countries. For the "Monetary" model, X_t contains two variables, the mean inflation difference between the U.S. and the other G10 countries and the mean growth difference between the U.S. 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 U.S. and the other G10 countries and the mean output gap differential between the U.S. and the other G10 countries. All macroeconomic variables are computed as the difference between the quarterly observation for the U.S. versus the average of all other G10 countries. Panel (A) reports regression results from 1977Q1-2006Q4 and Panel (B) reports regression results from 2007Q1-2017Q4. Exchange rate data is from Thomson Reuters Datastream, international investment data is from the IMF Balance of Payments, and macroeconomic data is from the IMF International Financial Statistics Database.

Table 3: Broad Dollar and Risk Measures

Panel A: 1977-2006					
	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}
$\Delta \ln(VXO)$	0.0361*				
	(0.0182)				
ΔTreasury Premium		-2.898			
		(4.071)			
ΔGZ Spread			0.000834		
			(0.0156)		
$\Delta \ln(SP500)$				-0.0119	
				(0.0653)	
Intermediary Returns					-0.0438
					(0.0362)
Observations	83	42	120	120	120
R^2	0.049	0.007	0.000	0.001	0.017
Panel B: 2007-2017					
	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}
$\Delta \ln(VXO)$	-0.0682***				
	(0.0158)				
ΔTreasury Premium		-15.78***			
		(2.927)			
ΔGZ Spread			-0.0299***		
			(0.00801)		
$\Delta \ln(SP500)$				0.296***	
				(0.0669)	
Intermediary Returns					0.114***
					(0.0402)
Observations	44	44	44	44	44
R^2	0.273	0.325	0.245	0.299	0.154

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 US broad dollar and X_t captures various measures of risk. $\Delta \ln(VXO)$ is the change in the log of the VXO index, Δ Treasury Premium 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), ΔGZ Spread is the change in the US corporate bond credit spread from Gilchrist and Zakrajšek (2012), and Intermediary Returns is the value-weighted return on a portfolio of NY Fed primary dealers' holding companies and is taken from He et al. (2017). Panel (A) reports regression results from 1977Q1-2006Q4 and Panel (B) reports regression results from 2007Q1-2017Q4.

Table 4: G10 Bilateral Exchange Rates and U.S. Foreign Bond Purchases

R^2	AUD	CAD	CHF	EUR	GBP	JPY	NOK	NZD	SEK	USD
AUD		3	28	17	2	42	0	4	3	36
CAD	3		17	9	0	36	2	0	0	47
CHF	28	17		7	16	18	31	16	27	5
EUR	17	9	7		8	23	23	6	24	14
GBP	2	0	16	8		29	2	0	0	39
JPY	42	36	18	23	29		41	34	37	5
NOK	0	2	31	23	2	41		2	4	37
NZD	4	0	16	6	0	34	2		0	29
SEK	3	0	27	24	0	37	4	0		32
USD	36	47	5	14	39	5	37	29	32	
Mean	15	13	18	14	11	29	16	10	14	27

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 quarterly change in the bilateral exchange rate of the currency in row i and column j, and f_t isnet 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. Exchange rate data is from Thomson Reuters Datastream and bond position data is from the IMF Balance of Payments database. Data is measured quarterly from 2007Q1-2017Q4.

Table 5: 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	-1.025***	0.427	-0.799***	-0.213	0.47	0.043
BRL	-1.025***	0.265	-1.049***	0.0649	0.269	0.004
CAD	-0.560***	0.265	-0.446**	-0.154	0.291	0.026
CHF	-0.327**	0.098	-0.342**	0.179**	0.173	0.075
COP	-0.844***	0.258	-0.634***	-0.301***	0.332	0.074
CZK	-0.605***	0.142	-0.590***	-0.00595***	0.218	0.076
EUR	-0.297	0.055	0.0171	-0.304**	0.17	0.115
GBP	-0.653***	0.306	-0.695**	0.0821	0.313	0.007
IDR	-0.423**	0.144	-0.399*	-0.108	0.166	0.022
ILS	-0.317**	0.087	-0.306**	-0.00735	0.088	0.001
INR	-0.530***	0.312	-0.488***	-0.0893*	0.345	0.033
JPY	-0.041	0.001	-0.0426	0.0574	0.006	0.005
KRW	-0.718***	0.36	-0.725***	0.0152	0.364	0.004
MXN	-0.607***	0.187	-0.607**	-0.0008	0.187	0.000
MYR	-0.364***	0.135	-0.356***	-0.00501	0.136	0.001
NOK	-0.786***	0.279	-0.690***	-0.0965***	0.361	0.082
NZD	-0.780***	0.316	-0.756***	-0.0141	0.317	0.001
PLN	-0.856***	0.2	-0.670***	-0.0594**	0.232	0.032
RUB	-0.817***	0.149	-0.791***	-0.0496	0.152	0.003
SEK	-0.745***	0.291	-0.684***	-0.0409	0.299	0.008
SGD	-0.300***	0.185	-0.297***	-0.0025	0.185	0.000
TRY	-0.571**	0.14	-0.500**	-0.154*	0.181	0.041
ZAR	-0.651***	0.165	-0.294	-0.206***	0.336	0.171
Average		0.21			0.24	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-squared is the mean R-squared 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 U.S. 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 U.S. is purchasing that country’s bonds. Units are defined as percentage changes, as described in section A.1. All regressions are conducted at a quarterly frequency. The sample period for all regressions is from 2007Q1 to 2017Q4. Standard errors are calculated allowing for heteroskedasticity. *p< 0:1; **p< 0:05; ***p< 0:01. Exchange rate data is from Thomson Reuters Datastream and bond position data is from Morningstar.

Table 6: US Dollar and Subcomponents of U.S.Outflows

Asset Class	Destination	Currency	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}	Δe^B_{USD}
Corporates	EM	NonUSD	-0.0132							
			(0.0163)							
		USD		0.243***						
				(0.0819)						
	G10	NonUSD			0.235***					
					(0.0705)					
		USD				0.430***				
						(0.0711)				
Sovereigns	EM	NonUSD					0.192**			
							(0.0728)			
		USD						0.162		
								(0.119)		
	G10	NonUSD							0.160***	
									(0.0527)	
		USD								0.104
										(0.0886)
	Observations		44	44	44	44	44	44	44	44
	R^2		0.008	0.220	0.181	0.279	0.169	0.055	0.138	0.035

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 US purchases of foreign securities belonging to a particular category, scaled by US holdings of bonds belonging to that category at the end of the previous quarter. "Corporates" refers to corporate debt, "Sovereigns" refers to sovereign debt, "EM" refers to debt issued by entities domiciled in an emerging market country, "G10" refers to debt issued by entities domiciled in a G10 country, "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, EM, NonUSD indicates US purchases of corporate debt issued by an emerging market firms denominated in a currency other than the US dollar. All other variables are defined equivalently.

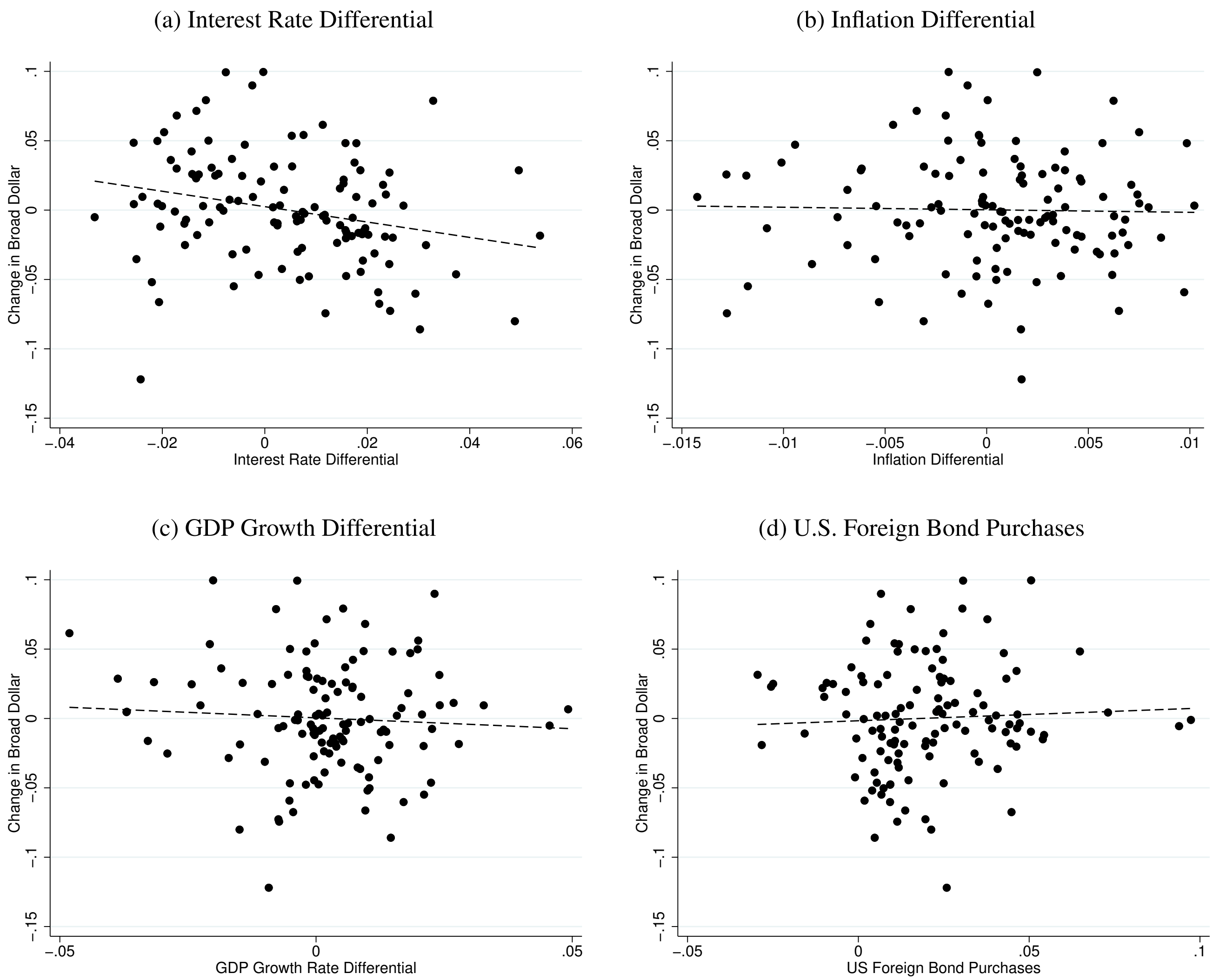
Table 7: The Broad Dollar and US Domestic Investment

	Δe^{B}_{USD}	Δe^{B}_{USD}	Δe^{B}_{USD}
All USA Bonds	-0.536**		
	(0.238)		
Sovereign Bonds		-0.273***	
		(0.0823)	
Corporate Bonds			0.710**
			(0.306)
Constant	0.00841	0.00766	-0.0199**
	(0.00631)	(0.00608)	(0.00901)
Observations	44	44	44
R^2	0.111	0.207	0.166

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 USA Bonds" refers to US domiciled mutual fund purchases of US debt, scaled by the value all holdings of US bonds by US 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 US Federal Government and US corporations, respectively. Exchange rate data is from Thomson Reuters Datastream and bond position data is from Morningstar.

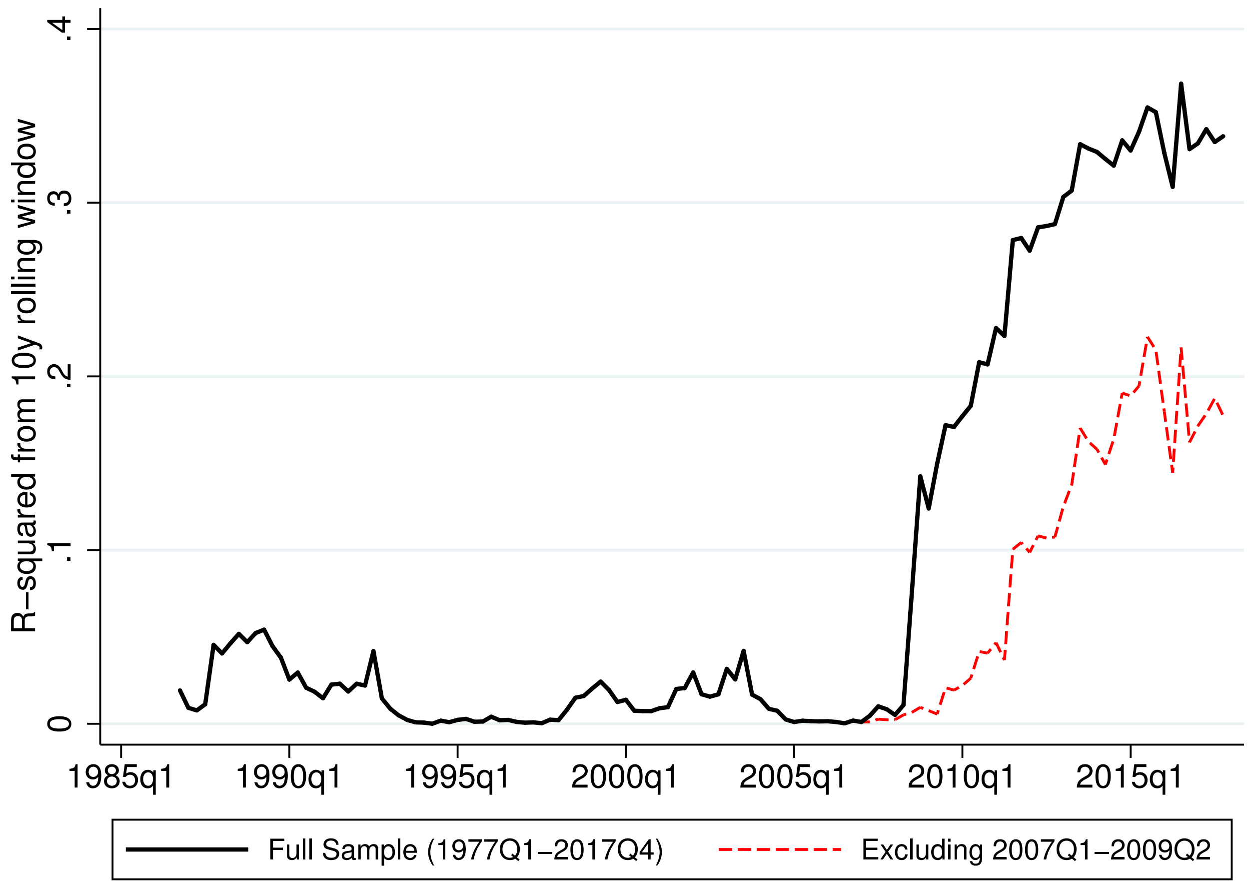
Figures

Figure 1: Exchange Rate Disconnect (1977-2006)



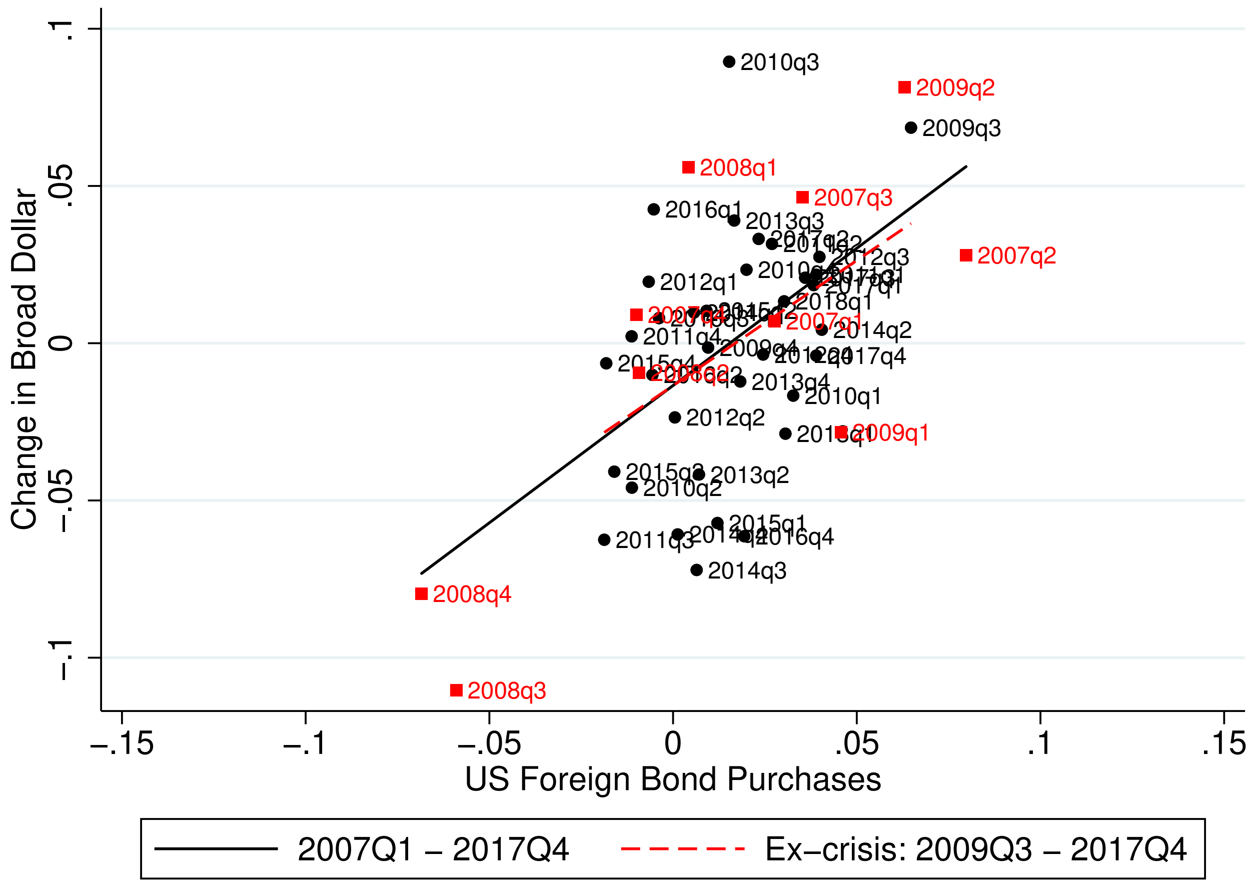
Notes: This figure plots the relationship between various macroeconomic variables and quarterly changes in the broad dollar exchange rate from 1977-2006. Changes in the broad dollar are reported on the y-axis and the relevant macroeconomic quantity is reported on the x-axis. A positive change in the broad dollar indicates dollar depreciation, and a rightward move in the x-axis corresponds to a higher level for the U.S. minus the G10 countries. Panel A tests the UIP model, using the average lagged interest rate differential in the US relative to the mean of the other G10 economies. Panel B looks at the equivalent in the US inflation rate relative to the inflation rate of the other G10 economies. Panel C looks at the average growth rate differential in the US relative to the mean of the other G10 economies. Panel D looks at US 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. Exchange rate data is from Thomson Reuters Datastream and macroeconomic data is from the IMF International Financial Statistics Database.

Figure 2: U.S. Purchases of Foreign Bonds and the Broad Dollar



Notes: The y-axis corresponds to the R^2 of a 40 quarter rolling regression of the following specification: $\Delta e^B_{USD,t} = \alpha + \beta f_t + \varepsilon_t$, where $\Delta e^B_{USD,t}$ is the average log appreciation of the USD against all other G10 currencies and f_t is the 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. The blue line corresponds to the full sample, and the dashed red line corresponds to the sample which excludes the crisis, defined as 2007Q1-2009Q2. Exchange rate data is from Thomson Reuters Datastream and bond purchase data is from the IMF Balance of Payments Database.

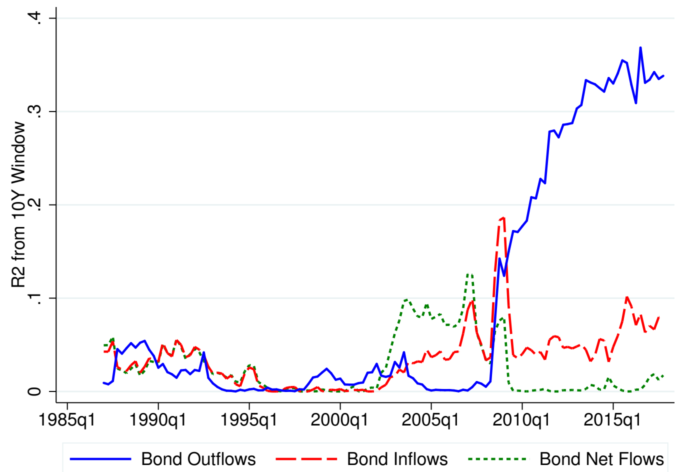
Figure 3: Exchange Rate Reconnect (2007 - 2017)



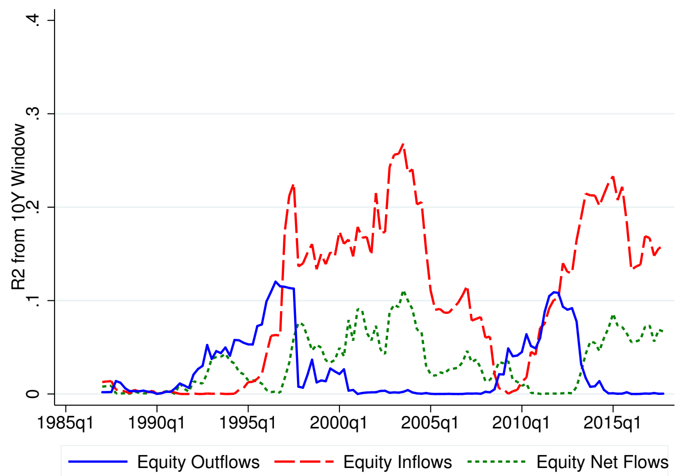
Notes: The y-axis corresponds to the quarterly average change in the USD against all other G10 currencies, defined such that a positive value corresponds to a depreciation. The x-axis shows the purchases of foreign bonds by the United States in the contemporaneous quarter, normalized as a percentage of the United States' value of foreign bond investment at the end of the prior quarter. Regression lines are estimated using the full sample (2007Q1 to 2017Q4) and excluding the crisis (2009Q3 to 2017Q4). Exchange rate data is from Thomson Reuters Datastream and bond purchase data is from the IMF Balance of Payments Database.

Figure 4: US Dollar and Multiple Types of U.S. Capital Flows

(a) Bond Flows

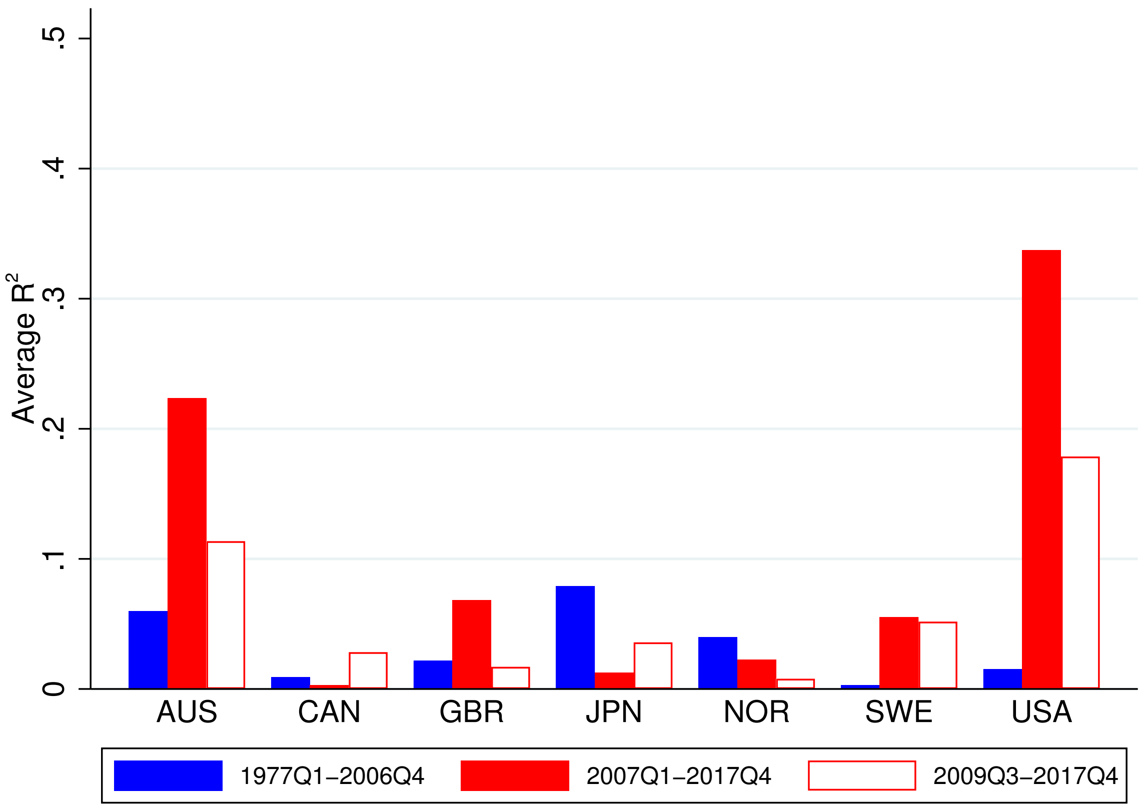


(b) Equity Flows



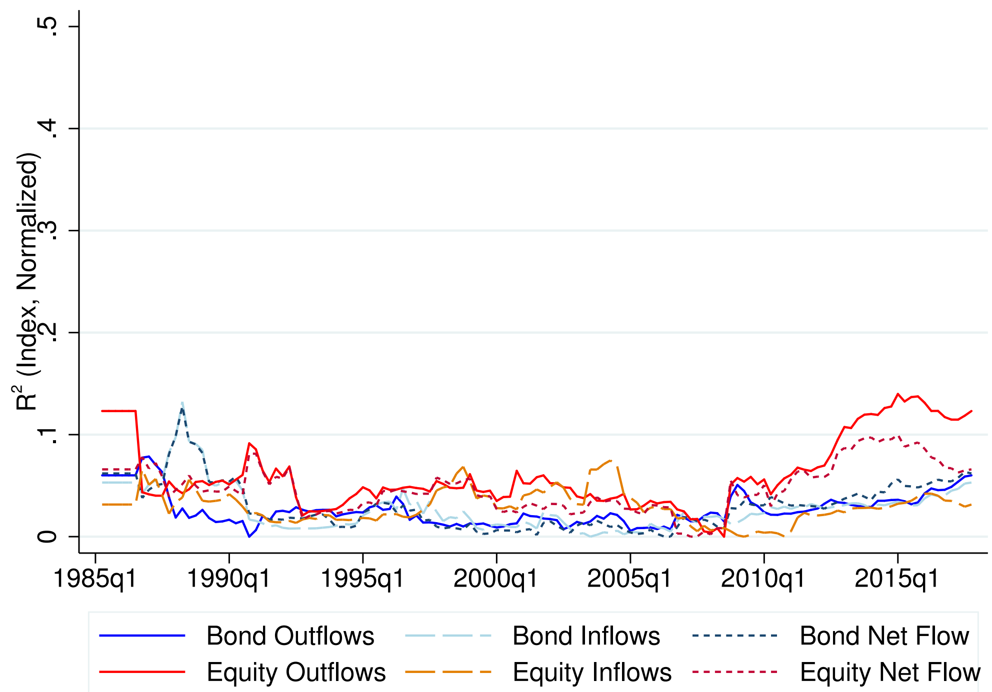
Notes: The y-axis corresponds to the R^2 of a 40 quarter rolling regression specification of the following form: $\Delta e^{B}_{USD,t} = \alpha + \beta f_t + \varepsilon_t$, where $\Delta e^{B}_{USD,t}$ is the average log appreciation of the USD against all other G10 currencies and f_t a measure of a capital flow from the IMF Balance of Payments data for the US. f_t can refer to Outflows, Inflows, or Net Flows. Outflows refers to purchases of foreign bonds (panel A) or equities (panel B) by the United States, normalized as a percentage of the United States' value of foreign bond or equity investment at the end of the prior quarter. Inflows refers to the purchases of bonds or equities issued within the U.S. by the RoW, normalized as a percentage of the RoW value of foreign bond or equity investment in the U.S. Net refers to the change in the foreign bond (or equity) asset minus liabilities position of the U.S., normalized by the average of both U.S. foreign bond assets and liabilities. All observations are at a quarterly frequency from 1976 to 2017. Exchange rate data is from Thomson Reuters Datastream and investment data is from the IMF Balance of Payments.

Figure 5: Foreign Bond Purchases and Broad Exchange Rates, Developed Countries



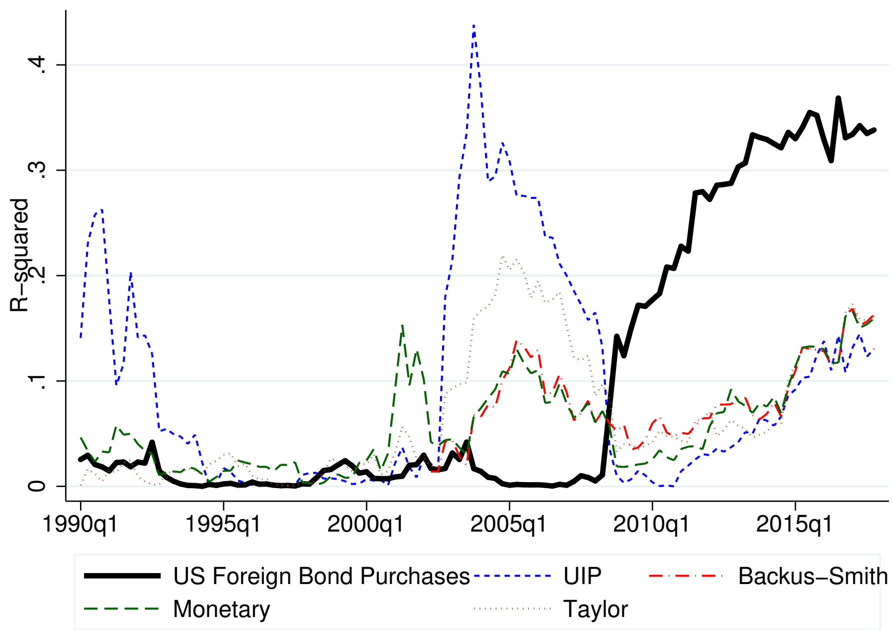
Notes: The y-axis corresponds to the averaged R^2 of rolling regressions of the change in each country's currency against the basket of G10 currencies against the net purchases of foreign bonds by each country, normalized as a percentage of the value of gross foreign bond investment of that particular country at the end of the prior quarter. The sample of G10 countries was selected according to those who had data available by 1997Q1. The regression specification is of a quarterly frequency, of the form $\Delta e^B_{i,t} = \alpha + \beta f_{i,t} + \varepsilon_t$, where $\Delta e^B_{i,t}$ is defined as the change the broad exchange rate of country i and $f_{i,t}$ is country i's net purchases of foreign bonds. The blue bar reports the averaged R^2 for rolling regressions run on a sample of data from 1977Q1-2006Q4, the red bar is the averaged R^2 for the sample 2007Q1-2017Q4, and the red-outline box is the R^2 from a single shortened 34 quarter regression from 2009Q3-2017Q4 to focus on the reconnect period excluding the crisis. Exchange rate data is from Thomson Reuters Datastream and investment data is from the IMF Balance of Payments.

Figure 6: Capital Flows and Broad Exchange Rates, Global Average (Ex-USA)



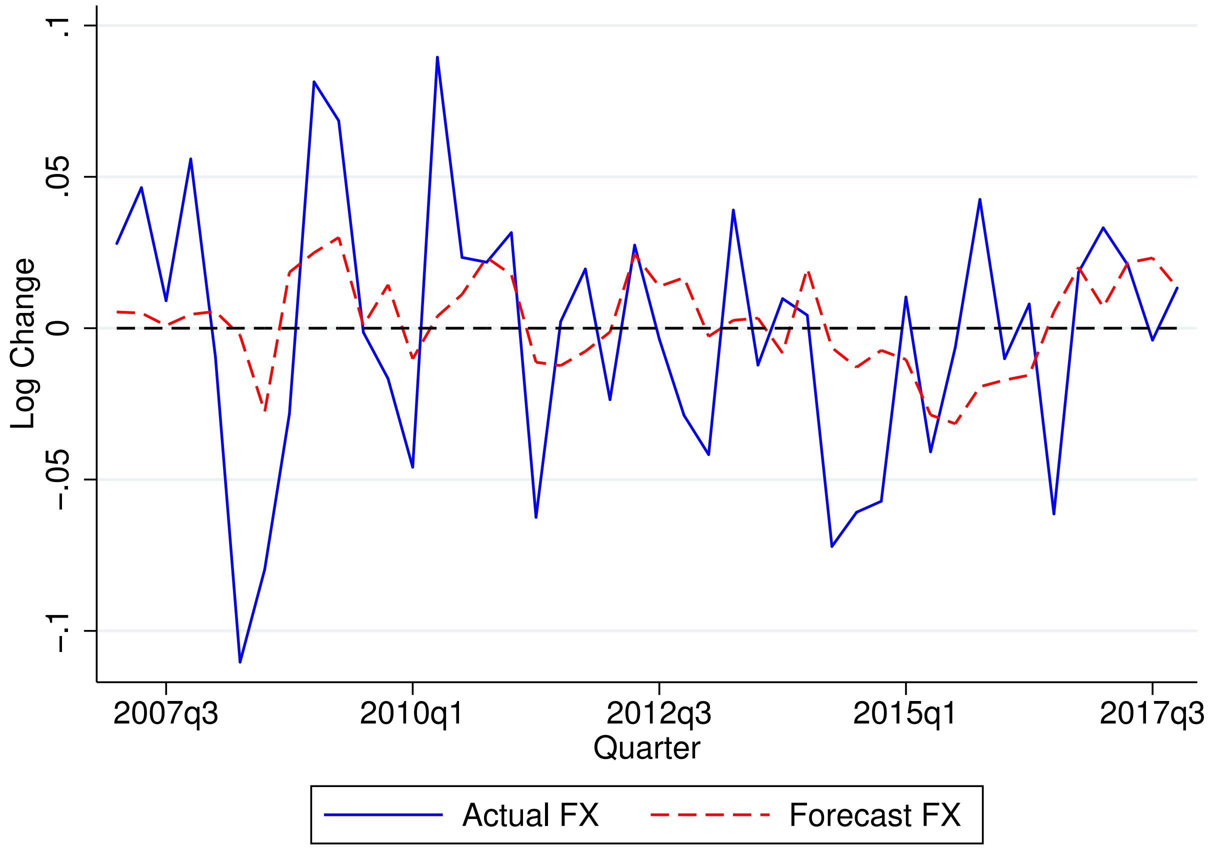
Notes: The figure demonstrates the lack of explainability for nonUSD broad exchange rates from Non-U.S. flows over multiple ten year windows. We first estimate the average R^2s of 40 quarter rolling regressions of the average log appreciation of each country's broad exchange rate against all other G10 currencies against a measure of a capital flow from the IMF Balance of Payments data for that country. These regressions are of the form $\Delta e^B_{i,t} = \alpha + \beta f_{i,t} + \varepsilon_t$. In this regression $f_{i,t}$ can refer to Outflows, Inflows or Net Flows. Outflows refers to purchases of foreign securities (either bonds or equities) by country i, normalized as a percentage of the value of foreign investment in that type of security at the end of the prior quarter. Inflows refers to the purchases of bonds or equities issued within country i by the rest of the world, and Net refers to the percentage change in the net position of country i bond holdings abroad minus foreign bond holdings in country i. All observations are at a quarterly frequency from 1977 to 2017. After running these rolling regressions country-by-country, we have an unbalanced panel of end of 10 year R^2s for each country and time period. We then run a fixed effect regression of the $R^2_{i,t}$ values on country and time dummies of the form: $R^2_{i,t} = \gamma_i + \omega_t$, where the purpose of country coefficients is to control for the changing composition of the panel. We then plot the ω_t time dummies in order to measure the average change in the R^2 over time. Exchange rate data is from Thomson Reuters Datastream and international investment data is from the IMF Balance of Payments.

Figure 7: In-Sample Explanatory Power of Capital Flows and Other Fundamentals



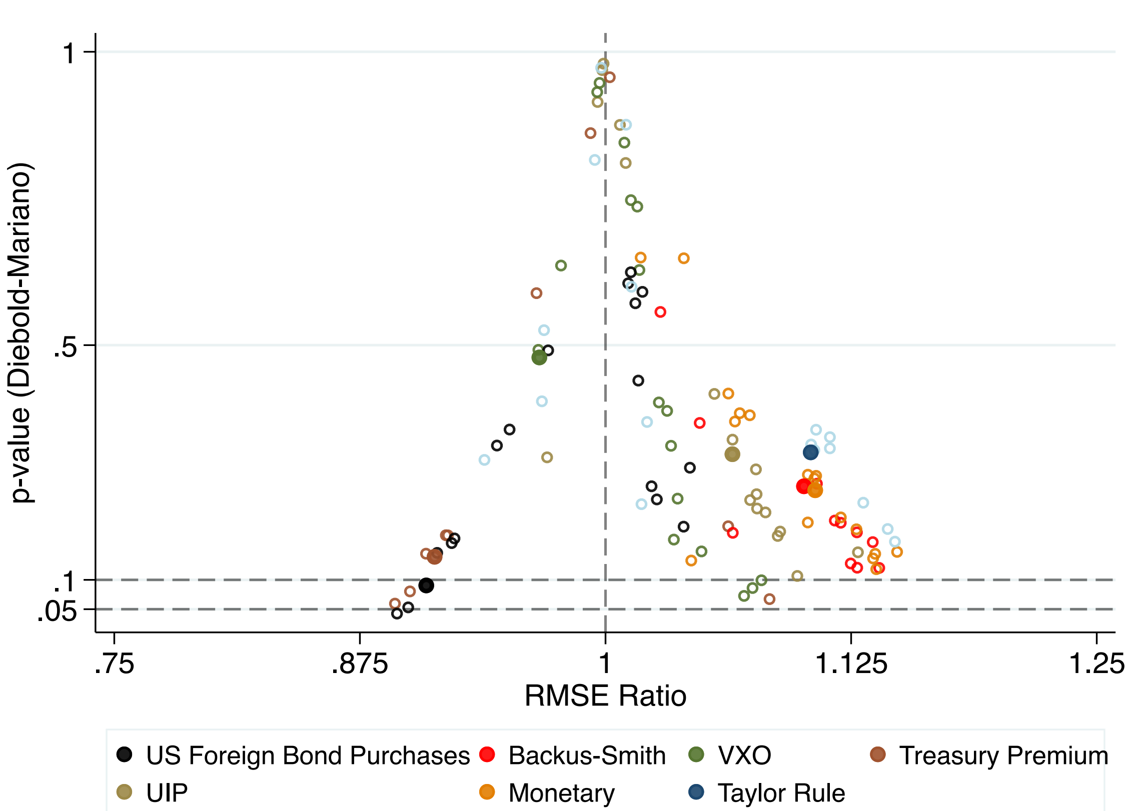
Notes: The figure shows the 40 quarter rolling R^2 for regressions of the form $\Delta e^B_{USD,t} = \alpha + \beta X_t + \varepsilon_t$ where $\Delta e_{USD,t^B}$ is the average log change in the USD versus the other G10 currencies against various models. X_t will correspond to different variables depending on the model in question. For "US 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 US and the average of the other G10 countries. For the "Monetary" model, X_t contains two variables, the mean inflation difference between the U.S. and the other G10 countries and the mean growth difference between the U.S. 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 U.S. and the other G10 countries and the mean output gap differential between the U.S. and the other G10 countries. All macroeconomic variables are computed as the difference between the quarterly observation for the U.S. 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 is from Thomson Reuters Datastream, international investment data is from the IMF Balance of Payments, and macroeconomic data is from the IMF International Financial Statistics Database.

Figure 8: Broad USD, OOS Forecast using U.S. Foreign Bond Purchases (BoP)



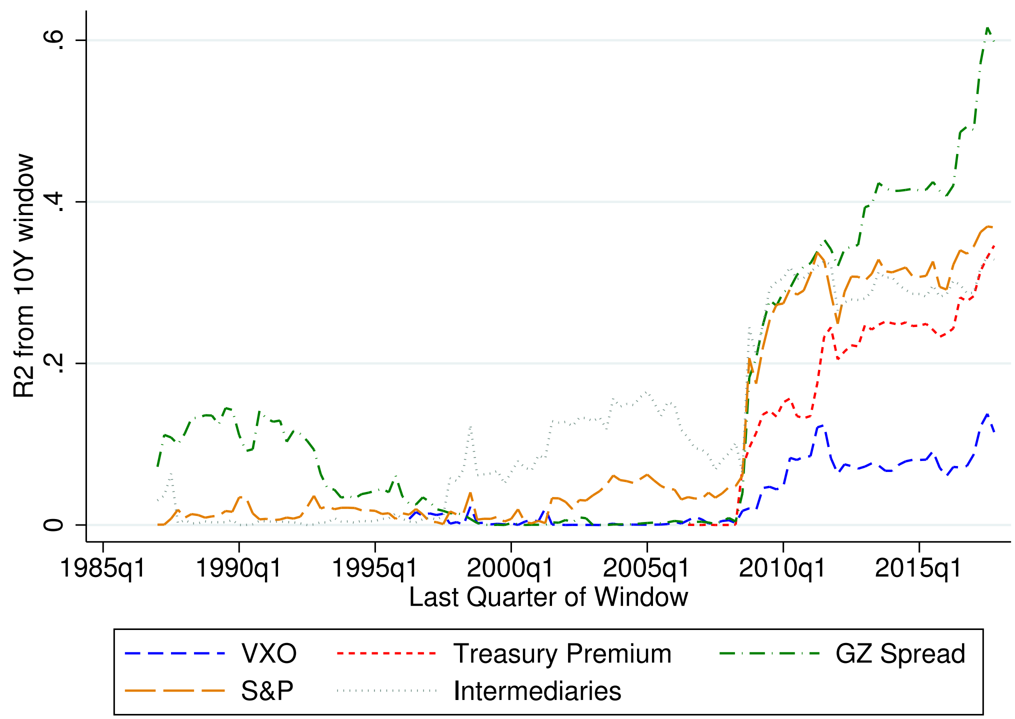
Notes: This figure plots the time series of realized equal-weighted broad dollar exchange rate changes ("Actual FX") against the model out-of-sample forecasts ("Forecast FX"). The model forecasts are calculated by estimating equation A.1 for the 40 quarters prior to the quarter being estimated. Then the estimated coefficients and the realized of U.S. foreign bond purchases in that quarter to calculate an estimate of that quarter's exchange rate change, as in equation A.2. The model is then re-estimated one quarter ahead, and the new coefficients and realization of capital flows are used to forecast next quarter's exchange rate.

Figure 9: Out-Of-Sample Forecasting Performance Comparison



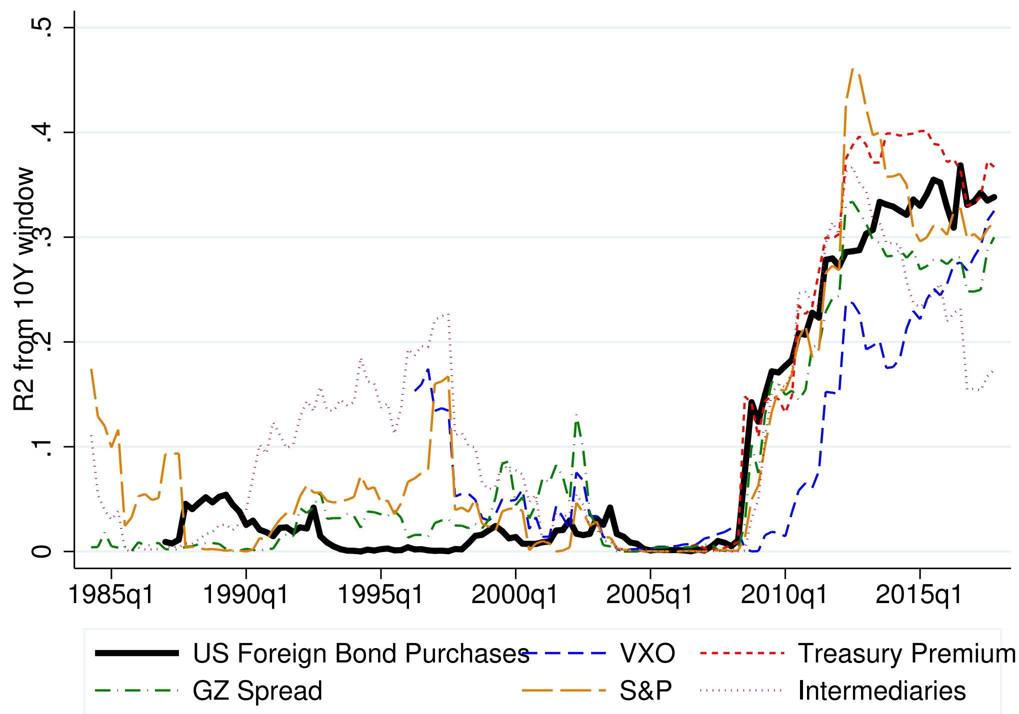
Notes: This figure reports the performance of various exchange rate models relative to a random walk over different sample periods. Each dot reports the p-value of a Diebold-Mariano test for the performance of the model relative to a random walk (y-axis) and the ratio of the model's root mean squared forecast error relative to a random walk. Each observation represents a 40 quarter model evaluation period, using 40 quarter rolling estimation windows as described in Appendix section A.1. The solid dots represent the most recent 40 quarter period used, 2008Q1-2017Q4. The first model evaluation period is 1987Q1-1996Q4, because we require 40 quarters of data for the estimation period before beginning the evaluation sample. The first evaluation period for VXO is 1996Q2-2006Q1 and the first evaluation period for the Treasury Premium is 1998Q2-2008Q1 because of data availability.

Figure 10: U.S. Foreign Bond Purchases and Risk Based Fundamentals



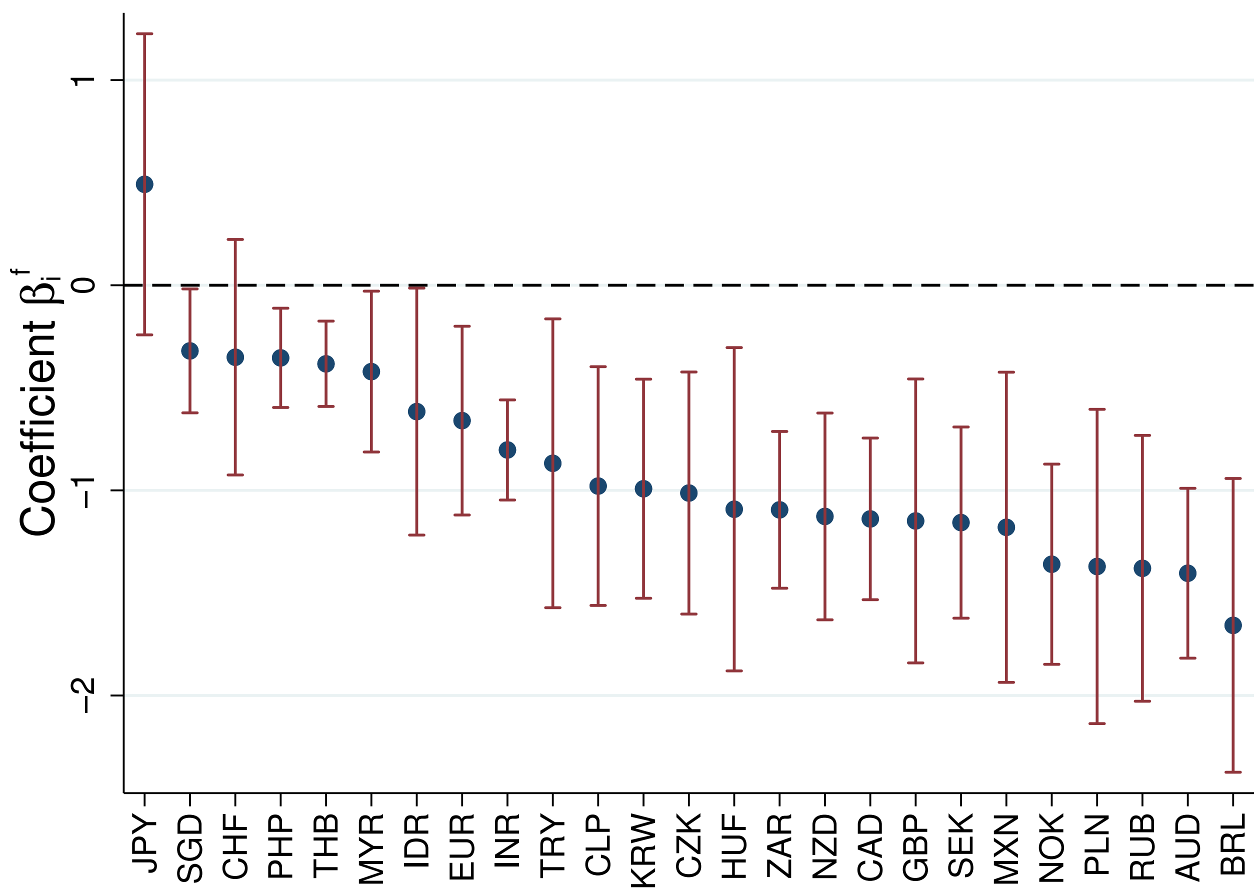
Notes: The figure shows the 40 quarter rolling R^2 for regressions of US Foreign Bond Purchases against various indicators of risk. The regression specification is $f_t = \alpha + \beta X_t + \varepsilon_t$, where f_t refers to the net purchases of foreign bonds by the United States, normalized as a percentage of the United States' value of foreign bond investment at the end of the prior quarter. X_t will correspond 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 SP100, from the CBOE. For "S&P," 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 US 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).

Figure 11: The Broad Dollar and Risk Based Fundamentals



Notes: The figure shows the 40 quarter rolling R^2 for regressions of the average log change in the USD 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 will correspond to different variables depending on the model in question. For "US 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 "VXO", X_t is the quarterly change in the log transformation of an index of implied volatility on the stocks in the SP100, from the CBOE. For "S&P", 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 US 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).

Figure 12: Bilateral Exchange Rates against USD and U.S. Foreign Bond Purchases, 2007Q1-2017Q4

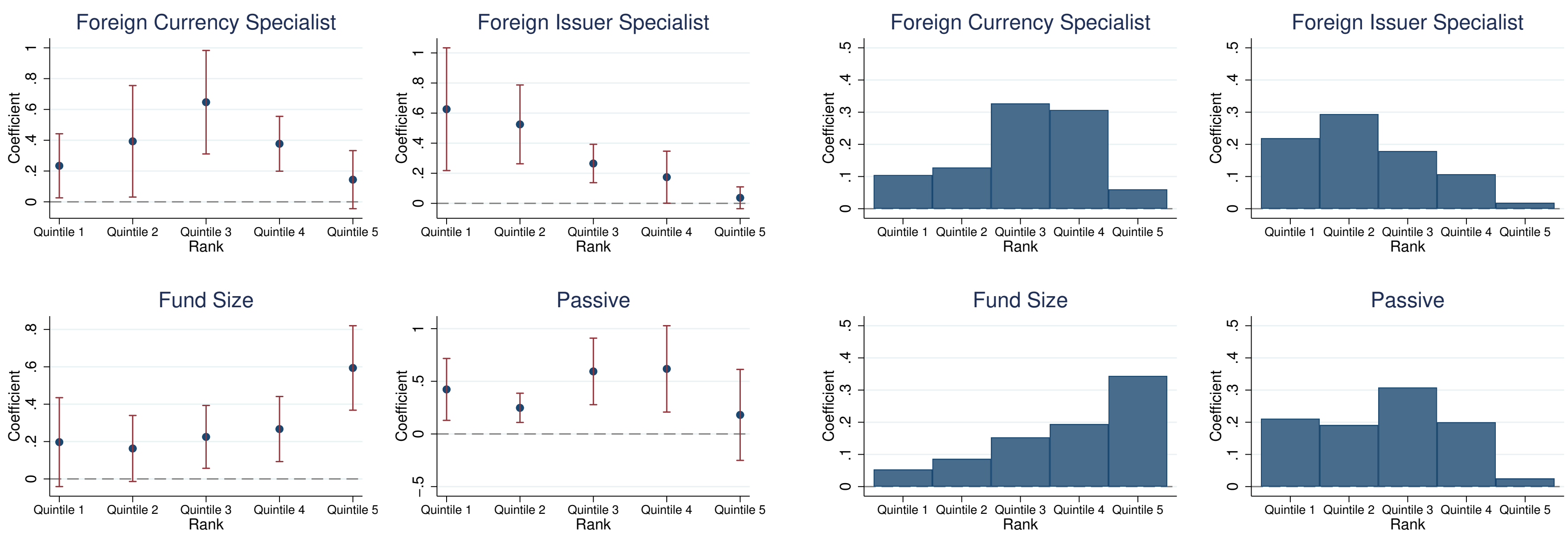


Notes: This figure reports the coefficient estimate of the following regression specification: $\Delta e^{\$}_{i,t} = \alpha_i + \beta_i f_t + \varepsilon_t$, where $\Delta e^{\$}_{i,t}$ is the change in the log bilateral exchange rate against the USD and f_t is the U.S. foreign bond purchases, normalized as a percentage of the United States' value of foreign bond investment at the end of the prior quarter. The blue dots indicate the coefficient point estimates, β_i^f, and the red bars indicate two standard error bands. A negative coefficient indicates that the listed currency appreciates bilaterally against the USD when the U.S. is purchasing foreign bonds.

Figure 13: Broad USD and U.S. Foreign Bond Purchases by Subsets of Mutual Funds

(a) Coefficients by Fund Characteristics

(b) R^2s 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 USD 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 USD). For each quarter from 2007Q1 to 2017Q4, 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 a NonUSD currency. 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.