Deviations from FIRE and Exchange Rates: A GE Theory of Supply and Demand

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Abstract

In this paper, we build a general equilibrium model that takes the institutional details of the foreign exchange market into account and allows for deviations from full information rational expectations (FIRE) in a way consistent with forecast survey data and positions. We show that the testable implications of this model—related to foreign exchange derivatives positions, and both realized and expected exchange rates—are strongly supported in the data. Moreover, we argue that the particular form of deviation from FIRE implied by the data can help resolve important exchange rate puzzles, such as the Fama puzzle and the delayed overshooting puzzle, and can generate hump-shaped dynamics of exchange rates.

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1 Introduction

Exchange rates, as any other market-driven price, are determined by an equilibrium of supply and demand. However, little is known regarding the net demand for assets of the various agents participating in currency markets and the types of beliefs underlying observed demand. Understanding how agents form expectations of exchange rates, which in turn affect their currency positions, is of first-order importance for explaining the observed dynamics of realized exchange rates.

This paper's contribution is three-fold. First, we build a general equilibrium model of exchange rates that takes into account the institutional details of foreign exchange rate markets. In particular, in addition to spot markets, we introduce derivatives markets and allow for heterogeneity across currency market participants. Last, but not least, we allow for deviations from full information rational expectations (FIRE) in a manner consistent with exchange rate survey forecasts and positions in currency derivatives markets.

Second, we show that the testable predictions of the model—related to foreign exchange derivatives positions, and both realized and expected exchange rates—are strongly supported in the data. We show that average exchange rate forecasts and, in particular, the average *Consensus Economics* forecasts, are consistent with average positions of the largest foreign exchange (forex) market participants while FIRE expectations are not. To our knowledge this is the first paper that documents this result, which provides support to the importance of incorporating survey data when studying exchange rate dynamics. Moreover, in contrast to the exchange rate disconnect literature, we find that survey-based exchange rate expectations and average foreign exchange rate derivatives positions can explain the majority of exchange rate fluctuations at both short and long horizons.[1] The signs of the estimated coefficients are as predicted by the theory and are highly significant. In summary, we find that survey-based exchange rate expectations are reflected in positions, both of which account for the bulk of exchange rate movements.

Third, we simulate the model and show that the particular form of deviation from FIRE of the *Consensus Economics* forecasts that we document in the survey data can

[1]The exchange rate disconnect puzzle/literature refers to the disconnect between exchange rate movements and economic fundamentals. For details see Meese and Rogoff (1983) and Obstfeld and Rogoff (2000) and the following literature.

help explain a number of exchange rate puzzles, such as the Fama puzzle and the delayed overshooting puzzles, and can generate hump-shaped dynamics of exchange rates.[2]

We build a two-country endowment economy model with a single tradable good and country-specific non-tradable goods. It features three forex trading venues—an over-the-counter (OTC) spot market for government bonds, an OTC derivatives market and an exchange-traded derivatives market. For simplicity, we assume that the futures contracts (exchange-traded derivative contracts) and forward contracts (OTC derivatives contracts) have the same terms and conditions. There is market segmentation as some agents can only trade in a subset of these markets. In particular, the consumers in each country can trade only the domestic currency bond in the spot OTC market. There is also a group of speculators that trade only in the exchange-traded derivatives market. We also model financial institutions ("financiers") that can access all three markets. The derivatives and spot markets are linked through a covered interest parity (CIP) no-arbitrage condition implying that the currency forward/futures premium equals the interest rate differential.

In reality, of these three markets, the OTC derivatives market is the largest, followed by the spot market while the size of the futures market is only about 2 percent of the size of the OTC market.[3] Though its size is small, the model still includes a futures market to show how the average OTC derivatives positions of the financiers—the largest forex market participants—can be measured using publicly available futures data in a novel way.

Based on this model, we derive two main testable implications. The first tests whether our measures of financiers' expectations are consistent with observed behavior, in this case, financial positions. Specifically, the model implies that financiers' net exposure to foreign currency will be larger when they expect a larger average excess return from being long the foreign currency and short the home currency. We test this relationship using two different measures of beliefs. First, we assume that the financiers are fully informed and rational, and use realized currency returns to proxy for their beliefs. Second, we relax the FIRE assumption and proxy for financiers'

[2]When studying the properties of the *Consensus Economics* forecasts, we use both the average (consensus) exchange rate forecast and individual level forecasts.

[3]See Table 1 of the 2019 BIS Triennial Central Bank Survey.

beliefs using the average exchange rate forecast from the *Consensus Economics* survey, which we confirm are inconsistent with FIRE. The observed positions turn out to be very strongly consistent with the survey expectations and the hypothesis that the financiers are fully informed and rational can be rejected. These results hold very significantly for the dollar against all seven currencies considered—AUD, CAD, CHF, DEM/EUR, GBP, JPY, NZD—and for all available forecast horizons in the *Consensus Economics* survey—1, 3, 12 and 24 months ahead, where the time period considered is post-1990.

The second testable implication of the model is that the foreign currency should appreciate between periods t and $t+1$ if: (1) the speculators increase their foreign currency net futures demand between periods t and $t+1$, (2) the foreign interest rate increases relative to the home interest rate between periods t and $t+1$, or (3) the average financier's n-period-ahead expectation of the foreign currency's value, proxied by the average *Consensus Economics* forecast, increases between t and $t+1$, where n is the investment horizon. We confirm that all of these relationships hold significantly in the data and find that these measures jointly explain most of the variation in exchange rate changes at both short and long horizons. The change in speculators' average futures positions alone can explain as much as 70–80 percent of the variation of exchange rate changes over some sub-periods while it explains, on average across all currency pairs, about 30 percent of the variation in one-month exchange rate changes over the full sample.[4] When we include all three above-mentioned explanatory variables, the explanatory power over the whole period, averaged across currency pairs, is 41, 72, 87, and 85 percent for exchange rate changes at 1, 3, 12, and 24 months, respectively. The most important explanatory variable at longer horizons is the revision in exchange rate expectations, while the change in the financiers' positions is most important at shorter horizons. The change in the interest rate differential plays the smallest role at all horizons. Overall, the adjusted R^2s of the model-implied regressions are significantly higher relative to the findings in the literature, which tends to find a disconnect between exchange rates and other economic variables at monthly

[4]It has been notoriously hard to beat the random walk exchange rate forecast at monthly and quarterly frequency even using realized contemporaneous regressors [see Meese and Rogoff (1983) and the ensuing literature]. We find that the change in futures' demand of the speculators generates "out-of-sample" short-run exchange rate change forecasts, based on realized regressors, with lower mean squared forecast error (MSFE) than the random walk model.

and quarterly horizons.

The next part of the paper explores the type of beliefs consistent with speculators' futures demand and the type of deviation from FIRE that can rationalize the financiers' exchange rate expectations. We find that a "momentum-driven" trading strategy can explain more than 50 percent of the variation in speculators' demand. This implies that speculators believe that a currency will appreciate in the future if it has appreciated in the recent past. This result is consistent with the fact that the largest futures market participants among the speculators – CTAs and MMFs — have been shown to follow primarily momentum like strategies [See Baltas and Kosowski (2013) and Brian, Ooi, and Pedersen (2013)]. In contrast, the financiers' average beliefs, proxied by the *Consensus Economics* exchange rate forecasts, are such that they tend to underweight the importance of exchange rate appreciation over the last month relative to FIRE and they believe that the currency will depreciate if it has appreciated in the recent past. Given that the financiers are the counterparty to speculators in the futures market, it is not surprising that they have opposing beliefs about the implications of past appreciations. The same form of deviation from FIRE that we find for the average forecast is also found for individual-level exchange rate forecasts from *Consensus Economics*, which to our knowledge, have not been previously used in academic research.

Finally, we show that the financiers' underweighting of past exchange rate appreciations relative to FIRE, i.e. they believe that the exchange rate will appreciate by more/depreciate by less in the future relative to FIRE if it has depreciated in the past, introduces exchange rate persistence in response to shocks. Such persistence can help to reconcile some long-standing exchange rate puzzles, whereas the same model under FIRE cannot.[5] For example, with this particular deviation from FIRE, which is motivated and strongly supported by the data, the model can explain the Fama puzzle, can generate hump-shaped dynamics of exchange rates and a delayed overshooting in response to monetary policy shocks.

Literature Review

This paper relates to a number of different literatures. One is the literature documenting deviations from FIRE in survey forecasts of both macroeconomic and financial variables [see Coibion and Gorodnichenko (2015), Gennaioli, Ma, and Shleifer

[5]The beliefs of the speculators play a secondary role in the simulations to those of the financiers due to the small size of the exchange-traded futures market relative to the OTC market.

(2015), Coibion, Gorodnichenko, and Kamdar (2018), Bordalo et al. (2019), Nagel and Xu (2019)] and, specifically, for exchange rates [see Dominquez (1986), Froot and Frankel (1987; 1989), Ito (1990), Frankel and Chinn (2002; 2019)].[6]

We make two main contributions to this literature. First and foremost, this is the first paper, to our knowledge, establishing that average survey data exchange rate expectations are consistent with average positions, and hence beliefs, of the participants in one of the largest forex markets—OTC derivatives markets.[7] Second, we find that both individual and average survey expectations underweight past exchange rate movements relative to FIRE.[8] Importantly, this is a different deviation from FIRE than what has been previously documented in the literature, which focuses on showing the forecastability of forecast errors using forecast revisions (see, for example, Coibion and Gorodnichenko (2015) and Bordalo et al. (2019)].[9]

This paper also relates to the literature on momentum-driven trading strategies, which can be interpreted as a form of extrapolative beliefs [see Menkhoff et al. (2012), Moskowitz, Ooi, and Pedersen (2012), Brian, Ooi, and Pedersen (2013), Baltas and Kosowski (2013), Hurst, Ooi, and Pedersen (2017) and Burnside and Cerrato (2019) for empirical evidence regarding momentum strategies in currency markets]. Similarly

[6]For empirical papers that use survey data to study expected excess currency returns or deviations from uncovered interest rate parity, see Froot and Frankel (1989), Bussiere et al. (2018), Frankel and Chinn (2019), Kalemli-Ozcan and Varela (2019).

[7]Several other papers have also shown the ability of survey forecasts to explain economic behavior. Malmendier and Nagel (2016) show that households that have higher inflation expectations tend to enter into fixed-rate rather than floating-rate contracts. Using a survey of chief financial officers (CFOs), Gennaioli, Ma, and Shleifer (2015) show that CFO expectations explain firm investment decisions well and have explanatory power above and beyond Tobin's Q or discount rates. Greenwood and Shleifer (2014) provide one of the most exhaustive recent studies on the quality of survey data on stock return expectations. They show correlations between reported returns expectations and agents' portfolio and funding decisions. De Marco, Macchiavelli, and Valchev (2019) show that during the European sovereign debt crisis, banks' sovereign debt positions are higher when the bank expects the sovereign bond to have lower yields (higher prices) in the future. Giglio et al. (2019) survey retail investors regarding their views on stock and bond returns and show that their are reflected in their positions.

[8]The deviation from FIRE that we document is consistent with the finding in Froot and Frankel (1987) that survey data expectations are stabilizing.

[9]We show, using individual-level forecasts from *Consensus Economics*, that individuals overemphasize their own recent forecast revisions relative to FIRE when forecasting, as Bordalo et al. (2019) shows for various other macroeconomic and financial data series. However, we find that individuals also underweight past exchange rate changes. In average expectations, those relevant for aggregate exchange rate dynamics in the theory, the overweighting of forecast revisions disappears, but the underweighting of past exchange rate changes remains highly significant, which is why we focus only on the latter in this paper.

to our model, heterogeneous beliefs of equity traders that deviate from FIRE, including momentum-driven beliefs, are the main building block in Hong and Stein (1999). Moreover, the authors use the model to match a similar dynamic for equity returns that we examine for exchange rates—under-reaction to news followed by an overreaction which makes momentum strategies profitable in the short run. Unlike Hong and Stein (1999), in our model, the momentum traders play a secondary role for the exchange rate dynamics due to the small size of the futures market relative to the OTC market. As a result, the hump-shaped response of exchange rates to shocks in our model, and, hence, the short-run profitability of "momentum" strategies, is generated by the particular form of deviation from FIRE of the beliefs of the financiers, which are captured by the Consensus Economics forecasts.

Our model presents an alternative explanation to three long-standing puzzles in international finance: the Fama puzzle, the delayed overshooting puzzle and the hump-shaped dynamics of exchange rates.

The Fama puzzle dates back to Fama (1984), and relates to the observation that, in the short and medium run, the uncovered interest parity condition is violated in such a way that the currency of the country with the higher interest rate has positive excess returns on average (i.e. one would make money, on average, by being long that currency).[10] The delayed overshooting puzzle relates to the empirical observation that the exchange rate first appreciates over some period in response to contractionary monetary policy shocks before depreciating, hence the name delayed overshooting. It was first documented by Eichenbaum and Evans (1995).[11]

There are many theoretical papers on the delayed overshooting puzzle and the Fama puzzle or the forward premium puzzle, which is the stronger version of the Fama puzzle because it implies that the currency of the country with the higher interest rate appreciates in the future. One of the most closely related papers is Gourinchas and Tornell (2004) which relies on a different form of deviation from FIRE. Namely, they assume that investors incorrectly perceive the importance of transitory versus persistent interest rate shocks. Two other closely related papers are Bacchetta and van Win-

[10] See Hassan and Mano (2019) for more recent evidence on the puzzle and the references within.

[11] Other papers that reach a similar conclusion include Clarida and Gali (1994), Grilli and Roubini (1996) and Scholl and Uhlig (2008). More recently, Kim, Moon, and Velasco (2017) revisit the puzzle, identifying monetary policy shocks using sign restrictions, and find that during the post-Volcker period, delayed overshooting is still present but less pronounced than during the Volcker period.

coop (2010) and Bacchetta and van Wincoop (2018). They match the delayed overshooting dynamics and the forward premium puzzle using slow portfolio adjustment. Relative to these papers, we resolve the Fama puzzle by introducing a particular form of deviations from FIRE of exchange rate beliefs that is strongly supported in survey forecast data, which, in turn, are consistent with observed positions.

The hump-shaped dynamics of exchange rates is a related to, but different from, the delayed overshooting puzzle in the sense that it documents a hump-shaped response of the exchange rate with respect to its own disturbances in an AR process rather than specifically a monetary policy shock. Papers have tried to resolve the puzzle using models that have fairly rich production sides [see Steinsson (2008), Crucini, Shintani, and Tsurugac (2014), Candian (2019), among others].[12] In contrast to these papers, we model an endowment economy where hump-shaped dynamics are generated by the deviation from FIRE of the expectations of the main financial participants in foreign exchange rate markets.

An influential literature in international finance has emphasized the study of order flows to understand the behavior of exchange rates, mostly at shorter horizons, [see Evans and Lyons (2002; 2005b;a), Berger et al. (2008), Bacchetta and Van Wincoop (2006) and Burnside and Cerrato (2019), among others]. Unlike this literature which focuses on spot markets and uses confidential data from a single financial institution, we use publicly available aggregate data on futures markets to proxy for the aggregate net demand for derivatives of the broker-dealers' OTC clients. We also focus on both short and long horizons.

Finally, the model we build is related to a literature which examines the role of financial intermediaries in cross-country flows in a general equilibrium setting [see Gabaix and Maggiori (2015) and Itskhoki and Mukhin (2019), for example]. While these papers take an important step in incorporating richer descriptions of financial markets in general equilibrium international macroeconomic models, they do not model the largest forex market—the derivatives market. Most importantly, with the exception of noise traders, agents in these models are fully rational. By modeling derivative contracts, our model allows us to use measures, novel to this literature, of aggregate

[12] Other papers that present or review empirical evidence related to the hump-shaped dynamics of real exchange rates include Huizinga (1987), Rogoff (1996) and Cheung and Lai (2000). In Section 7, we also report statistics on hump-shaped dynamics for the set of nominal exchange rates in our sample.

positions in order to test the theory. Additionally, allowing for deviations from FIRE in the way that we do makes this class of models able to generate hump-shaped exchange rate dynamics.

2 Model

The model has three types of agents: a representative consumer in the home and foreign country, financiers and speculators. The foreign exchange market consists of three distinct markets: the OTC spot market, the OTC derivatives market and the exchange-traded derivatives market (the futures market). For simplicity, we assume that there is a single type of standardized derivative contract traded in both the OTC derivative and futures markets.[13] However, what differentiates the various markets is that the set of participants is exogenously assumed to differ in a way that captures realistic institutional details in the data.

In particular, consumers participate only in the spot currency market, where we assume that each country's consumer can trade only bonds denominated in their country's currency. This assumption captures the fact that, in reality, consumers cannot easily access derivatives markets due to the large fixed cost associated with trading derivatives – related to margin or trading volume requirements – and due to the lack of understanding of derivatives products by the average consumer. The assumption that consumers do not trade the foreign currency bond simplifies the exposition of the model by eliminating some trivial equilibria but can be easily relaxed.

The counterparty to both home and foreign consumers in the spot market are the financiers who can trade bonds denominated in either currency. The OTC derivatives market is accessible only to the financiers who trade with each other. The financiers' category, in practice, primarily consists of banks, hedge funds and asset managers but also large corporations.[14]

[13] Both the future and forward contracts involve an exchange of two currencies at some point in the future at a pre-agreed price. In practice, the forward contract is customizable in the sense that the forward price, contract maturity and margin requirements are trader-specific while the futures contract is standardized and all traders can access the same maturities for the same price and same margin requirements. Note that the two main instruments traded in the OTC derivatives market are forwards and forex swaps, where the forward leg of the forex swap is the same as a forward contract, and, hence, the two contracts are similar. [See 2019 BIS Triennial Central Bank Survey].

[14] The OTC clients of the broker-dealers, who are the market makers, include (non-dealer) banks, institutional investors, hedge funds, proprietary trading desks of large banks, the official sector (for example,

In reality, at the heart of the OTC derivatives market are the market makers (broker-dealers) who always have zero net positions. Their only job is to net out all the transactions in the OTC derivatives market and to hedge any remaining exposures in the futures market.[15] Since the broker-dealers are intermediaries with zero net exposure, they are not explicitly modelled. Instead, without loss of generality, the financiers are assumed to transact with each other in the OTC derivatives markets. The net demand from this OTC derivatives market determine the aggregate positions taken by financiers in the exchange-traded futures market, with the speculators as counterparties. In practice, the largest volume-wise group within the speculators group in the futures market are leveraged funds that specialize in futures trading such as commodity trading advisers (CTAs) and managed futures fund (MFFs). The main reasons why these funds prefer to trade futures rather than forwards is liquidity of the market, lack of counterparty risk and fast execution time which allows for high frequency trading. [See the discussion in Sections 4 and 6.1 for details and references.]

We also abstract from modelling the margin requirements and participation costs in any of these markets as we believe they are second order to the channels that we emphasize. Furthermore, foreign exchange markets for advanced economy currencies are very liquid and have low transaction costs. Finally, without loss of generality, we assume that the financiers and speculators pay all of their profits/losses to the home consumer. One can think of them as being part of the same household but with potentially different objective functions.

Next, we present the optimization problem of each type of agent.

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central banks), and non-financial corporations. [See 2019 BIS Triennial Central Bank Survey].

[15] Regulations require the presence of a strict "Chinese Wall", which prohibits broker-dealers from giving special treatment or disclosing information to the proprietary trading desk of the same parent institution, thus separating any proprietary trading from market-making activities of broker-dealers. Market-making divisions are also required to hedge any risk as quickly as possible. Given the highly liquid nature of currency futures markets, broker-dealer exposures to the major currencies that we consider remain unhedged for no more than a few minutes. Conversations with practitioners working at one of the largest foreign exchange broker-dealers, as of 2019, revealed that exposures to major currencies are hedged in about 30 seconds, on average. Thus, both in the real world and in our framework, broker-dealers simply net the foreign exchange demand in OTC derivatives markets from their clients and any remaining aggregate net exposure is immediately and fully passed along as net demand on currency futures exchanges.

2.1 Consumer's Problem

There is a measure one of consumers in each country. The representative home consumer chooses how much to consume, C_t, and the amount of money to hold, M_t to maximize the following utility:

$$\max_{C_t, M_t} \tilde{E}_0 \sum_{t=0}^{\infty} \Pi_{\tau=0}^{t} (\beta_\tau) \left(\ln C_t + \omega \ln \left(\frac{M_t}{P_t} \right) \right),$$

where $\tilde{E}_t$ can stand for either rational or subjective expectations and we assume that $\tilde{E}_t y_t = y_t$ for any random variable y_t. For tractability, we assume that the variance of any variable y_t from the perspective of all agents is given by $E_t(y_t - E_t(y_t))^2$ where E_t stands for full information rational expectations. β_τ is a time-varying discount rate such that $\beta_0 = 1$, P_t is the aggregate price index, and ω is a parameter regulating the marginal rate of substitution between consumption and real money balances. C_t is a Cobb-Douglas aggregate

$$C_t = \left(C_t^T\right)^{\gamma} \left(C_t^{NT}\right)^{1-\gamma},$$

where C_t^T and C_t^{NT} stand for the consumption of the tradable and non-tradable goods while γ captures the economy's openness.

The consumer's budget constraint is

$$M_t + \tilde{B}_t^{H,n} + P_t C_t \leq P_t^T Y_t^T + P_t^{NT} Y_t^{NT} + R_{t-n}^{H,n} \tilde{B}_{t-n}^{H,n} + \pi_t^F + \pi_t^S + M_t^s, \qquad [\chi_t \Pi_{\tau=0}^{t} (\beta_\tau)]$$

where M_t^s is the exogenous money supply that the consumer receives. The aggregate profits of the financier and speculators are given by π_t^F and π_t^S, respectively. The exogenous endowments of the tradable and non-tradable goods are Y_t^T and Y_t^{NT}, where P_t^T and P_t^{NT} are their respective prices. The consumer can save/borrow only in an n-period bond denominated in the home currency and the amount saved in period t is $\tilde{B}_t^{H,n}$, where the period t interest rate is $R_t^{H,n}$. For simplicity, we assume no secondary market for the n-period bond. If $n = 1$, the setup collapses to the standard setup with a one-period bond. The Lagrange multipliers are in square brackets. Finally, we can define net exports as $NX_t = P_t^T \left(Y_t^T - C_t^T\right)$ and P_t is an aggregate consumption price index implicitly defined such that $P_t C_t = P_t^T C_t^T + P_t^{NT} C_t^{NT}$.

The first-order conditions for optimality are given by:

$$\begin{aligned} M_t &: \omega \frac{1}{M_t} = \chi_t, \\ C_t &: \frac{1}{C_t} = \chi_t P_t, \\ \tilde{B}_t^{H,n} &: \chi_t = R_t^{H,n} \tilde{E}_t \left(\Pi_{\tau=t+1}^{t+n} (\beta_\tau) \chi_{t+n} \right). \end{aligned}$$

For simplicity, and to focus only on exchange rate expectations, we assume that $M_t = M_t^s = \omega$ which implies $\chi_t = 1$. As a result, the home risk-free interest rate is

$$R_t^{H,n} = \frac{1}{\tilde{E}_t \Pi_{\tau=t+1}^{t+n} (\beta_\tau)}.$$

We assume that $\tilde{E}_t \Pi_{\tau=t+1}^{t+n} (\beta_\tau)$ is time varying and, later on, model an exogenous process for the interest rate $R_t^{H,n}$. This is a reduced form way of introducing interest rate shocks in the model which can be easily relaxed at the cost of greater complexity.

We solve for the demand for non-tradable and tradable consumption goods and derive the aggregate price index following the standard cost-minimization approach where the consumer chooses $\{C_t^T, C_t^{NT}\}$ to minimize total expenditures $P_t C_t = P_t^T C_t^T + P_t^{NT} C_t^{NT}$ given the definition that $C_t = \left(C_t^T\right)^\gamma \left(C_t^{NT}\right)^{1-\gamma}$. The first-order conditions of this optimization problem imply

$$P_t C_t = \frac{1}{\gamma} P_t^T C_t^T = \frac{1}{1-\gamma} P_t^{NT} C_t^{NT} = 1.$$

Thus, γ is the fraction of total nominal consumption spent on the tradable good. Using the properties of the Cobb-Douglas aggregator, we solve for the aggregate price level:

$$P_t = \frac{\left(P_t^T\right)^\gamma \left(P_t^{NT}\right)^{1-\gamma}}{\gamma^\gamma (1-\gamma)^{(1-\gamma)}}.$$

The representative foreign consumer's problem is symmetric with the exception that the foreign consumer does not receive any profits from the financiers and the speculators. This asymmetry will be irrelevant when we solve the linearized version of the model as the profits will become second order. Foreign variables are denoted with a * and the foreign bond risk free interest rate is $R_t^{F,n}$. Finally, the real exchange rate is

defined as:

$$RER_t = \frac{S_t P_t}{P_t^*} = (S_t)^{1-\gamma} \left(\frac{Y_t^{*NT}}{Y_t^{NT}} \right)^{1-\gamma},$$

where S_t is the nominal exchange rate defined as units of the foreign currency per one unit of the home currency. The second equality follows from assuming that purchasing power parity (PPP) holds for the tradable good, $\frac{S_t P_t^T}{P_t^{*T}} = 1$, and from using the market clearing conditions of the non-tradable sectors in both countries: $C_t^{NT} = Y_t^{NT}$ and $C_t^{*NT} = Y_t^{*NT}$. If $\gamma = 1$, then the economy has no non-tradable goods in equilibrium and, as is well-known in the literature, this implies that $RER_t = 1$.

2.2 Financier's Problem

In this section we solve the optimization problem of financier i. There is a measure one of financiers. Each financier lives for n periods where she invests in period t and terminates the investment in $t+n$. While, in reality, investors have heterogeneous investment horizons, we allow for a single investment horizon in the model for tractability. The financier has no start-up capital and trades domestic and foreign bonds and a standardized foreign exchange derivative contract in either the OTC or exchange-traded derivatives markets. The period t budget constraint of a financier i is

$$B_t^{H,n,i} + \frac{B_t^{F,n,i}}{S_t} \leq 0,$$

and her period $t+n$ profits are given by

$$\pi_{t+n}^{F,i} = \left(\frac{1}{S_{t+n}} - \frac{1}{F_t^n} \right) X_t^{n,i} + \left(\frac{R_t^{F,n}}{S_{t+n}} - \frac{R_t^{H,n}}{S_t} \right) B_t^{F,n,i},$$

where F_t^n is the futures/forward price (exchange rate) defined as units of the foreign currency per one unit of the home currency.

The equation above is interpreted as follows. In period t, the financier chooses to be long $X_t^{n,i}$ units of the foreign currency using the derivative contract (i.e., she agrees to buy $X_t^{n,i}$ units of the foreign currency in $t+n$ at the pre-agreed price of F_t^n). Therefore, in $t+n$ she needs to pay $\frac{X_t^{n,i}}{F_t^n}$ units of the home currency. Then, she can sell the $X_t^{n,i}$ units of the foreign currency in exchange for home currency at the spot rate prevailing in period $t+n$, which implies a profit/loss from trading derivatives of $\left(\frac{1}{S_{t+n}} - \frac{1}{F_t^n} \right) X_t^{n,i}$. If $S_{t+n} < F_t^n$, then the foreign currency appreciates relative to the

forward/futures price, which implies positive profits. Note that this derivatives trade requires no upfront capital since we've assumed zero transaction costs.

The financier can also choose to be long $B_t^{F,n,i}$ units of the foreign-currency bond, financed by borrowing $\frac{B_t^{F,n,i}}{S_t}$ units of the home currency bond. The profits of this transaction in terms of home currency are given by: $\left(\frac{R_t^{F,n}}{S_{t+n}} - \frac{R_t^{H,n}}{S_t}\right) B_t^{F,n,i}$. Financier i has mean variance preferences over nominal profits:[16]

$$\max_{X_t^{n,i}, B_t^{F,n,i}} \tilde{E}_t^{F,i} \pi_{t+n}^{F,i} - \frac{\rho}{2} Var_t \left(\pi_{t+n}^{F,i}\right). \tag{1}$$

The parameter ρ captures how much the financier dislikes volatile profits and can be interpreted as a measure of risk aversion. $\tilde{E}_t^{F,i}$ is the financier's i expectations operator where we assume that $\tilde{E}_t^{F,i} y_t = y_t$ for any random variable y_t. The first-order conditions imply:

$$\begin{aligned}
X_t^{n,i} : \tilde{E}_t^{F,i} \left[\frac{1}{S_{t+n}} - \frac{1}{F_t^n}\right] - \rho Var_t \left(\frac{1}{S_{t+n}} - \frac{1}{F_t^n}\right) X_t^{n,i} \\
-\rho Cov \left(\frac{R_t^{F,n}}{S_{t+n}} - \frac{R_t^{H,n}}{S_t}, \frac{1}{S_{t+n}} - \frac{1}{F_t^n}\right) B_t^{F,n,i} = 0 \\
B_t^{F,n,i} : \tilde{E}_t^{F,i} \left[\frac{R_t^{F,n}}{S_{t+n}} - \frac{R_t^{H,n}}{S_t}\right] - \rho Var_t \left(\frac{R_t^{F,n}}{S_{t+n}} - \frac{R_t^{H,n}}{S_t}\right) B_t^{F,n,i} \\
-\rho Cov \left(\frac{R_t^{F,n}}{S_{t+n}} - \frac{R_t^{H,n}}{S_t}, \frac{1}{S_{t+n}} - \frac{1}{F_t^n}\right) X_t^{n,i} = 0.
\end{aligned}$$

Combining these first-order conditions gives the CIP condition:[17]

$$\frac{1}{F_t^n} = \frac{R_t^{H,n}}{R_t^{F,n} S_t},$$

[16] The fact that both the financiers and speculators have different preferences and potentially different beliefs from the home consumers captures well the reality of how financial markets operate due to principal agent problems, asymmetric information, individual biases of portfolio managers or the necessity to simplify and standardize the operations of financial institutions.

[17] There is a recent literature documenting CIP deviations during and after the global financial crisis [see Du, Tepper, and Verdelhan (2018), for example]. In empirical results not reported here, we found that allowing for CIP deviations in the regressions in no way changes the results or adds to the narrative, which is why we chose to not explicitly model CIP deviations.

and the combined foreign currency demand:

$$R_t^{F,n} B_t^{F,n,i} + X_t^{n,i} = \frac{\tilde{E}_t^{F,i}\left[\frac{1}{S_{t+n}} - \frac{R_t^{H,n}}{R_t^{F,n} S_t}\right]}{\sigma_{n,s}^2 \rho},$$

where $\sigma_{n,s}^2 \equiv Var_t\left(\frac{1}{S_{t+n}}\right)$.

It is the case that, from the perspective of the financiers, $B_t^{F,n,i}$ and $X_t^{n,i}$ are not uniquely determined; only $R_t^{F,n} B_t^{F,n,i} + X_t^{n,i}$ is. To see why, notice that when CIP holds, one can synthetically generate any zero capital long-short position in domestic and foreign bonds only using derivative contracts. For example, the home currency return from being long one unit of the foreign bond, financed by borrowing $\frac{1}{S_t}$ units of the domestic bond, is $\frac{R_t^{F,n}}{S_{t+n}} - \frac{R_t^{H,n}}{S_t}$. If CIP holds, the investor can obtain the same return by being long $R_t^{F,n}$ units of the foreign currency using a derivative position of $X_t^{n,i} = R_t^{F,n}$.

Aggregating the demand schedules for all financiers gives:

$$R_t^{F,n} B_t^{F,n} + X_t^{n} = \frac{\tilde{E}_t^{F}\left[\frac{1}{S_{t+n}} - \frac{R_t^{H,n}}{R_t^{F,n} S_t}\right]}{\sigma_{n,s}^2 \rho},$$

where $X_t^n = \int_0^1 X_t^{n,i} di$, $B_t^{F,n} = \int_0^1 B_t^{F,n,i} di$ and $\tilde{E}_t^F\left[\frac{1}{S_{t+n}}\right] \equiv \int_0^1 \tilde{E}_t^{F,i}\left[\frac{1}{S_{t+n}}\right] di$. As only the financiers can trade OTC derivative contracts, the interpretation of X_t^n is the net aggregate demand from financiers for futures contracts.

2.3 Speculator's Problem

Assume that there is a measure m of speculators that can trade only in the foreign exchange futures market. A speculator born in period t chooses his investment in period t and dies in period $t+n$. The profits of the representative speculator are:

$$\pi_{t+n}^S = \left(\frac{1}{S_{t+n}} - \frac{1}{F_t^n}\right) X_t^{S,n},$$

where $X_t^{S,n}$ is the speculator's long position in the foreign currency via derivative contracts. Assume that he has mean variance preferences which imply:

$$X_t^{S,n} = \frac{\tilde{E}_t^S \left[\frac{1}{S_{t+n}} - \frac{1}{F_t^n} \right]}{\rho \sigma_{n,s}^2} + \mu \varepsilon_t^{\mu}. \tag{2}$$

where $\mu e^{\varepsilon_t^{\mu}}$ reflects a noise trading component of demand and $\tilde{E}_t^S$ is the expectations operator of the representative speculator, where we assume that $\tilde{E}_t^S y_t = y_t$ for any random variable y_t.

2.4 Market Clearing Conditions and System of Equations

First, we start by presenting the market-clearing conditions for the home and foreign-currency denominated bond markets and the derivatives market:

$$B_t^{H,n} + \tilde{B}_t^{H,n} = 0; \quad B_t^{F,n} + \tilde{B}_t^{*F,n} = 0; \quad X_t^n + m X_t^{S,n} = 0. \tag{3}$$

When combined with the financiers' budget constraint, $B_t^{H,n} = -\frac{B_t^{F,n}}{S_t}$, these conditions imply that $S_t \tilde{B}_t^{H,n} + \tilde{B}_t^{*F,n} = 0$.

Market-clearing conditions for the goods markets are:

$$Y_t^{NT} = C_t^{NT}; \quad Y_t^{*NT} = C_t^{*NT}; \quad C_t^T - Y_t^T + C_t^{*T} - Y_t^{*T} = 0.$$

Combining all of the first-order conditions, market-clearing conditions, and budget constraints leaves us with the following system of equations that fully characterizes the model and determine equilibrium values for $\{X_t^{S,n}, X_t^n, \tilde{B}_t^{H,n}, S_t\}$:

$$NX_t = P_t^T \left(Y_t^T - C_t^T \right) = \gamma \frac{Y_t^T}{Y_t^T + Y_t^{*T}} \left(1 + \frac{1}{S_t} \right) - \gamma = \tilde{B}_t^{H,n} - \frac{S_{t-n}}{S_t} R_{t-n}^{F,n} \tilde{B}_{t-n}^{H,n}, \tag{4}$$

$$\tilde{E}_t^F \frac{1}{S_{t+n}} - \frac{R_t^{H,n}}{R_t^{F,n} S_t} = \rho \sigma_{n,s}^2 X_t^n + \rho \sigma_{n,s}^2 R_t^{F,n} S_t \tilde{B}_t^{H,n}, \tag{5}$$

$$\tilde{E}_t^S \frac{1}{S_{t+n}} - \frac{R_t^{H,n}}{R_t^{F,n} S_t} = \rho \sigma_{n,s}^2 X_t^{S,n} - \rho \sigma_{n,s}^2 \mu \varepsilon_t^{\mu}, \tag{6}$$

$$X_t^n + m X_t^{S,n} = 0. \tag{7}$$

The full system of equations can be found in the Appendix in Section B. Equation (4) is the aggregate budget constraint of the home country, which determines $\tilde{B}_t^{H,n}$.

Equations (5) and (6) determine X_t^n and $X_t^{S,n}$. They imply that the uncovered interest rate parity (UIP) conditions for both the average financier and speculator, defined with respect to their subjective beliefs, don't hold as long as these investors are not risk neutral, $\rho \neq 0$. The nominal exchange rate is determined by the market clearing condition of the derivatives market, equation (7), that is, by equating supply and demand in the derivatives market.

We solve the model using a first-order Taylor approximation. We log-linearize variables that are strictly positive and linearize the ones that can take negative values, $\{X_t^n, \tilde{B}_t^{H,n}\}$, around a deterministic steady state. Small letters denote logs while small letters with a hat denote deviations of the level of the variable from its steady state value.[18] More details on the model solution, including the steady state, are presented in the Online Appendix and in Section 7.

3 Testable Implications: Expectations, Positions and Exchange Rates

In relative terms, the futures market is orders of magnitude smaller than the OTC market (about two percent of the volume in the OTC market). This is why understanding what drives the beliefs of financiers, the OTC market participants, is of first-order importance for the aggregate dynamics of exchange rates. For these reasons, this section focuses on testing the Euler equation of the average financier given by equation (5).

Having said that, the futures market presents an unique way to measure the net derivatives positions in the OTC market and hence the average beliefs of the OTC foreign exchange market participants.

The approximated equation (5) becomes:

$$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \rho \sigma_{n,s}^2 X_t^n + \frac{\rho \sigma_{n,s}^2}{\bar{\beta}} B_t^{F,n}, \tag{8}$$

where $\tilde{r}_t^n = r_t^{F,n} - r_t^{H,n}$ and $X_t^n = \hat{x}_t^n$. Also we used the fact that from the linearized market clearing conditions for bonds, it is also the case that the savings of the home consumers in the home currency bond are equal to the foreign currency bond holdings of the financiers, $\tilde{B}_t^{H,n} = \hat{\tilde{b}}_t^{H,n} = \hat{b}_t^{F,n} = B_t^{F,n}$. First, we test whether either an average survey-based forecast or full information rational expectations are consistent with the

[18] The results are similar if we linearize all the variables in the model instead. However, the mapping between the empirical results and the model in that case is less direct.

average expectations of the financiers, as reflected in their financial positions.

To do so, we focus on the following regressions based on equation (8). The first regression tests whether the financiers' average expectations are consistent with an average survey-based forecast and is given by:

$$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \alpha^1 + \beta^1 X_t + \varepsilon_t^1, \tag{9}$$

where $\tilde{E}_t^F s_{t+n}$ will be proxied by an average survey-based forecast. In all of the regression specifications we drop the super-script n from X_t as the futures data is not broken down by investment horizon. When we refer to n in the regression results it will be to indicate that we use expectations of the exchange rate n months ahead and the yields of n-month bonds. If survey forecasts are consistent with the beliefs of the financiers, then we should find $\beta^1 > 0$, implying that an expectation of positive returns in period $t + n$ from being long the foreign currency and short the home currency is correlated with a larger long position in the foreign currency via derivatives.

In the following regression specification we also control for B_t^F, where, once again, we drop the n super-script as the proxy for debt holdings that we use does not have a maturity breakdown. The regression we estimate is:

$$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^1 + \bar{\beta}^1 X_t + \bar{\gamma}^1 B_t^F + \bar{\varepsilon}_t^1. \tag{10}$$

The theory predicts that the coefficient $\bar{\gamma}^1$ is positive, which implies that if the financiers, on average, expect the foreign currency to appreciate, they would also hold more of the foreign currency bond, controlling for their average open interest positions in the foreign currency in the futures market.

The following regression tests whether the financiers' average expectations are consistent with FIRE. We use the fact that average expectations consistent with FIRE, denoted by E_t, imply:

$$s_{t+n} = E_t s_{t+n} + \epsilon_{t+n},$$

where ϵ_{t+n} is a surprise component that is orthogonal to any period t variable. Therefore, we can replace $\tilde{E}_t^F s_{t+n} = E_t s_{t+n} = s_{t+n} - \epsilon_{t+n}$ in equation (8) to derive the regression specification:

$$s_t - s_{t+n} + \tilde{r}_t^n = \alpha^2 + \beta^2 X_t + \varepsilon_{t+n}^2. \tag{11}$$

If the financiers' expectations are consistent with FIRE, then we should see $\beta^2 > 0$. Parallel to 10, we also estimate the following regression specification:

$$s_t - s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^2 + \bar{\beta}^2 X_t + \bar{\gamma}^2 B_t^F + \bar{\varepsilon}_2^1, \tag{12}$$

where the theory predicts that $\bar{\gamma}^2$ is positive.

In order to derive a relationship between realized exchange rate changes and observable endogenous variables, using the market clearing conditions for futures and bonds, we re-write the linearized equation (5) as:

$$s_t - s_{t-j} = -\rho\sigma_s^2(mX_t^{S,n} - mX_{t-j}^{S,n}) + \tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n} - (\tilde{r}_t^n - \tilde{r}_{t-j}^n) - \rho\sigma_s^2 \frac{1}{\bar{\beta}} \left(\tilde{B}_t^{*F,n} - \tilde{B}_{t-j}^{*F,n} \right),$$

which implies the following regression specification:

$$\begin{aligned} s_t - s_{t-j} &= \alpha^3 + \beta^3 \left(mX_t^S - mX_{t-j}^S \right) + \psi^3 \left(\tilde{r}_t^n - \tilde{r}_{t-j}^n \right) \\ &\quad + \lambda^3 \left(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n} \right) + \varepsilon_t^3. \end{aligned} \tag{13}$$

This regression tests how well the model can explain realized exchange rate changes. We will estimate a number of variations of this regression. The first one will contain only X_t^S on the right hand side (i.e., we assume $\psi^3 = \lambda^3 = 0$) while the second regression will include all the regressors. The reason for reporting the constrained regressions is, first, because the frequency of the variables differ and, second, it helps us to assess the additional explanatory power provided by each additional variable. The theory predicts that $\beta^3 < 0$, implying that an increase in speculators' net foreign currency exposure via futures will appreciate the foreign currency contemporaneously. It also predicts that $\psi^3 < 0$, implying that an increase in the foreign interest rate relative to the home interest rate also appreciates the foreign currency contemporaneously, which is consistent with the conventional wisdom in financial markets. Finally, the model predicts $\lambda^3 > 0$, implying that if the financiers' increase their expectations of the future value of the foreign currency, $\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n} > 0$, it will appreciate contemporaneously, $s_t - s_{t-j} > 0$.

The regression specification which controls for the foreign currency debt holdings

of the foreign consumers is given by:

$$\begin{aligned} s_t - s_{t-j} &= \bar{\alpha}^3 + \bar{\beta}^3 \left(mX_t^S - mX_{t-j}^S \right) + \bar{\psi}^3 \left(\tilde{r}_t^n - \tilde{r}_{t-j}^n \right) \\ &\quad + \bar{\lambda}^3 \left(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n} \right) + \bar{\gamma}_t^3 \left(\tilde{B}_t^{*F} - \tilde{B}_{t-j}^{*F} \right) + \bar{\varepsilon}_t^3. \end{aligned} \tag{14}$$

The theory predicts that $\bar{\gamma}_t^3 < 0$, implying that an increased demand for the foreign currency bond by the foreign consumers will appreciate the foreign currency.

Next we discuss why the foreign currency appreciates when the speculators' demand for foreign currency futures or the foreign consumers' demand for foreign currency bonds increases rather than an equivalent increase in the financiers' demand for the foreign currency. The reason why this is the case is because 1) both the derivatives and bonds market are zero net supply markets and 2) we are controlling in regression (14) for changes in the financiers' average exchange rate expectations and the interest rate differential. The fact that the futures and the bonds markets are in zero net supply inevitably means that an increase in the demand for an asset of one of the agents would decrease the demand for the same asset of the other agents participating in this market. More specifically, more foreign currency futures demanded by the speculators means less foreign currency futures demanded by the financiers. Similarly, more foreign currency bonds demanded by the foreign consumers means less foreign currency bonds demanded by the financiers. The reason why it's the other agents' demand but not the financiers' demand for a currency that correlates positively with the currency's price (the exchange rate) is because we are controlling in (14) for changes in the financiers' forecast of the exchange rate and changes of the interest rate differential. If between two periods these two variables don't change, the financiers wouldn't want to change their demand for the same price, s. As a result, if the speculators increase their foreign currency futures demand, for example, due to an increase in ε_t^{μ}, the foreign currency has to appreciate to clear the market. More specifically, the appreciation of the foreign currency will decrease the expected excess return from being long the foreign currency from the perspective of the financiers between the two periods. This will make the financiers want to hold fewer of the foreign currency futures contracts, thus, accommodating the higher demand for foreign currency futures contracts by the speculators. The same argument holds with respect to the foreign currency debt markets where the counter-party to the financiers are the foreign consumers.

4 Data

Before discussing the empirical results, we discuss how we measure the variables in the previous section's regression specifications. We measure the speculators' aggregate derivatives positions, which is the negative of the aggregate financiers' derivatives positions, $X_t^n = -mX_t^{S,n}$, using data from the U.S. Commodity Futures Trading Commission (CFTC) Commitment of Traders (COT) reports.

In its legacy reports, which have data starting in the early 1990s, CFTC classifies traders in futures markets as hedgers and speculators where the hedgers' positions are equal to the negative of the speculators' positions. CFTC classifies hedgers and speculators at a trader level rather than at an institutional level which is important given the multitude of activities that large financial institutions engage in. Moreover, a trader can be classified as a hedger for one commodity and a speculator for another commodity. According to CFTC, a hedger is defined as a trader who *"engaged in business activities hedged by the use of the futures or option markets"*.[19]

Since 2006 CFTC has also published a different break down of the futures market participants in their Traders in Financial Futures (TFF) reports. In the TFF reports the market participants are divided into Dealer/Intermediary, Asset Manager/Institutional, Leveraged Funds, and Other Reportables. The CFTC website describes the four categories as follows: *"The TFF report divides the financial futures market participants into the "sell side" and "buy side." This traditional functional division of financial market participants focuses on their respective roles in the broader marketplace, not whether they are buyers or sellers of futures/option contracts. The category called "dealer/intermediary," for instance, represents sell-side participants. Typically, these are dealers and intermediaries that earn commissions on selling financial products, capturing bid/offer spreads and otherwise accommodating clients. The remaining three categories ("asset manager/institutional;" "leveraged funds;" and "other re-*

[19]Only positions above a certain threshold are reported in the COT reports. If reported in the legacy reports, the trade is classified as "commercial" if it fulfils the description provided in the text and is classified as "non-commercial" if it does not. There is also a "non-reporting" category, which consists of small transactions, and is calculated as a residual by subtracting the reported transactions from the total transactions, which are also observed. The "commercial" category is also referred to as the "hedgers" category. The "speculators" category is constructed as the sum of the "non-commercial" category – known as large speculators – and the "non-reporting" category – known as small speculators. The two are highly correlated with a correlation of 0.62. All the results are robust to using the large speculators only.

portables") represent the buy-side participants. These are essentially clients of the sell-side participants who use the markets to invest, hedge, manage risk, speculate or change the term structure or duration of their assets. ...[Dealers] tend to have matched books or offset their risk across markets and clients. Futures contracts are part of the pricing and balancing of risk associated with the products they sell and their activities. These include large banks (US and non-US) and dealers in securities, swaps and other derivatives."[20]

Based on the dealers' description as market makers with zero net exposure at any point of time, we interpret the aggregate dealers' currency futures positions in the CFTC data as equal to the aggregate derivatives positions of their OTC clients, who, in the model, correspond to the financiers. As a result, by interpreting the publicly available futures data in this novel way, we can measure the *net/average* OTC derivatives positions of the participants in the largest forex market—the OTC derivatives market. Finally, since the futures market is a zero net supply market, dealers' net currency futures open interest positions are equal to the negative of speculators' net currency futures open interest positions.

The "hedgers" category in the legacy reports is almost entirely represented by the "dealers" category in the TFF reports. The correlation between the two series is between 0.92 and 0.96, depending on the currency, and Figure A1 in the Online Appendix plots the positions of these two categories and shows that they are almost one and the same series. As a result, we use the hedgers' positions from the legacy reports as a measure of X_t for a longer sample, but the results are robust to using the dealers' positions.

This observation also implies that the "speculators" category is approximately equal to the sum of the "buy-side" categories in the TFF reports. Next, we examine which one of the TFF "buy-side" categories is the largest and correlates the most with the speculators' net positions from the legacy reports. Figure A2 in the Online Appendix plots the net positions of the speculators from the legacy reports and the net positions of the Asset Manager, Leveraged Funds, and Other Reportables from the TFF reports.

[20]Of course, the use of futures by the dealers as a hedge to their OTC operations is not perfect as futures contracts are standardized and therefore different from the myriad of OTC derivatives contracts that broker-dealers tailor for their clients. However, according to market makers, the futures market is still used for hedging purposes given its liquidity and the desire of market makers to quickly hedge their risk.

It is clear that the Leveraged Funds is the largest and most important sub-category. Moreover, the correlation between the net speculators' positions and the net positions of the Leveraged Funds is 0.94 across all currency pairs. The corresponding correlation is only 0.03 with the net positions of the Asset Managers and -0.38 with the net positions of the Other Reportables category.

The CFTC COT reports detail the open interest at the end of every Tuesday and are made publicly available on the Friday of the same week. The CFTC data we use is for seven currencies against the dollar: AUD, CAD, CHF, EUR (DEM prior to 1999), GBP, JPY, and NZD. We use the "futures only" series as they have a longer history than the "futures and options" series. However, given the small amount of options traded on exchanges, the two series are almost identical. The positions are in billions of the non-US currency.

Next, we discuss how we proxy the exchange rate expectations of the financiers. When we test whether the financiers have expectations consistent with FIRE (regression (11)), we use realized excess returns. The data sources for yields/interest rate and exchange rates used to calculate the excess returns are listed in Section A in the Online Appendix. For the regression specification which uses survey data based expectations, (regression (9)) and, we use the average forecast from *Consensus Economics*.

There are a number of reasons why we believe that the *Consensus Economics* forecasts are a good proxy for the average exchange rate expectations of the financiers. The companies reporting to *Consensus Economics* include primarily large financial institutions (for a sub-sample see Section A in the Online Appendix) and usually are done by the research departments in those institutions. The OTC forex market participants are themselves the large financial institutions or clients of those who, as such, often have access to these forecasts. In practice, the OTC market participants would most likely use the average *Consensus Economics* forecast as one of the input variables in their forecasting models. If their forecast is approximately the average *Consensus Economics* forecast plus an idiosyncratic component, then the average expectation of the financiers will be exactly equal to the average *Consensus Economics* forecast.[21]

We obtain monthly measures of the *Consensus Economics* forecast for horizons 1,

[21] Notice that we will not be able to identify whether the financiers use the average *Consensus Economics* forecast (or the forecasts of the large banks that fill out the *Consensus Economics* survey) when forming their own belief regarding future exchange rate movements or they happen to use the same models as the participants in the *Consensus Economics* survey.

3, 12, and 24 months in the future. We also obtain individual level forecasts for a subset of the forecasters, mainly comprised of large financial institutions, reporting to *Consensus Economics*. This study is the first to use the individual level *Consensus Economics* exchange rate forecasts for research purposes.

Regarding the timing of the expectations, the *Consensus Economics* survey is sent out once per month on a Monday with the results typically being published on the following Thursday. When we estimate regressions (9) and (13) using monthly data, we assume that when trading on Tuesday, the participants in the futures market use expectations from the most recent *Consensus Economics* publication released on the previous Thursday. When we estimate the regressions using weekly data, we assume that the financiers' expectations in period t of the exchange rate n periods ahead are given by the most recently published *Consensus Economics* forecast of the expected exchange rate n periods ahead, regardless of whether the Consensus Expectations release was the previous week on Thursday or two or three weeks ago. This assumption is required as we do not have weekly Consensus Economics survey forecasts.

Since open interest from the CFTC is not broken down by maturity, we will run regressions with total CFTC positions and various horizons, one at a time, of either survey expectations or realized returns. As the most liquid futures contract is the 3-month contract and the second most liquid contract is the 6-month contract, we focus on results for the 3- and 12-month horizons ($n = 3, 12$) in the main text and present results for other horizons in the Online Appendix (note that we don't have a 6-month exchange rate forecast in the data). Moreover, our data samples tend to be the longest for the 3- and 12-month horizons across all currency pairs due to yields/interest rate availability. Our data starts in the early-1990s for all currency pairs besides NZD/USD which starts in the mid-2000s. In most of our regressions, the data will be weekly or monthly, though we consider changes in variables over longer periods (j).

Finally, we proxy the average foreign currency bond holdings of the financiers (which is the negative of the foreign currency bond holdings of the foreign consumers) using BIS data. Unlike the average foreign currency futures positions of the financiers, which we can measure precisely, finding a good proxy for the financiers' average foreign currency bond holdings is more challenging. For tractability purposes in the model we assumed that the financiers live in the home country (the US). However, financial institutions are global. Moreover, in an attempt to minimize taxes paid, US

financial companies wire the majority of their transactions through offshores (see BIS data). For these reasons, using positions from the US into the 7 countries we study will be incorrect. Therefore, we calculate the aggregate financiers' foreign currency bond holdings as the net foreign currency positions of all reporting BIS countries with respect to the 7 counter-party countries we study. The first proxy we consider is bilateral net positions of all reported foreign currency instruments held by all financial institutions in the reporting countries with respect to all entities in a given counterparty country. The second proxy focuses only on foreign currency interbank loans. The two series are plotted in Figure A3 in the Online Appendix. More details on the data, including sample ranges and how we construct the variables, can be found in Section A in the Online Appendix.

5 Empirical Results

In this section, we report the results from regressions (9)–(13). While we use the unscaled financiers' net open interest positions, as implied by the model, all the results remain very similar if we scale financiers' positions by total open interest. For regressions with overlapping observations, we report Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for autocorrelated errors and we use heteroskedasticity consistent standard errors otherwise.

First, we focus on the weekly regressions, which assess whether the average financiers' expectations are more consistent with the Consensus Economics average expectations or with rational expectations. To account for potential structural breaks due to the crisis, we split the sample into before and after February 7, 2007.[22]

Table 1 reports the pre- and post-crisis weekly estimates of regression (9) for investment horizons $n \in \{3, 12\}$ while results for $n \in \{1, 24\}$ can be found in Table A1 of the Online Appendix. The results point unambiguously to the fact that the financiers' average expectations are consistent with the *Consensus Economics* average survey data forecasts. The estimates of β^1 are always positive and are very statistically significant for all subsamples, currency pairs and investment horizons n.

[22] On this date HSBC reports losses due to sub-prime mortgages.

Table 1: Positions and Expected Excess Returns – Weekly Frequency

(A) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	2.354^{***}	1.809^{***}	2.255^{***}	0.540^{***}	2.790^{***}	0.016^{***}	22.886^{***}
	(0.168)	(0.090)	(0.128)	(0.086)	(0.215)	(0.001)	(2.822)
# of Obs	710	746	465	711	740	741	52
Adj. R^2	0.16	0.44	0.40	0.03	0.23	0.26	0.63

(B) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.892^{***}	0.752^{***}	2.748^{***}	0.247^{***}	0.841^{***}	0.006^{***}	4.594^{***}
	(0.094)	(0.072)	(0.215)	(0.031)	(0.151)	(0.001)	(0.444)
# of Obs	586	587	206	587	585	587	587
Adj. R^2	0.08	0.12	0.37	0.07	0.04	0.15	0.11

(C) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.028^{***}	0.504^{***}	0.620^{***}	0.421^{***}	0.775^{***}	0.004^{***}	6.968^{***}
	(0.054)	(0.041)	(0.039)	(0.031)	(0.053)	(0.000)	(0.581)
# of Obs	710	746	470	494	746	746	52
Adj. R^2	0.22	0.29	0.31	0.15	0.17	0.14	0.77

(D) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.174^{***}	0.301^{***}	0.701^{***}	0.067^{***}	0.620^{***}	0.002^{***}	1.596^{***}
	(0.026)	(0.023)	(0.042)	(0.009)	(0.041)	(0.000)	(0.170)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.05	0.23	0.26	0.06	0.28	0.28	0.14

Note: All of the regressions are estimated at weekly frequency. Estimates of β^1 from the regression $s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{3, 12\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

In terms of robustness, the estimates are robust to using monthly frequency instead of weekly [see Tables A21 and A22 in the Online Appendix.] The results also do not

change if we estimate the regressions after the end of the crisis (dated as June 1, 2009) [tables available upon request] or if we use the expected exchange rate change rather than the expected excess return on the left hand side (that is, the results aren't driven by the interest rate differential) [see Tables A11 and A12 in the Online Appendix for the weekly and Tables A33 and A34 for the monthly regressions].

Next we present the results from regression (10). The weekly regression results are reported in Tables A2-A5 while the monthly results can be found in Tables A23-A26 in the Online Appendix. Even after controlling for B_t^F, $\bar{\beta}^1$ remains positive and highly significant. However, the estimates of $\bar{\gamma}^1$ take both positive and negative values, depending on the currency and the period, while the theory predicts they should be positive and, unlike the estimates of $\bar{\beta}^1$, they are often insignificant, particularly, at monthly frequency.

Table 2 reports the pre- and post-crisis weekly estimates of regression (11) for investment horizons $n \in \{3, 12\}$ while the remaining horizons can be found in Table A6 in the Online Appendix. The monthly regression estimates are reported in Tables A27 and A28 in the Online Appendix.[23]

[23]The results for the regression specifications where the left hand side variable is the realized exchange rate change can be found in Tables A35 and A36 for the monthly regressions and Tables A13 and A14 for the weekly regressions.

Table 2: Positions and Realized Excess Returns – Weekly Frequency

(A) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-2.143^{**}	-0.599	0.720	-1.029^{**}	0.156	0.001	-21.455^{**}
	(0.881)	(0.654)	(0.543)	(0.450)	(0.732)	(0.004)	(8.803)
# of Obs	711	747	465	711	740	742	54
Adj. R^2	0.05	0.01	0.01	0.03	-0.00	-0.00	0.29

(B) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.004	0.105	0.668	-0.290	0.179	-0.003	2.590
	(0.496)	(0.436)	(0.809)	(0.208)	(0.741)	(0.003)	(2.522)
# of Obs	586	587	206	587	585	587	587
Adj. R^2	-0.00	-0.00	0.00	0.02	-0.00	0.01	0.01

(C) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-2.022^{**}	-0.448	-0.082	-1.215^{**}	-0.146	-0.001	-0.070
	(0.865)	(0.433)	(0.384)	(0.492)	(0.477)	(0.003)	(1.800)
# of Obs	711	747	470	494	747	747	54
Adj. R^2	0.13	0.03	-0.00	0.18	-0.00	0.00	-0.02

(D) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.119	-0.039	0.823^{*}	0.031	0.915^{*}	-0.004^{*}	3.061^{*}
	(0.376)	(0.297)	(0.426)	(0.138)	(0.471)	(0.002)	(1.749)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.00	-0.00	0.07	-0.00	0.06	0.07	0.05

Note: All of the regressions are estimated at weekly frequency. Estimates of β^1 from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{3, 12\}$ months. Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for overlapping observations. The realized excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

The estimates of β^2 tend to be almost always insignificant for all currency pairs, subsamples and investment horizons, n. In the very few cases when they are signifi-

cant, they are negative more often than not. The results are similar when we control for B_t^F [See Tables A7-A10 for the weekly regressions while the monthly results can be found in Tables A29-A32.] Both $\bar{\beta}^2$ and $\bar{\gamma}^2$ tend to be insignificant.

This result, combined with the highly significant and positive estimates of β^1, leads us to conclude that the financiers' average expectations, implied by our model, are consistent with the *Consensus Economics* average expectations and not consistent with FIRE.[24]

After establishing that the *Consensus Economics* average exchange rate expectations are consistent with the financiers' average expectations, we can reverse regression (9) to assess the extent to which these survey expectations alone can explain variation in financiers' net futures market positions by regressing

$$X_t = \tilde{\alpha}^1 + \tilde{\beta}^1 \left(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n \right) + \tilde{\varepsilon}_t^1. \tag{15}$$

Tables A15 and A16 in the Online Appendix report the pre- and post-crisis weekly estimates of regression (15) for investment horizons $n \in \{1, 3, 12, 24\}$.[25] The adjusted R^2 averaged across pairs and horizons is 30 and 19 percent in the pre- and post-crisis periods, respectively.

We interpret the fact that $\tilde{\beta}^1$ is positive and significant as supportive of the fact that the financiers' positions are driven by their beliefs, as proxied by the average *Consensus Economics* forecast. In order to be able to claim causality, in the regressions we use *Consensus Economics* survey expectations that are available before the positions are undertaken. One might be concerned with our interpretation of the results as causal if the positions were autocorrelated and the participants in the *Consensus Economics* survey used lagged CFTC positions when forming their expectations. If that was the case, controlling for lagged positions in regression (15) should make $\tilde{\beta}^1$ insignificant. The results from this alternative regression specification are reported in Tables A17 – A20 of the Online Appendix. One can see that $\tilde{\beta}^1$ remains positive and highly significant when we additionally control for lags of X_t in regression (15), which alleviates the concerns stated above.

[24] Section 6 explores the particular form of deviation from FIRE that is consistent with the *Consensus Economics* exchange rate expectations, while Section 7 examines what the deviation from FIRE implies for aggregate exchange rate dynamics in our model.

[25] The equivalent monthly results can be found in Tables A37 and A38.

Next, we examine the results from regression (13). First, we estimate the constrained regression of exchange rate changes on only changes of the financiers' position (i.e. $\psi^3 = \lambda^3 = 0$). Figure A4 plots β^3, two-standard-error bands around β^3, and the adjusted R^2. On the x-axis, we vary the number of weeks over which we calculate these changes (i.e. we vary j). The maximum number of weeks that we consider is 100. From Panel (A) of Figure A4, one can see that the estimated coefficient β^3 is always negative and significantly different from zero for any j and currency pair as the theory predicts. The adjusted R^2 is higher for shorter horizons and lower for longer horizons. This result is consistent with results from the order flow literature estimated using spot transactions data instead of futures' positions. The highest adjusted R^2s are for six-week changes, where the average adjusted R^2 across currency pairs is 34 percent. As the horizon increases, the adjusted R^2 falls to 16 percent, on average, for 100-week changes.

To gauge how much the relationship between exchange rate changes and changes in the financiers' average futures positions varies over time, Figures A5 and A6 plot the coefficients, β^3, two-standard-error bands, and adjusted R^2 estimated over 100-week rolling windows for $j \in \{4, 12\}$. For four-week changes, the estimated β^3 coefficient is negative and significant for all currency pairs and rolling windows with the exception of late-2004 to early-2006 for DEM/EUR during which the point estimate is negative but the lower bound of the confidence band grazes the zero line. For 12-week changes, β^3 tends to be almost always negative and significant with a few more exceptions, such as the crisis period for the GBP.

Allowing for structural breaks in β^3 by estimating rolling regressions increases the adjusted R^2s substantially relative to the full sample regressions. More precisely, the average adjusted R^2, across all currencies and estimation windows, is 46 percent for the four-week change regressions and 44 percent for the 12-week change regressions. The adjusted R^2s range from 4 to 79 percent for the four-week change regressions and 0 to 85 percent for 12-week changes.

Additionally, we perform a pseudo "out-of-sample" exercise. We compare the mean squared forecast error (MSFE) from the rolling regression above to the MSFE from the random walk (RW) model. We use the realized positions when calculating the MSFE while the regression coefficients are estimated out-of-sample. The results and details of the estimation are presented in Figure A7 in the Online Appendix. One can clearly

see that for $j \in \{4, 12\}$ the MSFE from the model we estimate is lower than the MSFE from the RW model for every currency pair.

In the next set of results, we add controls for the remaining explanatory variables implied by the model in regression (13). Tables 3 and 4 report the results for quarterly and annual changes. We also report results of regressions with only the financiers' positions on the right hand side for the same sample periods to evaluate the increase in explanatory power gained by adding the change in interest rate differentials and the change in exchange rate expectations. Results for the remaining horizons can be found in Tables A39–A40 in the Online Appendix. For brevity, we only report results for the same investment and change horizons ($n = j$).

Table 3: Testing the Supply-Demand Equation: Quarterly Changes

(A) Only Positions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.853^{***}	-0.502^{***}	-0.793^{***}	-0.387^{***}	-1.027^{***}	-0.005^{***}	-2.346^{***}
	(0.106)	(0.053)	(0.062)	(0.039)	(0.108)	(0.000)	(0.448)
# of Obs	295	302	130	294	300	300	143
Adj. R^2	0.28	0.30	0.53	0.23	0.28	0.30	0.25

(B) With All Variables, $n = 3$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.629^{***}	-0.385^{***}	-0.663^{***}	-0.332^{***}	-0.731^{***}	-0.004^{***}	-1.684^{***}
	(0.073)	(0.048)	(0.050)	(0.034)	(0.077)	(0.000)	(0.328)
$\Delta\tilde{r}_t^n$	-0.681^{*}	0.087	0.915^{*}	-0.529	-1.190^{***}	-0.653	-0.584
	(0.378)	(0.233)	(0.476)	(0.563)	(0.399)	(0.552)	(0.615)
$\Delta\tilde{E}_t^F s_{t+n}$	0.657^{***}	0.660^{***}	0.544^{***}	0.668^{***}	0.618^{***}	0.713^{***}	0.653^{***}
	(0.054)	(0.071)	(0.052)	(0.042)	(0.062)	(0.046)	(0.076)
# of Obs	295	302	130	294	300	300	143
Adj. R^2	0.72	0.66	0.81	0.69	0.71	0.76	0.69

Note: Estimates of $\{\beta^3, \psi^3, \lambda^3\}$ from the regression $s_t - s_{t-j} = \alpha^3 + \beta^3(mX_t^S - mX_{t-j}^S) + \psi^3(\tilde{r}_t^n - \tilde{r}_{t-j}^n) + \lambda^3(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n}) + \varepsilon_t^3$ for $n = j = 3$ with or without restricting $\psi^3 = \lambda^3 = 0$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses. The realized exchange rate changes and the changes in expectations are multiplied by 100 (in percentage points) while the interest rate differential changes are in percentages and annualized. X_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency.

Table 4: Testing the Supply-Demand Equation: Annual Changes

(A) Only Positions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-1.152^{***}	-0.618^{***}	-0.972^{***}	-0.285^{***}	-1.164^{***}	-0.006^{***}	-5.284^{***}
	(0.300)	(0.163)	(0.124)	(0.070)	(0.167)	(0.001)	(1.045)
# of Obs	268	270	210	216	269	273	115
Adj. R^2	0.18	0.15	0.25	0.10	0.21	0.17	0.27

(B) With All Variables, $n = 12$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.469^{***}	-0.288^{***}	-0.660^{***}	-0.146^{***}	-0.534^{***}	-0.003^{***}	-2.964^{***}
	(0.136)	(0.074)	(0.082)	(0.025)	(0.067)	(0.001)	(0.369)
$\Delta\tilde{r}_t^n$	-0.880^{***}	-0.261	-1.183^{***}	-1.818^{***}	-1.384^{***}	-0.966^{*}	-1.773^{***}
	(0.333)	(0.207)	(0.408)	(0.409)	(0.234)	(0.558)	(0.668)
$\Delta\tilde{E}_t^F s_{t+n}$	0.995^{***}	1.074^{***}	0.980^{***}	1.038^{***}	0.968^{***}	0.898^{***}	0.840^{***}
	(0.049)	(0.049)	(0.073)	(0.066)	(0.070)	(0.062)	(0.067)
# of Obs	268	270	210	216	269	273	115
Adj. R^2	0.89	0.90	0.82	0.86	0.87	0.83	0.91

Note: Estimates of $\{\beta^3, \psi^3, \lambda^3\}$ from the regression $s_t - s_{t-j} = \alpha^3 + \beta^3(mX_t^S - mX_{t-j}^S) + \psi^3(\tilde{r}_t^n - \tilde{r}_{t-j}^n) + \lambda^3(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n}) + \varepsilon_t^3$ for $n = j = 12$ with or without restricting $\psi^3 = \lambda^3 = 0$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses. The realized exchange rate changes and the changes in expectations are multiplied by 100 (in percentage points) while the interest rate differential changes are in percentages and annualized. X_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency.

For all change and investment horizons, we estimate $\beta^3 < 0$ and $\lambda^3 > 0$ with high degrees of statistical significance, as predicted by the theory. In almost all cases, we also estimate $\psi^3 < 0$ as the theory would suggest, but ψ^3 tends to only be significantly different from zero for investment horizons $n \in \{12, 24\}$. Focusing on one-month changes, the improvement in terms of explanatory power is from an average adjusted R^2 of 31 percent when the only explanatory variable is the change in the financiers' positions to 41 percent when we include all theory-implied explanatory variables. When considering exchange rate changes over longer periods, the improvement in adjusted R^2 between the unconstrained and constrained regressions is much greater. For the quarterly change regression with an investment horizon of $n = 3$, the adjusted R^2, on

average, improves from 31 percent to 72 percent. For the annual change regression with an investment horizon of $n = 12$, the adjusted R^2, on average, improves from 19 to 87 percent while for the biannual change regression with an investment horizon of $n = 24$, the improvement is from 19 to 85 percent.

Next we consider the results from regression specification (14), which controls for changes in the foreign currency bond holdings of the foreign consumers. The results are reported in Tables A41-A44 in the Online Appendix. $\bar{\beta}^3$ and $\bar{\lambda}^3$ still have the right sign and are very significant and $\bar{\psi}^3$ has the right sign and still tends to be more significant for longer horizons. Interestingly, the coefficient in front of the $\bar{\gamma}_t^3$ tends to be negative for most currency pairs as the theory predicts but much less significant than $\bar{\beta}^3$.

In summary, the variables implied by the model explain about 45 percent of the variation for monthly exchange rate changes. The explanatory power increases significantly for longer-horizon changes with the model-implied variables explaining about 85 percent of the variation in annual or biannual exchange rate changes. We interpret these results as strong evidence in support of the supply and demand exchange rate modelling framework that we use.

6 Deviations from FIRE

This section addresses the question of how the financiers and speculators form expectations and the particular forms of deviation from FIRE that we observe in the data.

6.1 Speculators' Beliefs

First, we start with the speculators who participate only in the futures market. As we discussed in Section 4, the speculators category from the CFTC legacy reports is approximately the same as the leveraged funds category in the CFTC TFF reports. The CFTC describes the leveraged funds category as follows: "These are typically hedge funds and various types of money managers, including registered commodity trading advisors (CTAs); registered commodity pool operators (CPOs) or unregistered funds identified by CFTC. The strategies may involve taking outright positions or arbitrage within and across markets. The traders may be engaged in managing and conducting proprietary futures trading and trading on behalf of speculative clients."

One of the most popular trading strategies among these types of leveraged funds

is the currency "momentum" trading strategy, where positions are determined based on past currency movements. More precisely, this strategy is based on a belief that a currency will appreciate in the future if it has appreciated in the recent past. For example, Baltas and Kosowski (2013) and Brian, Ooi, and Pedersen (2013) show that the returns of managed futures funds and commodity trading advisors can be explained almost entirely by the "momentum" trading strategy.

Here we take a different approach where we test whether the speculators' positions are consistent with the "momentum" trading strategy. We do so by estimating the following regression:

$$X_t^S = \alpha^s + \beta_{30}^s \Delta_{30}^{-1} s_{t-1} + \beta_{90}^s \Delta_{90}^{-1} s_{t-1} + \beta_{120}^s \Delta_{120}^{-1} s_{t-1} + \beta_{365}^s \Delta_{365}^{-1} s_{t-1} + \beta_3^i \tilde{r}_{t-1}^3 + \beta_{12}^i \tilde{r}_{t-1}^{12} + \varepsilon_t^s, \tag{16}$$

where $\Delta_k^{-1} s_{t-1} = s_{t-k-1} - s_{t-1}$ stands for a k-day change of the nominal exchange rate such that if $\Delta_k^{-1} s_{t-1} > 0$ then the foreign currency has appreciated over the last k days. By controlling for the interest rate differentials $\tilde{r}_{t-1}^3$ and $\tilde{r}_{t-1}^{12}$ and estimating both a constrained regression with $\beta_3^i = \beta_{12}^i = 0$ and the unconstrained regression, we evaluate the relative importance of "carry trade" investment strategies relative to the momentum strategies. If the momentum investment strategy is an important component of the speculators' demand, then we would expect that $\beta_k^s > 0$ and the adjusted R^2 of the constrained regression to be large. If th"carry trade" strategy is an important determinant of the speculators' demand, then we would expect $\beta_k^i > 0$ along with a sizable improvement in the adjusted R^2 between the constrained and the unconstrained regression. The reason why in addition to the "momentum" trading strategy we also test whether the "carry trade" can explain the speculators' futures positions is because studies such as Brunnermeier, Nagel, and Pedersen (2009) and Curcuru, Vega, and Hoek (2010) have suggested using the CFTC speculators category as one way to measure "carry trade" dynamics.

The results are reported in Table A45 in the Appendix. Focusing first on the estimated coefficients, β_k^s is almost always positive and highly significant while β_k^i is only sometimes positive and often not significant. Comparing the adjusted R^2s between the constrained and unconstrained regressions, the average adjusted R^2 across currency pairs for the constrained regressions is 44 percent and 51 percent for the unconstrained regressions. However, the improvement in adjusted R^2s is often with a β_k^i estimate

that is of the wrong sign and significant so it cannot be attributed to the carry trade strategy. The results clearly point to the fact that the "momentum" strategy has played a dominant role in the demand, and implicitly the beliefs, of the speculators in the futures market.

Next, we decompose the speculators' demand using estimates from regression (16) by defining:

$$Momentum = \beta^s_{30}\Delta^{-1}_{30}s_{t-1} + \beta^s_{90}\Delta^{-1}_{90}s_{t-1} + \beta^s_{120}\Delta^{-1}_{120}s_{t-1} + \beta^s_{365}\Delta^{-1}_{365}s_{t-1},$$

$$Carry = \beta^i_3\tilde{r}^3_{t-1} + \beta^i_{12}\tilde{r}^{12}_{t-1},$$

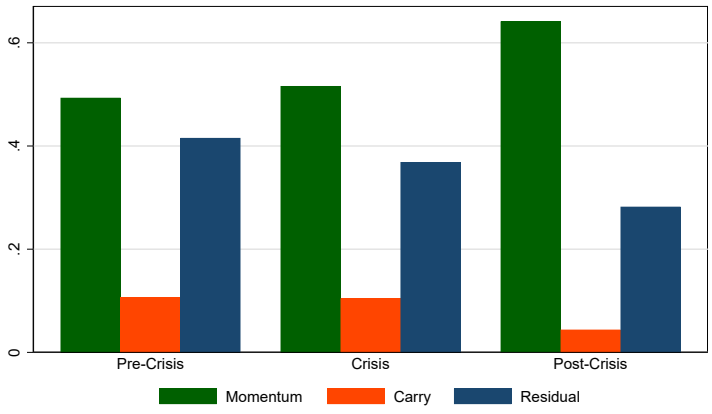
$$Residual = \varepsilon^s_t,$$

and decomposing the variance of the speculators' demand, X^S, as follows:

$$1 = \frac{Cov\left(Momentum, X^S\right)}{Var\left(X^S\right)} + \frac{Cov\left(Carry, X^S\right)}{Var\left(X^S\right)} + \frac{Cov\left(Residual, X^S\right)}{Var\left(X^S\right)}.$$

We report the results estimated over three subperiods: before, during, and after the crisis. The scaled covariances averaged across currencies are reported in Figure 1. Figure A8 in the Online Appendix reports the same decompositions by currency.

Figure 1: Fraction of Variation in Positions Explained by Trading Strategies (Average Across Currency Pairs)



It is the case that for all three periods, the momentum strategy accounts for 50 percent or more of the variation of X^S_t on average, with the number being higher than 60 percent during the post-crisis period. These results are consistently seen across

currencies with the momentum strategy explaining a very large fraction of speculators' demand for all pairs.

Therefore, based on this empirical evidence, we model the expectations of the speculators as:

$$\tilde{E}_t^S \left(f_t^n - s_{t+n} \right) = \mu^s \left(s_{t-1} - s_t \right), \tag{17}$$

where $\mu^s > 0$. This way of modeling the beliefs, and hence the demand, of momentum-driven speculators is similar to Hong and Stein (1999). The residual unexplained component of the speculators' demand is captured in the model with a noise trading component of speculative demand denoted by $\mu \varepsilon_t^{\mu}$ which we assume is white noise [see equation (2)].

6.2 Financiers' Beliefs

The subjective beliefs of the average financier have to be able to rationalize the results from regressions (9) and (11) and also the fact that the speculators' beliefs are consistent with the "momentum" investment strategy, captured by equation (17). Assume that the average financiers' expectations can be expressed as the sum of rational expectations, $E_t s_{t+n}$, and deviations from FIRE component, κ_t^n:

$$\tilde{E}_t^F s_{t+n} = E_t s_{t+n} + \kappa_t^n. \tag{18}$$

Re-writing the regression coefficients of regressions (9) and (11), β^1 and β^2, and substituting in equation (3), which implies $E_t s_{t+n} = s_{t+n} - \epsilon_{t+n}$, and equation (18), we can decompose β^1 as follows:

$$\beta^1 = \frac{Cov(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n, X_t)}{Var(X_t)} = \frac{Cov(s_t - (s_{t+n} - \epsilon_{t+n} + \kappa_t^n) + \tilde{r}_t^n, X_t)}{Var(X_t)} = \beta^2 - \frac{Cov(\kappa_t^n, X_t)}{Var(X_t)}. \tag{19}$$

Since we estimated β^1 to be positive and significant while β^2 was negative for most currency pairs and horizons, then it has to be the case that

$$Cov(\kappa_t^n, X_t)/Var(X_t) < 0. \tag{20}$$

Combining the log linearized demand function of the speculators, equation (2), the market clearing condition for futures, equation (3), and equation (17), which captures

the speculators' beliefs, we obtain:

$$X_t = -mX_t^S = m\frac{\mu^s\left(s_t - s_{t-1}\right)}{\rho\sigma_{n,s}^2} + m\mu\varepsilon_t^{\mu}. \tag{21}$$

In practice, the covariance between the exchange rate change and the noise trading component of the speculative demand, ε_t^{μ}, will be close to zero as the futures market is very small relative to the OTC market and, hence, exogenous shocks originating in the futures market will not affect the exchange rate dynamics. We show that formally in the next section where we simulate the model. As a result, inequality (20) will be satisfied only if κ_t^n is a function of $(s_t - s_{t-1})$. Therefore, the functional form that we postulate for $\tilde{E}_t^F s_{t+n}$ (i.e., for the *Consensus Economics* average exchange rate expectations) is:

$$\tilde{E}_t^F s_{t+n} = \begin{cases} E_t s_{t+n} + \eta^n\left(s_t - s_{t-1}\right) & \text{for} \quad n \geq 1 \\ s_{t+n} \quad \text{for} \quad n = 0 \end{cases} \tag{22}$$

where $\tilde{E}_t^F$ denotes the consensus forecast and $\kappa_t^n = \eta^n\left(s_t - s_{t-1}\right)$. η^n will have to be negative in order for inequality (20) to be satisfied since $Cov(\kappa_t^n, X_t) \approx \frac{\eta^n m\mu^s}{\rho\sigma_{n,s}^2} Var\left(s_t - s_{t-1}\right)$. This result implies that the particular form of deviation from FIRE of the financiers' beliefs is such that the financiers, on average, believe that past appreciations of the currency will lead to larger future depreciations/smaller future appreciations relative to full information rational expectations; i.e. the financiers underweight exchange rate changes over the last month relative to expectations under FIRE. Notice that if the survey expectations exhibited no deviation from FIRE, then it would have to be the case that $\eta^n = 0$.

Next we estimate η^n. Rewriting the equation above implies:

$$\tilde{E}_t^F s_{t+n} - s_{t+n} = \eta^n\left(s_t - s_{t-1}\right) - \epsilon_{t+n},$$

which corresponds to the following regression specification:

$$\tilde{E}_t^F s_{t+n} - s_{t+n} = \alpha_n^4 + \beta_n^4\left(s_t - s_{t-1}\right) + \varepsilon_{t+n}^4, \tag{23}$$

Being the forecast error under FIRE, $-\epsilon_{t+n} = E_t s_{t+n} - s_{t+n}$ is orthogonal to period t information which implies that β_n^4 is an unbiased estimate of η^n.

Table 5 reports the results of regression (23) for $n \in \{3, 12\}$ while results for $n \in \{1, 24\}$ can be found in Table A46. As expected, the estimates indicate that η^n is negative and very significant for almost all currency pairs for $n \in \{1, 3, 12, 24\}$. This implies that the financiers underweight exchange rate changes over the last month relative to expectations under FIRE.

Table 5: Predicting Exchange Rate Surprises With Exchange Rate Change over the Past Month

(A) 3M Ahead ($n = 3$)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	-0.649^{***}	-0.670^{***}	-0.357^{***}	-0.430^{***}	-0.430^{***}	-0.601^{***}	-0.707^{***}
	(0.140)	(0.140)	(0.112)	(0.110)	(0.141)	(0.122)	(0.161)
# of Obs	334	334	334	334	334	334	334
Adj. R^2	0.08	0.09	0.03	0.03	0.04	0.07	0.09

(B) 12M Ahead ($n = 12$)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	-0.553	-0.592^{**}	-0.338^{*}	-0.467^{*}	-0.308^{*}	-0.768^{***}	-0.673^{**}
	(0.345)	(0.245)	(0.198)	(0.265)	(0.157)	(0.167)	(0.318)
# of Obs	264	264	264	264	264	264	264
Adj. R^2	0.01	0.02	0.01	0.01	0.00	0.04	0.02

Note: Estimates of β_n^4 from the regression $\tilde{E}_t^F s_{t+n} - s_{t+n} = \alpha_n^4 + \beta_n^4(s_t - s_{t-1}) + \varepsilon_{t+n}^4$. Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for overlapping observations.

To put our results into perspective, we compare our results to the existing macroeconomic literature that studies deviations from FIRE in terms of predictability of forecast errors by forecast revisions by adding revisions of exchange rate expectations to regression (23):

$$\tilde{E}_t^F s_{t+n} - s_{t+n} = \alpha_n^5 + \beta_n^5 (s_t - s_{t-1}) + \psi_n^5 \left(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t+n} \right) + \varepsilon_{t+n}^5. \quad (24)$$

Notice that we can only construct forecast revisions for forecast horizons $n \in \{1, 3, 12\}$. A number of influential papers studying forecasts of various other macroeconomic and financial variables have found that regressing forecast errors only on forecast revisions (i.e. imposing $\beta_n^5 = 0$ in the regression above) would produce a coefficient such that $\psi_n^5 < 0$ [see Coibion and Gorodnichenko (2015) and Bordalo et al. (2019)]. For some variables Bordalo et al. (2019) find that ψ_n^5 is close to zero or insignificant. Such an es-

timate implies a deviation from FIRE because the forecast errors of fully informed and rational agents should not be predictable by variables observed at time t and neither should be the average forecast error.

Tables 6 and 7 report the results from regression (24) with the alternate assumption that $\psi_n^5 = 0$ and the unconstrained regression with both terms, respectively, for $n \in \{3, 12\}$, while results for $n = 1$ are in Table A47 in the Online Appendix.

Table 6: Exchange Rate Surprises, 3M Ahead

(A) Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}_t^F s_{t+3} - \tilde{E}_{t-9}^F s_{t+3}$	0.018	-0.002	-0.006	0.031	0.191^{***}	-0.019	-0.035
	(0.082)	(0.069)	(0.077)	(0.065)	(0.065)	(0.060)	(0.079)
# of Obs	334	334	334	334	334	334	334
Adj. R^2	-0.00	-0.00	-0.00	-0.00	0.07	-0.00	-0.00

(B) Monthly Exchange Rate Change and Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}_t^F s_{t+3} - \tilde{E}_{t-9}^F s_{t+3}$	0.050	0.032	0.013	0.058	0.220^{***}	0.009	0.005
	(0.079)	(0.065)	(0.076)	(0.066)	(0.059)	(0.059)	(0.075)
$s_t - s_{t-1}$	-0.675^{***}	-0.684^{***}	-0.362^{***}	-0.460^{***}	-0.532^{***}	-0.605^{***}	-0.710^{***}
	(0.148)	(0.143)	(0.113)	(0.118)	(0.137)	(0.126)	(0.156)
# of Obs	334	334	334	334	334	334	334
Adj. R^2	0.08	0.09	0.02	0.04	0.13	0.07	0.09

Note: Estimates of $\{\beta_n^5, \psi_n^5\}$ from the regression $\tilde{E}_t^F s_{t+n} - s_{t+n} = \alpha_n^5 + \beta_n^5(s_t - s_{t-1}) + \psi_n^5(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t+n}) + \varepsilon_{t+n}^5$ for $n = 3$ with or without restricting $\beta_n^5 = 0$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses.

Table 7: Exchange Rate Surprises, 12M Ahead

(A) Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}^F_t s_{t+12} - \tilde{E}^F_{t-12} s_{t+12}$	-0.040	-0.168	-0.042	0.017	0.116	0.109	-0.014
	(0.196)	(0.205)	(0.167)	(0.170)	(0.152)	(0.173)	(0.203)
# of Obs	264	264	264	264	264	264	264
Adj. R^2	-0.00	0.02	-0.00	-0.00	0.01	0.00	-0.00

(B) Monthly Exchange Rate Change and Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}^F_t s_{t+12} - \tilde{E}^F_{t-12} s_{t+12}$	-0.020	-0.143	-0.031	0.034	0.128	0.135	0.012
	(0.190)	(0.200)	(0.163)	(0.165)	(0.151)	(0.170)	(0.196)
$s_t - s_{t-1}$	-0.546^{*}	-0.525^{***}	-0.332^{*}	-0.479^{*}	-0.351^{**}	-0.812^{***}	-0.677^{**}
	(0.305)	(0.184)	(0.191)	(0.256)	(0.158)	(0.168)	(0.277)
# of Obs	264	264	264	264	264	264	264
Adj. R^2	0.01	0.03	0.00	0.01	0.01	0.05	0.02

Note: Estimates of $\{\beta^5_n, \psi^5_n\}$ from the regression $\tilde{E}^F_t s_{t+n} - s_{t+n} = \alpha^5_n + \beta^5_n(s_t - s_{t-1}) + \psi^5_n(\tilde{E}^F_t s_{t+n} - \tilde{E}^F_{t-j} s_{t+n}) + \varepsilon^5_{t+n}$ for $n = 12$ with or without restricting $\beta^5_n = 0$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses.

In the case where we don't control for $s_t - s_{t-1}$, there is evidence for $\psi^5_n < 0$ and deviation from FIRE with respect to forecast revisions for the $n = 1$ forecast horizon. However, the estimates tend to be almost always insignificant for $n = 3$ and $n = 12$ and often positive for these horizons. Once we control for $s_t - s_{t-1}$, ψ^5_n is insignificant for almost all currency pairs and n, while β^5_n remains negative and highly significant.

The consensus, rather than the individual-level, exchange rate expectation is the relevant variable for the aggregate exchange rate dynamics, which is why we have so far focused only on the average expectation. However, in order to compare our results to the existing literature, we also estimate regressions (23) and (24) using individual-level forecasts and allowing for individual-level fixed effects (results are reported in Tables A48–A51).

We find that, at an individual level, β^5_n is still negative and very significant while ψ^5_n is positive and significant. This implies that, at an individual level, the expectations are such that the forecaster underweights past exchange rate changes but she overweights her own forecast revision. The fact that the individual forecaster over-weights her own forecast revision is consistent with the diagnostic expectations theory by Bordalo et al.

(2019) and so is the fact that there is no such overweighting with the consensus forecast data, if one were also to assume incomplete information. The striking difference between the consensus and individual-level regressions with respect to the estimates for ψ_n^5 can be potentially explained with the fact that, on average, for exchange rates, the forecast bias with respect to individual-level exchange rate forecast revisions cancels out.[26]

This paper does not provide a deep microfoundation for the deviations from FIRE with respect to past exchange rate change movements. While doing so would be interesting, such a microfoundation is left for future work as it would result in a significantly less tractable model and will distract from the main message of the paper.

Finally, to better understand what underlies the survey data expectations, we report the following regressions for both the average *Consensus Economics* exchange rate change expectations and the individual-level exchange rate change expectations:

$$s_t - \tilde{E}_t^F s_{t+n} = \alpha_n^6 + \beta_n^6 (s_t - s_{t-1}) + \psi_n^6 rer_t + \varepsilon_{n,t}^6, \quad \text{where} \quad rer_t \equiv s_t + p_t - p_t^*. \tag{25}$$

Notice that according to equation (22), the correct regression would include $s_t - E_t s_{t+n}$ instead of rer_t. However, we don't observe $E_t s_{t+n}$ or have an intuitive closed-form solution for it. When we simulate the model in the next section we find that the correlation between these two variables for our preferred parametrization is about 35 percent for $n = 1$ and about 90 percent for $n = 12$. Therefore, if the belief formation process of the financiers is indeed consistent with equation (22), we will find that the rer_t will be able to better explain long-term rather than short-term exchange rate consensus forecasts.

We report both the constrained regression results, where $\psi_n^6 = 0$, and the unconstrained ones. The results are reported in Tables 8 and 9 for $n \in \{3, 12\}$ and Tables A52 and A53 for $n \in \{1, 24\}$ for the average exchange rate *Consensus Economics* forecasts while Tables A54–A57 present panel regressions that use individual-level *Consensus Economics* exchange rate forecasts.

[26] As our sample with individual-level forecasts is only a sub-sample of the forecasts used to calculate the consensus expectations, we confirm that the same conclusions remain if we use the average of the forecasts in our individual-level instead of the published consensus forecast.

Table 8: Exchange Rate Expectations, 3M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.489^{***}	0.520^{***}	0.454^{***}	0.411^{***}	0.347^{***}	0.479^{***}	0.485^{***}
	(0.046)	(0.033)	(0.047)	(0.042)	(0.052)	(0.036)	(0.051)
# of Obs	342	342	342	342	342	342	342
Adj. R^2	0.29	0.48	0.29	0.25	0.34	0.38	0.29

(B) Monthly Exchange Rate Change and RER

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.449^{***}	0.499^{***}	0.393^{***}	0.370^{***}	0.352^{***}	0.469^{***}	0.445^{***}
	(0.040)	(0.032)	(0.036)	(0.035)	(0.054)	(0.036)	(0.047)
RER_t	0.076^{***}	0.041^{***}	0.118^{***}	0.075^{***}	-0.007	0.015^{***}	0.078^{***}
	(0.005)	(0.003)	(0.008)	(0.008)	(0.009)	(0.005)	(0.006)
# of Obs	342	342	342	342	342	342	342
Adj. R^2	0.56	0.60	0.57	0.40	0.34	0.39	0.52

Note: Estimates of $\{\beta_n^6, \psi_n^6\}$ from regression $s_t - \tilde{E}_t^F s_{t+n} = \alpha_n^6 + \beta_n^6 (s_t - s_{t-1}) + \psi_n^6 rer_t + \varepsilon_{n,t}^6$ for $n = 3$ with or without restricting $\psi_n^6 = 0$. Heteroskedasticity consistent standard errors in parentheses.

Table 9: Exchange Rate Expectations, 12M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.557^{***}	0.568^{***}	0.553^{***}	0.504^{***}	0.372^{***}	0.598^{***}	0.526^{***}
	(0.089)	(0.056)	(0.100)	(0.105)	(0.094)	(0.071)	(0.098)
# of Obs	342	342	342	342	342	342	342
Adj. R^2	0.11	0.21	0.11	0.09	0.13	0.16	0.09

(B) Monthly Exchange Rate Change and RER

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.442^{***}	0.501^{***}	0.384^{***}	0.367^{***}	0.300^{***}	0.559^{***}	0.415^{***}
	(0.051)	(0.037)	(0.059)	(0.068)	(0.083)	(0.069)	(0.061)
RER_t	0.219^{***}	0.134^{***}	0.326^{***}	0.252^{***}	0.119^{***}	0.059^{***}	0.220^{***}
	(0.009)	(0.006)	(0.015)	(0.015)	(0.017)	(0.013)	(0.011)
# of Obs	342	342	342	342	342	342	342
Adj. R^2	0.73	0.70	0.65	0.52	0.31	0.20	0.59

Note: Estimates of $\{\beta_n^6, \psi_n^6\}$ from regression $s_t - \tilde{E}_t^F s_{t+n} = \alpha_n^6 + \beta_n^6 (s_t - s_{t-1}) + \psi_n^6 rer_t + \varepsilon_{n,t}^6$ for $n = 12$ with or without restricting $\psi_n^6 = 0$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses.

Both β_n^6 and ψ_n^6 are positive and very significant. $\beta_n^6 > 0$ implies that if the foreign currency has *depreciated* against the dollar between periods $t-1$ and t, then the forecaster believes that it will *appreciate* between periods t and $t+n$. This is consistent with the fact that the financiers are the counterparty to the speculators in the futures market and as such should have opposite views to the "momentum" strategy in order to observe trade in the futures market. The fact that $\psi_n^6 > 0$ implies that if the foreign currency is too weak relative to the predictions of PPP, which is captured by $rer_t > 0$, then the forecaster expects that the foreign currency will appreciate in the future.

The exchange rate change between periods $t-1$ and t and the period t real exchange rate explain the vast majority of the variation of the consensus and individual level expected exchange rate changes. An important observation is that for shorter horizon forecasts ($n \in \{1, 3\}$), $s_t - s_{t-1}$ carries almost all of the explanatory power while for longer horizon forecasts ($n \in \{12, 24\}$), rer_t is the more important explanatory variable. This latter result is consistent with the empirical evidence that PPP holds in

the long run and is a good forecaster of exchange rates, which appears to be taken into account by the forecasters taking part in the *Consensus Economics* survey.[27] It is also consistent with our finding, based on model simulations, that $s_t - E_t s_{t+n}$ and rer_t are more correlated for larger n and, therefore, provides further support for the model that we develop and the functional form of subjective financiers' beliefs that we assume.

7 Model Simulation and Exchange Rate Dynamics

After establishing that the survey forecast data is consistent with an under-weighting of past exchange rate changes, we now show how this property can help to resolve, at least qualitatively, a number of empirical exchange rate puzzles such as the Fama puzzle, the hump-shaped dynamics of exchange rates and the delayed overshooting puzzle.

In the model simulations, we take the lifespan of financiers and speculators to be $n = 1$, which will correspond to one month and simulate the model at monthly frequency. In the rest of the paper, we suppress the n superscripts. The model can be solved fully by solving for $\{s_t, \hat{x}_t, \widehat{\tilde{b}}_t^H\}$ using the following system of equations:

$$s_t = -\tilde{a}_t^T - \frac{2}{\gamma}\underbrace{\left(\widehat{\tilde{b}}_t^H - \frac{1}{\bar{\beta}}\widehat{\tilde{b}}_{t-1}^H\right)}_{nx_t}, \tag{26}$$

$$\hat{x}_t + m\frac{\mu^s}{\rho\sigma_s^2}\left(s_{t-1} - s_t\right) + m\mu\hat{\varepsilon}_t^{\mu} = 0, \tag{27}$$

$$\lambda_t = \rho\sigma_s^2\left(\hat{x}_t + \frac{1}{\bar{\beta}}\widehat{\tilde{b}}_t^H\right). \tag{28}$$

$\lambda_t \equiv -\tilde{E}_t^F s_{t+1} + s_t + \tilde{r}_t$ and the exogenous variables are given by $\hat{\varepsilon}_t^{\mu}$ and

$$\begin{aligned} Y_t^T = e^{a_t^T}, \quad Y_t^{*T} = e^{a_t^{*T}}, \\ Y_t^{NT} = e^{a_t^{NT}}, \quad Y_t^{*NT} = e^{a_t^{*NT}}, \\ R_t^H = e^{r_t^H}, \quad R_t^F = e^{r_t^F}. \end{aligned}$$

ε_t^{μ} is assumed to be i.i.d. over time while all remaining exogenous variables follow

[27] See Engel and West (2005) and Engel, Mark, and West (2008).

AR(1) processes given by:

$$\begin{aligned} a_t^T &= \rho_{a^T} a_{t-1}^T + \varepsilon_t^{a^T} \\ a_t^{NT} &= \rho_{a^{NT}} a_{t-1}^{NT} + \varepsilon_t^{a^{NT}} \\ r_t^H &= (1-\rho_r) \ln \frac{1}{\overline{\beta}} + \rho^r r_{t-1}^H + \varepsilon_t^r, \end{aligned}$$

where the foreign shocks follow similar AR(1) processes given in the Appendix. We also define $\tilde{a}_t^T \equiv a_t^{*T} - a_t^T$. λ_t is the expected excess return from being long the foreign currency bond and short the home currency bond, which due to the CIP condition holding, is the same as being long the foreign currency futures/forward contract. It is calculated using the subjective beliefs, $\tilde{E}_t^F$, defined in equation (22), which we reproduce below for convenience:

$$\tilde{E}_t^F s_{t+1} = E_t s_{t+1} + \eta \left(s_t - s_{t-1} \right). \tag{29}$$

To solve the model, we will also use the approximation $\sigma_s^2 = Var\left(\frac{1}{S}\right) \approx Var\left(s\right)$. We will contrast the results from the model simulations to the case where the financiers are rational, $\tilde{E}_t^F = E_t$, in which case λ_t will be the expected excess return based on rational expectations.

We focus on qualitatively matching a set of exchange rate moments in the simulations that are related to the Fama puzzle, the hump-shaped dynamics of exchange rates, and the delayed overshooting puzzle. Regarding the Fama puzzle, we match qualitatively the observation that, in contrast to the prediction from the uncovered interest rate parity theory, one would on average make profits in the short/medium run if he invests in the country with the higher interest rate. We document the puzzle by estimating the coefficient from regressing the realized excess return between periods t and $t+1$ on the period t interest rate differential, as is standard in this literature. Regarding the hump-shaped dynamics puzzle, we rely on the moments used in Steinsson (2008) and build on his code. In particular, he calculates the up-life (UL), half-life (HL) and quarter-life (QL) of exchange rate innovations, where these are defined in the Appendix in Section C. The interpretation of these statistics is such that the exchange rate dynamics will be hump-shaped if UL/HL > 0 and 2HL $-$ QL > 0.[28] Therefore,

[28]For more details see page 521 in Steinsson (2008).

as a measure of whether the model can match the hump-shaped dynamics of exchange rates, we focus on matching the fact that these statistics have to be positive. Finally, we will also focus on matching the evidence in Kim, Moon, and Velasco (2017) regarding the delayed overshooting puzzle. The authors identify monetary policy shocks using sign restrictions and argue that, during the post-Volcker period, the exchange rate appreciates for 2 months in response to a contractionary monetary policy shock before it starts to depreciate. They estimate that the structural break in the impulse response occurs in June 1985, which is why the sample we use to calculate all of the empirical moments starts in this period.

In order to isolate the importance of deviations of exchange rate expectations from FIRE for the dynamics of realized exchange rates, we make some extreme simplifying assumptions in the model. For example, given our assumed consumer preferences, assuming a fixed money supply results in consumers having constant marginal value of nominal wealth. Such a simplification allows us to avoid having to take a stand on the formation of consumption and inflation expectations. This comes at the cost of being able to generate realistic cross-country heterogeneity in money supplies, which could generate trends in exchange rates, for example. This is why we linearly detrend variables when we calculate moments in the data. Other simplifications include abstracting from production by modelling endowment economies, allowing prices to be fully flexible and abstracting from strategic complementarities in pricing. There are competing explanations of the hump-shaped dynamics of exchange rates which rely on a rich production side. Thus, these simplifications allow us to focus on how deviations from FIRE, on their own, can help us reconcile the exchange rate puzzles listed above. Given how stylized our model is, we focus on only qualitatively matching these puzzles, rather than quantitatively.

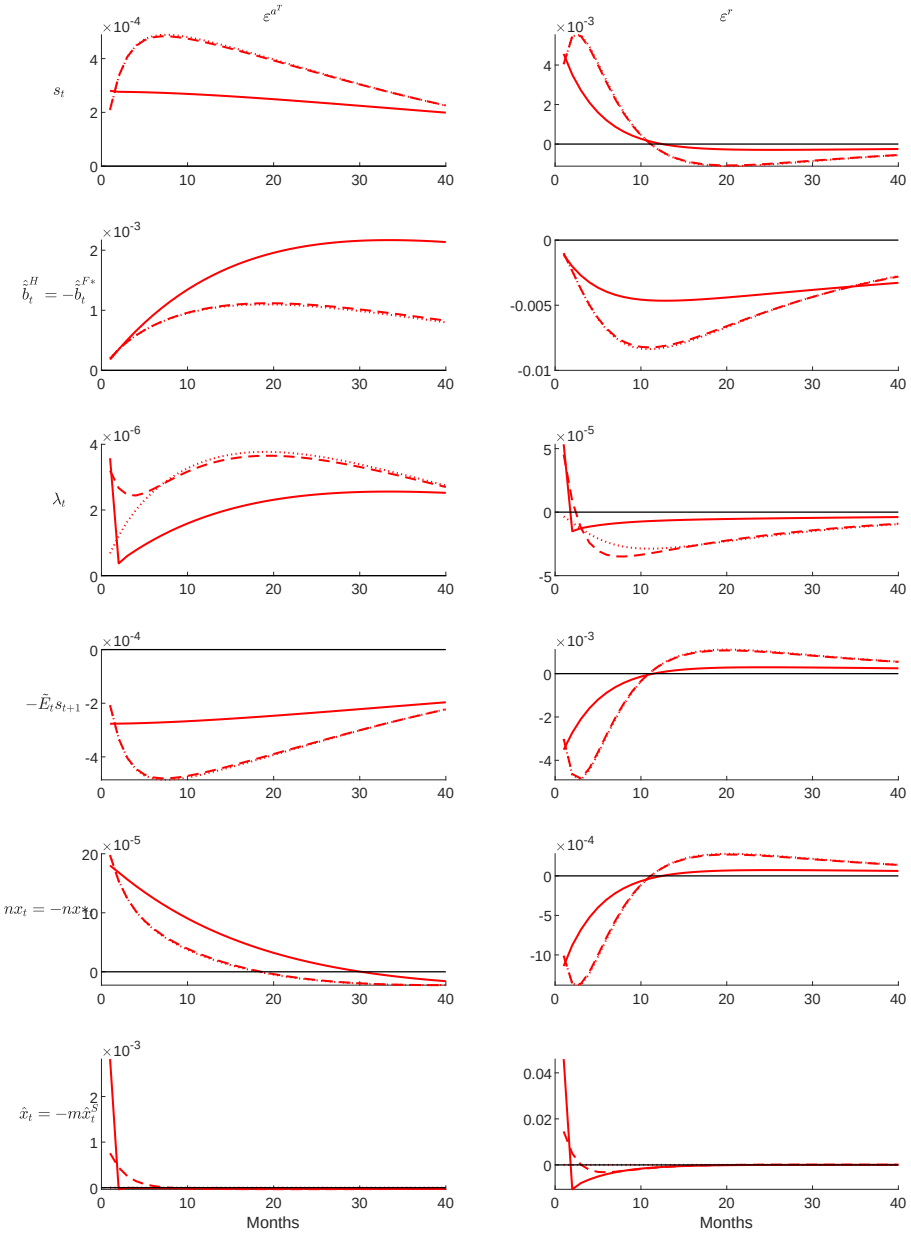
The key parameters, whose calibration mattes for matching the exchange rate puzzles, are η, μ^s and μ. We estimate $\eta = -0.6$ using the *Consensus Economics* data. We set $m = 0.02$ since the size of the futures market is two percent of the OTC market. We also set $\mu^s = 0.6$, which is less than one, implying that the speculators' beliefs are consistent with stationary exchange rate growth dynamics (i.e., if the exchange rate appreciates between $t-1$ and t, they expect to it to appreciate between t and $t+1$ by a smaller amount). The rest of the parameters are calibrated as follows. The steady state discount rate, $\bar{\beta}$, is chosen to match an annualized risk-free rate of 4

percent and is set to 0.9966 while γ is set to 0.5 to match the average share of tradable goods in the consumption basket between the US (0.3) and Germany (0.7) (see Lombardo and Ravenna (2010)). The shock persistence parameters are set as follows: $\rho_{a^{*T}} = \rho_{a^T} = \rho_{a^{*NT}} = \rho_{a^{NT}} = 0.95$ and $\rho_r = \rho_{r*} = 0.8$. The standard deviations of all shocks are set to 0.001. We also set $\mu = 1$, and $\rho = 10$.

7.1 Impulse Responses

Before addressing how the model can help towards resolving all of the puzzles discussed above, we present the impulse responses with respect to the shocks. We focus on the nominal exchange rate, but the behavior of the real exchange rate is very similar. Figure 2 presents the impulse responses of the nominal exchange rate, the bond holdings of the home consumers, which are equal to the negative of the bond holdings of the foreign consumes, $\widehat{\tilde{b}}_t^H = -\widehat{\tilde{b}}_t^{*F}$, the financiers' expected excess returns, the negative of the financiers' average subjective exchange rate beliefs, the futures positions of the financiers, which are equal to the negative of the speculators' futures positions, $\hat{x} = -m\hat{x}^S$ and the net exports of the home consumers which equal the negative of the net exports of the foreign consumers. Figure A9 presents the impulse responses of the remaining variables. The solid line represents the case where we assume that the financiers' beliefs are consistent with FIRE, $\eta = 0$ and $m = 0.02$, the dashed line represents the case where we allow for deviation from FIRE of the financiers' beliefs, $\eta = -0.6$ and $m = 0.02$ (our benchmark case), and the dotted line is the case where we allow for deviation from FIRE of the financiers' beliefs while there is no futures market, $\eta = -0.6$ and $m = 0$. The reason why we include both of the last two cases is to emphasize the fact that given the small size of the futures market, the speculators' beliefs and demand are irrelevant for the exchange rate dynamics.

Figure 2: Model Impulse Responses



$\eta = -0.6; m = 0.02$ $\eta = 0; m = 0.02$ $\eta = -0.6; m = 0$

Other model parameters: $\beta = 0.9966; \mu = 1; \mu^s = 0.6; \gamma = 0.5; \rho = 10; \rho_{a^T} = 0.95; \rho_{a^{T*}} = 0.95; \rho_r = 0.8; \rho_r* = 0.8$

In terms of the impulse responses of the nominal exchange rate, we provide intuition based on the supply/demand equation for foreign currency, derived from the linearized system of equations and the market clearing conditions:

$$
\begin{aligned}
Demand^{F}_{FC} &= -Demand^{S}_{FC} - \frac{1}{\bar{\beta}} Demand^{FC}_{FC} \\
Demand^{F}_{FC} &= \frac{\lambda_t}{\rho\sigma_s^2} = \frac{\overbrace{-E_t s_{t+1} - \eta\left(s_t - s_{t-1}\right)}^{-\tilde{E}^F_t s_{t+1}} + s_t + \tilde{r}_t}{\rho\sigma_s^2} \\
-Demand^{S}_{FC} &= -m\underbrace{\left(\frac{\mu^s}{\rho\sigma_s^2}\left(s_{t-1} - s_t\right) + \mu\hat{\varepsilon}^{\mu}_t\right)}_{\hat{x}^S_t} \\
-\frac{1}{\bar{\beta}} Demand^{FC}_{FC} &= -\frac{1}{\bar{\beta}}\underbrace{\left(\frac{1}{\bar{\beta}}\widehat{\tilde{b}}^{*F}_{t-1} + \overbrace{s_t\frac{\gamma}{2} + \tilde{a}^T_t\frac{\gamma}{2}}^{nx^*_t}\right)}_{\widehat{\tilde{b}}^{*F}_t},
\end{aligned}
$$

where $\tilde{a}^T_t \equiv a^{*T}_t - a^T_t$ and $\tilde{r}_t \equiv r^F_t - r^H_t$.

The exchange rate is determined by the market clearing conditions in both the bond and futures markets. More specifically, the total demand for foreign currency assets of the average financier is equal to the negative demand for foreign currency bonds of the foreign consumers plus the negative demand for foreign currency futures of the speculators.[29]

The demand for foreign currency of the average financier is given by her expected excess return from being long the foreign currency and short the domestic currency, scaled by her risk aversion and the exchange rate variance. The deviation from FIRE of the financier's beliefs affects the financier's demand for foreign currency assets by affecting her expected excess return. More precisely, past foreign currency appreciation, holding all else constant, lowers the expected excess return from being long the foreign currency and short the domestic currency relative to FIRE-consistent beliefs, which lowers the financier's demand for the foreign currency relative to FIRE.

[29] As a reminder, when the financier wants to increase her exposure to the foreign currency, she is indifferent between using futures contracts or long/short positions in bonds.

The demand for foreign currency futures of the speculators is equal to their expected return from being long the foreign currency futures contract plus a noise trading demand component. In contrast to the financiers, the speculators' beliefs are such that their demand for foreign currency futures is higher when the foreign exchange rate has appreciated in the past. Since the speculators follow a "momentum" trading strategy, their beliefs also deviate from FIRE. However, their beliefs will be of second order importance for the exchange rate dynamics due to the small size of the futures market. Finally, the foreign consumers' demand for the foreign currency bond is equal to the foreign consumers' scaled lagged foreign currency bond holdings plus foreign net exports.

The intuition for the sign of the impulse responses is similar if $\eta = 0$ or $\eta = -0.6$. Moreover, the presence of the futures market does not significantly affect the impulse responses of the endogenous variables unrelated to the futures market, with the exception of the expected excess return of the financiers. First, consider the impulse response of the nominal exchange rate with respect to $\varepsilon_t^{a^T}$ and assume that $m = 0$, i.e. there are no speculators. An increase in the supply of the home tradeable good, an increase of $\varepsilon_t^{a^T}$, appreciates the home currency regardless of the value of η. Holding all else constant, due to consumption smoothing, higher tradeable output at home increases the home consumers' home currency bond holdings (increases the net exports of the home country). In order for the bond market to clear, the average financier has to decrease her home currency bond holdings/increase her foreign currency bond holdings and the foreign consumers have to decrease their foreign currency bond holdings. The former is achieved via a contemporaneous foreign currency depreciation. The foreign currency depreciation increases the expected excess return of the average financier from investing in the foreign currency bond, which generates the required adjustment of the financier's portfolio. This is the case even if the average financier's beliefs don't deviate from FIRE, $\eta = 0$. If $\eta < 0$, then there is an amplification effect as the foreign currency depreciation implies that the average financier believes that the foreign currency will appreciate more/depreciate less in the future relative to FIRE, which will further increase the demand for the foreign currency bond. The increased supply of the tradeable good at home also leads to increased borrowing of the foreign consumers (lowers the foreign net exports). That is the case as the foreign currency price of tradeables falls, which leads to an increased consumption of tradeables by the

foreign consumer.

In the case where $m = 0.2$ the channels described above are still present. However, there is an additional margin that can help clear the increased demand for foreign currency by the financiers in response to an increase of $\varepsilon_t^{a^T}$. In particular, the foreign currency depreciation will decrease the demand for foreign currency futures contracts of the speculators.

Next we consider the impulse responses with respect to ε_t^r and, once again, first, we focus on the case where $m = 0$. Holding all else constant, an increase of the home interest rate lowers the average financier's expected excess return from being long the foreign currency. This increases her demand for the home currency bond/decreases her demand for the foreign currency bond. In order for the bond market to clear, it will have to be the case that the home consumers lower their saving in the home currency bond while the foreign consumers increase their savings in the foreign currency bond. Both are achieved via a contemporaneous foreign currency depreciation. The weaker foreign currency increases the foreign currency price of the tradeable good, which lowers the foreign consumers' consumption of the tradeable good and increases foreign net exports (i.e. the foreign consumers increase their savings in the foreign bond). The opposite is true for the home consumer. The weaker foreign currency decreases the home currency price of the tradeable good, which leads to higher consumption of the home consumers of the tradeable good and a decrease in home net exports (i.e. the home consumers decrease their savings in the home bond).

In the case where $m = 0.2$, the foreign currency depreciation implies that, initially, the speculators want to be short the foreign currency/long the home currency. To accommodate the lower demand for foreign currency futures by the speculators, the expectations of the financiers adjust in a way that her expected excess return from being long the foreign currency increases in the short run, rather than decrease. This is the case because the average financier expects the foreign currency in the future to appreciate by more than the increase of ε_t^r.

The intuition for the impulse responses with respect to $\varepsilon_t^{a*^T}$ and ε_t^{r*} is similar as the two countries are symmetric.

7.2 Hump-shaped Dynamics

In this sub-section we discuss the intuition as to why we observe a hump-shaped dynamic of the nominal exchange rate with respect to the various shocks when $\eta = -0.6$ and no such hump-shaped dynamic when $\eta = 0$. We combine equation (28) and equation (27) to obtain:

$$s_t - E_t s_{t+1} = -\left(\eta + m\mu^s\right)\left(s_{t-1} - s_t\right) - \tilde{r}_t - \rho\sigma_s^2 m\mu\hat{\varepsilon}_t^{\mu} + \rho\sigma_s^2\frac{1}{\bar{\beta}}\widehat{\tilde{b}}_t^{H}. \tag{30}$$

If we shut down the two novel ingredients in our model by assuming that the financiers' expectations are consistent with FIRE ($\eta = 0$) and that there are no momentum-driven speculators in the futures market ($m = 0$), then $s_t - E_t s_{t+1} = -\tilde{r}_t + \rho\sigma_s^2\frac{1}{\bar{\beta}}\widehat{\tilde{b}}_t^{H}$. That is, exchange rate dynamics would be fully determined by the interest rate differential and the home currency bond holdings of home consumers.

Next consider the full model in which there are two additional terms. $\rho\sigma_s^2 m\mu\hat{\varepsilon}_t^{\mu}$ is an exogenous noise trading demand shock that is of second-order importance given the small size of the futures market relative to the OTC market. All the results would go through if we set $\mu = 0$. The term that will be crucial for matching the exchange rate puzzles is $-\left(\eta + m\mu^s\right)\left(s_{t-1} - s_t\right)$.

The form of deviation from FIRE that we observe is such that $\eta < 0$ and, in particular, we estimate $\eta = -0.6$. Since we also set $\mu^s < 1$ and $m = 0.2$, it will be the case that $\eta + m\mu^s < 0$. This implies that if the foreign exchange rate appreciates between periods $t-1$ and t, it will appreciate between periods t and $t+1$, on average. This introduces persistence in exchange rate changes which generates the hump-shaped dynamics with respect to the underlying exogenous shocks. More specifically, if the exchange rate appreciates on impact in response to a shock, it will continue appreciating in the short run due to the persistence introduced by the subjective beliefs of the average financier. The exchange rate will depreciate eventually due to the decay of the shock itself (i.e. the shock is persistent but transient), thus, generating a hump-shaped dynamic.

While solving the model in closed form is infeasible, all of the results related to the hump-shaped dynamics of the impulse response functions if $\eta = -0.6$ and the lack of such when $\eta = 0$ are insensitive to changes in the calibration, as long as $\eta + m\mu^s < 0$. Finally, if it was the case that $\eta + m\mu^s > 0$, which would be inconsistent with the data,

then the exchange rate would have oscillating dynamics.

7.3 Explaining the Exchange Rate Puzzles

Given that the model delivers hump-shaped dynamics of the nominal exchange rate with respect to shocks to both tradable sectors' TFPs and interest rates, it is not surprising that it produces hump-shaped dynamics of the exchange rate with respect to its own disturbances estimated from an AR process. It also implies that the model can explain the exchange rate overshooting puzzle, which implies that the exchange rate exhibits a hump-shaped dynamics with respect to interest rate shocks. Naturally, the fact that the model can explain the exchange rate overshooting puzzle also implies that it can help reconcile the Fama puzzle.

Table 10 presents the moments capturing the hump-shaped exchange rate dynamics and the Fama puzzle. We present the moments from the baseline model, the model under FIRE, and the average of data moments estimated from each country in our sample.[30] In the data, we consider the U.S. to be the home country. The model moments are based on 1000 draws of simulations with 360 monthly observations, chosen to roughly match the length of our empirical sample. We estimate AR(12) processes for the exchange rate to compute the moments related to hump-shared dynamics. Wherever relevant, 5^{th} and 95^{th} percentile confidence intervals are presented in square brackets.

[30] See Table A58 in the Appendix for the country-specific data moments.

Table 10: Data and Model-Implied Moments

	Data	Baseline Model $\eta = -0.6$	Model under FIRE $\eta = 0$
α^s	0.974	0.890	0.800
		[0.843, 0.927]	[0.698, 0.875]
UL/HL	0.199	0.612	0
		[0.453, 0.717]	[0, 0]
2 HL−QL	0.876	0.397	-0.004
		[-0.558, 0.644]	[-0.341, 0.160]
ϕ	1.483	0.777	-0.051
		[0.676, 0.872]	[-0.309, 0.178]

Note: Estimates of α^s are obtained from the regression $s_t = \mu\alpha^s s_{t-1} + \sum_{j=1}^{12} \psi_j \Delta s_{t-j} + \epsilon_t$ following Steinsson (2008). UL, HL, and QL denote the up-life, half-life, and quarter-life as defined in Section C of the Online Appendix. ϕ is the estimate from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \alpha + \phi\tilde{r}_t^n + \varepsilon_t$, where we use $n = 3$ in the data, given the longer and better quality interest rate series for $n = 3$, while the model is simulated with $n = 1$. Data moments are the average of pair-specific estimates for the seven currency pairs in our sample while model moments come from 1000 simulations each with 360 monthly observations. 5^{th} and 95^{th} percentiles from these simulations are presented in square brackets.

Finally, Figure A10 shows the hump-shaped responses to the disturbances of the estimated AR(12) processes for the nominal exchange rate of each of the currencies while Figure A11 presents the model-equivalent versions for the cases where $\eta = -0.6$ or $\eta = 0$.

It is clear that the particular form of deviation from FIRE that we model, and which is strongly supported by the data, helps to at least qualitatively match the exchange rate hump-shaped dynamics, the delayed overshooting puzzle and the Fama puzzle.

8 Conclusion

In this paper we build a model of spot and derivative exchange rate markets which takes seriously the heterogeneity in beliefs of foreign exchange rate market participants and introduces deviations from FIRE. We derive a number of testable implications related to both expected excess returns, futures market positions, and realized exchange rates which we find are strongly supported in the data. We show that the data strongly rejects the hypothesis that exchange rate market participants have beliefs consistent with FIRE. Finally, we argue that the particular form of deviation from FIRE that we document in the data can help explain long-standing exchange rate puzzles such as the Fama puzzle, the delayed-overshooting and can generate hump-shaped exchange rate dynamics.

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Online Appendix

A Data Appendix

- *Futures positions*: CFTC COT reports.
  - Frequency: weekly frequency and higher
- *Exchange rate professional forecasts: Consensus Economics* Foreign Exchange Consensus Forecasts
  - Frequency: monthly frequency and higher; for the weekly regressions the series are linearly interpolated
  - Currencies pairs used: USDAUD, CADUSD, DEMUSD, USDEUR, JPYUSD, USDNZD, CHFEUR, USDGBP.
  - Available horizons: 1-, 3-, 12-, and 24-months ahead.
  - Subset of forecasters used in individual-level data:[31] ABN Amro, Allianz, ANZ Bank, Bank of America, Bank of America - Merrill Lynch, Bank of Nova Scotia, Bank of Tokyo Mistubishi, Barclays Capital, BNP Paribas, Citigroup, Commerzbank, Credit Suisse First Boston, Deutsche Bank Research, Dresdner Kleinwort Wasserstein, General Motors, Global Insight, Goldman Sachs, HSBC Economics, IHS Markit, ING Financial Markets, JP Morgan, Macquarie Capital, Morgan Stanley, Nomura, Oxford Economics, Rabobank, Royal Bank of Canada, Royal Bank of Scotland, Societe Generale, Standard Chartered, UBS Warburg, Westdeutsche Landesbank.
- *Exchange rates*: Global Financial Data.
  - Frequency: daily frequency and higher
- *One-month rates*:
  - Frequency: daily frequency and higher
  - Canada, Germany, New Zealand, Switzerland, United Kingdom, and United States: One-month government bill rates obtained through Haver Analytics and Bloomberg.

[31] We kept only those individual forecasters who consistently participate in the survey over our sample.

  - Australia, Japan: One-month LIBOR rates obtained through Haver Analytics.

- *Three-month bill rates*:
  - Frequency: daily frequency and higher
  - Australia, Canada, New Zealand, Switzerland, United Kingdom, and United States: Central bank data obtained through Haver Analytics.
  - Germany: Reuters data obtained through Haver Analytics.
  - Japan: Bloomberg.

- *Zero-coupon yields for 12- and 24-month maturities*:
  - Frequency: daily frequency and higher
  - Australia, Canada, Germany, euro area, New Zealand, Switzerland, and United Kingdom: Central banks. German zero-coupon bond yields are spliced with estimates of zero-coupon yields on AAA-rated euro area sovereign debt provided by the European Central Bank (ECB) when the DEM switches over to the EUR.
  - Japan: Bloomberg.
  - United States: Gürkaynak, Sack, and Wright (2007).

- *CPI inflation:* OECD.
  - Frequency: monthly frequency and higher; exceptions for NZ and AU where only quarterly data is available and it is interpolated at the monthly frequency using linear interpolation.

- *Cross country positions:* BIS including confidential data accessible at the level of Central Bank employees.
  - Frequency: quarterly frequency; when the data is used for the monthly frequency regressions, it is interpolated using linear interpolation.
  - The average financiers' foreign currency bond positions are calculated as the claims minus the liabilities (the net stock positions) from all reporting countries into one of the 7 countries whose currencies we consider (counterparty countries). We consider only positions denominated in the counterparty currency, which is the foreign currency from the perspective of the model. For Germany, United Kingdom, Japan and Switzerland we

can measure the net positions in their respective currencies directly as the BIS data provides a break down of positions into the currencies of these countries. For the remaining three countries – Canada, Australia and New Zealand – we proxy the net positions denominated in the local currency as the net positions in all currencies minus the positions in EUR/DEU, GBP, JPY, USD and CHF.

Samples used in regressions:

Sample Ranges for Regressions Using CFTC Positions Data and Expected or Realized Returns

	1-Month	3-Month	12-Month	24-Month
AUD	1997:6–2013:5	1992:10–2018:4	1992:10–2016:8	1994:1–2016:8
CAD	2001:5–2018:4	1992:10–2018:4	1992:10–2016:5	1994:1–2016:5
CHF	2001:5–2018:4	1998:1–2014:7	1998:1–2016:8	1998:1–2016:8
DEM/EUR	2001:5–2018:4	1993:6–2018:4	1997:8–2016:8	1997:8–2016:8
JPY	1997:6–2018:4	1992:10–2018:4	1992:10–2016:8	1994:1–2016:8
NZD	2006:1–2012:1	2006:1–2018:4	2006:1–2016:8	2006:1–2016:8
GBP	2001:5–2018:4	1992:1–2018:4	1992:1–2016:4	1994:1–2016:4

Sample Ranges for Regressions Using Exchange Rate Surprises or Exchange Rate Forecasts

	Surprises Regressed on Exch Rate Changes and Forecast Revisions	Forecasts Regressed on Exch Rate Changes and the RER
1-Month	1997:6–2018:8	1997:6–2018:10
3-Month	1990:11–2018:8	1990:3–2018:10
12-Month	1995:12–2017:11	1990:3–2018:10
24-Month	1994:12–2016:11	1994:12–2018:10

Sample Ranges for Data Moments

	AR(12) process for hump-shaped dynamics	Fama regression
AUD	1985:6–2018:8	1990:1–2018:8
CAD	1985:6–2018:8	1990:1–2018:8
CHF	1985:6–2018:8	1998:1–2018:8
DEM/EUR	1985:6–2018:8	1993:5–2018:8
JPY	1985:6–2018:8	1992:7–2018:8
NZD	1985:6–2018:8	1990:1–2018:8
GBP	1985:6–2018:8	1992:11–2018:8

B Solving the model

In this part of the Appendix we present the model solution.

The following set of equations fully characterizes the solution. We have aggregated the financier's first order conditions and budget constraints as only the aggregate equations matter for the equilibrium exchange rate.

Market clearing conditions in financial markets

$$B_t^{H,n} + \tilde{B}_t^{H,n} = 0; \quad B_t^{F,n} + \tilde{B}_t^{*F,n} = 0; \quad X_t^n + mX_t^{S,n} = 0$$

where from the financier's budget constraint $B_t^H = -\frac{B_t^F}{S_t}$, we get

$$S_t \tilde{B}_t^{H,n} + \tilde{B}_t^{*F,n} = 0.$$

Market clearing condition in goods market

$$Y_t^{NT} = C_t^{NT}; \quad Y_t^{*NT} = C_t^{*NT}$$
$$C_t^T - Y_t^T + C_t^{*T} - Y_t^{*T} = 0$$

First order conditions

$$X_t^n + R_t^{F,n} B_t^{F,n} = \frac{\tilde{E}_t^F \frac{1}{S_{t+n}} - \frac{R_t^{H,n}}{R_t^{F,n} S_t}}{\rho \sigma_{n,s}^2}$$

$$X_t^{S,n} = \frac{\tilde{E}_t^S \left(\frac{1}{S_{t+n}} - \frac{R_t^{H,n}}{R_t^{F,n} S_t} \right)}{\rho \sigma_{n,s}^2} + \mu \varepsilon_t^{\mu}$$

$$R_t^{H,n} = \frac{1}{\tilde{E}_t \Pi_{\tau=t+1}^{t+n} (\beta_\tau)}; \quad P_t = \frac{1}{C_t}$$

$$R_t^{F,n} = \frac{1}{\tilde{E}_t^* \Pi_{\tau=t+1}^{t+n} (\beta_\tau^*)}; \quad P_t^* = \frac{1}{C_t^*}$$

$$C_t^T = \gamma \frac{1}{P_t^T}$$

$$P_t^{NT} = (1-\gamma) \frac{1}{Y_t^{NT}}$$

$$P_t = \frac{\left(P_t^T\right)^{\gamma} \left(P_t^{NT}\right)^{1-\gamma}}{\gamma^{\gamma} (1-\gamma)^{(1-\gamma)}}$$

$$C_{t+1}^{*T} = \gamma \frac{1}{P_{t+1}^{*T}}$$

$$P_{t+1}^{*NT} = (1-\gamma) \frac{1}{Y_{t+1}^{*NT}}$$

$$P_{t+1}^* = \frac{\left(P_{t+1}^{*T}\right)^{\gamma} \left(P_{t+1}^{*NT}\right)^{1-\gamma}}{\gamma^{\gamma} (1-\gamma)^{(1-\gamma)}}$$

$$\frac{1}{F_t^n} = \frac{R_t^{H,n}}{R_t^{F,n} S_t}$$

Budget constraints

$$C_t^T P_t^T + C_t^{NT} P_t^{NT} = C_t P_t$$

$$C_t^{*T} P_t^{*T} + C_t^{*NT} P_t^{*NT} = C_t^* P_t^*$$

which implies that the budget constraints can be re-written as

$$\tilde{B}_t^{H,n} = -P_t^T \left(C_t^T - Y_t^T \right) + R_{t-n}^{H,n} \tilde{B}_{t-n}^{H,n} + \pi_t^F + \pi_t^S$$

$$\tilde{B}_t^{*F,n} = -P_t^{*T} \left(C_t^{*T} - Y_t^{*T} \right) + R_{t-n}^{F,n} \tilde{B}_{t-n}^{*F,n}$$

where

$$\begin{aligned}\pi_t^F &= \left(\frac{1}{S_t} - \frac{R_{t-n}^{H,n}}{R_{t-n}^{F,n} S_{t-n}}\right)\left(R_{t-n}^{F,n} B_{t-n}^{F,n} + X_{t-n}^n\right)\\ B_t^{H,n} &= -\frac{B_t^{F,n}}{S_t}\end{aligned}$$

So the home and foreign budget constraints can be re-written as:

$$\begin{aligned}-NX_t = P_t^T\left(C_t^T - Y_t^T\right) &\leq \frac{S_{t-n}}{S_t} R_{t-n}^{F,n} \tilde{B}_{t-n}^{H,n} - \tilde{B}_t^{H,n}\\ -NX_t^* = P_t^{*T}\left(C_t^{*T} - Y_t^{*T}\right) &\leq R_{t-n}^{F,n} \tilde{B}_{t-n}^{*F,n} - \tilde{B}_t^{*F,n}\end{aligned}$$

which implies that

$$S_t P_t^T\left(C_t^T - Y_t^T\right) + P_t^{*T}\left(C_t^{*T} - Y_t^{*T}\right) = 0.$$

Using the equation above and the good's market clearing condition, we get that law of one price hold

$$\frac{P_{t+1}^T}{P_{t+1}^{*T}} = \frac{1}{S_{t+1}}$$

Shocks

$$\begin{aligned}a_t^{*T} &= \rho_{a^{*T}} a_{t-1}^{*T} + \varepsilon_t^{a^{*T}}\\ a_t^T &= \rho_{a^T} a_{t-1}^T + \varepsilon_t^{a^T}\\ a_t^{*NT} &= \rho_{a^{*NT}} a_{t-1}^{*NT} + \varepsilon_t^{a^{*NT}}\\ a_t^{NT} &= \rho_{a^{NT}} a_{t-1}^{NT} + \varepsilon_t^{a^{NT}}\\ r_t^H &= (1-\rho_r)\ln\frac{1}{\bar{\beta}} + \rho^r r_{t-1}^H + \varepsilon_t^r\\ r_t^F &= (1-\rho_{r*})\ln\frac{1}{\bar{\beta}} + \rho^{r*} r_{t-1}^F + \varepsilon_t^{r*}\end{aligned}$$

In some of the derivations we will use the fact that for any AR(1) process ξ_t:

$$\xi_{t+k} = \rho_\xi^k \xi_t + \sum_{j=0}^{k-1} \rho_\xi^j \varepsilon_{t+k-j}^\xi.$$

Next we reduce the dimensionality of the problem and solve the model for $n = 1$,

where from now on we ignore the super-script n. More specifically, we solve for consumption and prices as a function of S_t, X_t, $\tilde{B}_t^H$ and the shocks. Since $P_t^T = \gamma \frac{1}{C_t^T} = \gamma \frac{1}{Y_t^T - C_t^{*T} + Y_t^{*T}} = \gamma \frac{1}{Y_t^T - \frac{\gamma}{P_t^{*T}} + Y_t^{*T}} = \gamma \frac{1}{Y_t^T - \frac{\gamma}{S_t P_t^T} + Y_t^{*T}}$, then

$$\begin{aligned} P_t^T &= \frac{\gamma}{Y_t^T + Y_t^{*T}} \left(1 + \frac{1}{S_t}\right) \\ P_t^{*T} &= P_t^T S_t = \frac{\gamma}{Y_t^T + Y_t^{*T}} \left(S_t + 1\right) \\ P_t^{NT} &= (1-\gamma) \frac{1}{Y_t^{NT}} \\ P_t^{*NT} &= (1-\gamma) \frac{1}{Y_t^{*NT}} \end{aligned}$$

$$\begin{aligned} P_t &= \left(\frac{1 + \frac{1}{S_t}}{Y_t^T + Y_t^{*T}}\right)^{\gamma} \left(\frac{1}{Y_t^{NT}}\right)^{1-\gamma} \\ P_t^* &= \left(\frac{S_t + 1}{Y_t^T + Y_t^{*T}}\right)^{\gamma} \left(\frac{1}{Y_t^{*NT}}\right)^{1-\gamma} \end{aligned}$$

$$\begin{aligned} C_t = \frac{1}{P_t}; \quad C_t^* = \frac{1}{P_t^*} \\ C_t^T = \gamma \frac{1}{P_t^T}; \quad C_t^{*T} = \gamma \frac{1}{P_t^{*T}} \end{aligned}$$

The budget constraints can be re-written as

$$\gamma - \gamma \frac{Y_t^T}{Y_t^T + Y_t^{*T}} \left(1 + \frac{1}{S_t}\right) = \frac{S_{t-1}}{S_t} R_{t-1}^F \tilde{B}_{t-1}^H - \tilde{B}_t^H = -NX_t \tag{31}$$

$$\gamma - \gamma \frac{Y_t^{*T}}{Y_t^T + Y_t^{*T}} \left(S_t + 1\right) = R_{t-1}^F \tilde{B}_{t-1}^{*F} - \tilde{B}_t^{*F} = -NX_t^*$$

Finally, from the market clearing conditions we have

$$\frac{\left(\tilde{E}_t^F \frac{1}{S_{t+1}} - \frac{R_t^H}{R_t^F S_t}\right)}{\rho \sigma_s^2} = X_t + R_t^F B_t^F = X_t + R_t^F S_t \tilde{B}_t^H \tag{32}$$

$$\tilde{E}_t^F \frac{1}{S_{t+1}} = E_t \frac{1}{S_{t+1}} + \eta \left(\frac{1}{S_t} - \frac{1}{S_{t-1}} \right)$$

$$X_t^S = \frac{\mu^s}{\rho \sigma_s^2} \left(\frac{1}{S_t} - \frac{1}{S_{t-1}} \right) + \mu \varepsilon_t^\mu$$

$$X_t = -m X_t^S = -m \frac{\mu^s}{\rho \sigma_{n,s}^2} \left(\frac{1}{S_t} - \frac{1}{S_{t-1}} \right) - m \mu \varepsilon_t^\mu \tag{33}$$

Due to Walras' law one of the budget constraints is redundant which implies that one can solve for S_t, X_t and $\tilde{B}_t^H$ from equations (31), (32) and (33) given beliefs $\tilde{E}_t^F$ and $\tilde{E}_t^S$.

Steady State

$$X^{SS} = 0; \quad \tilde{B}^{H,SS} = 0; S^{SS} = 1$$

$$P^{SS} = P^{*SS} = 1; \quad C^{SS} = C^{*SS} = 1$$

$$C^{T,SS} = C^{*T,SS} = 1; \quad C^{NT,SS} = C^{*NT,SS} = 1$$

$$R^{H,SS} = R^{F,SS} = \frac{1}{\bar{\beta}}$$

$$Y^{T,SS} = Y^{*T,SS} = Y^{NT,SS} = Y^{*NT,SS} = 1$$

$$P^{*,NT,SS} = P^{NT,SS} = 1 - \gamma$$

$$P^{*,T,SS} = P^{T,SS} = \gamma$$

C Hump-shaped Statistics

In order to calculate the half-life, up-life and quarter-life we follow Steinsson (2008) and estimate the following process of the HP filtered nominal and real bilateral exchange rate or the simulated model implied nominal and real exchange rates:

$$s_t = \zeta^s + \alpha^s s_{t-1} + \sum_{j=1}^{p} \varphi_j^s \Delta s_{t-j} + \varepsilon_t^s \tag{34}$$

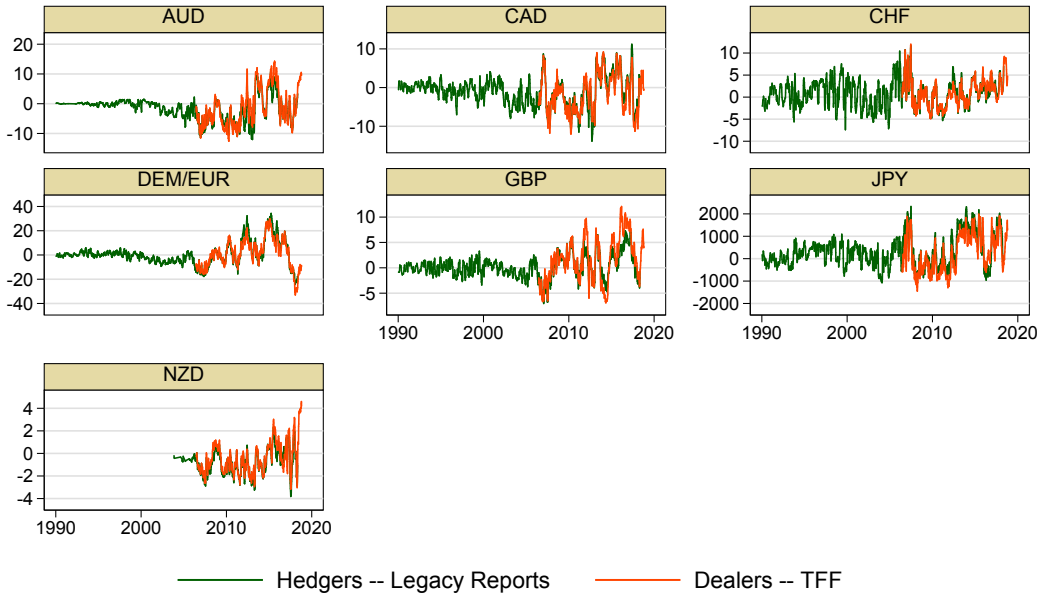
$$IR(t) = \frac{\partial \left(E_k s_t - E_{k-1} s_t \right)}{\partial \varepsilon_k^s} \text{ for } k < t$$

where $E_k s_t$ stands for the expected exchange rate in period t given the realization of the shock in period k and the prior history of shocks while $E_{k-1} s_t$ stands for the expected exchange rate in period t given the history of shocks prior to period k. Note that the expectation is defined with respect to the exchange rate dynamics specified in equation (34). The half-life is defined as $|IR(T)| \geq 0.5$ and $|IR(J)| < 0.5$ for every $J > T$. The up-life is defined as $|IR(T)| \geq 1$ and $|IR(J)| < 1$ for every $J > T$ where the up-life is set to zero if the IR never reaches one. The quarter-life is defined as $|IR(T)| \geq 0.25$ and $|IR(J)| < 0.25$ for every $J > T$. Similarly to Steinsson (2008) we calculate median unbiased point estimates and use a bootstrap with sample size of 1000 to calculate the standard errors.

D Additional Tables and Figures

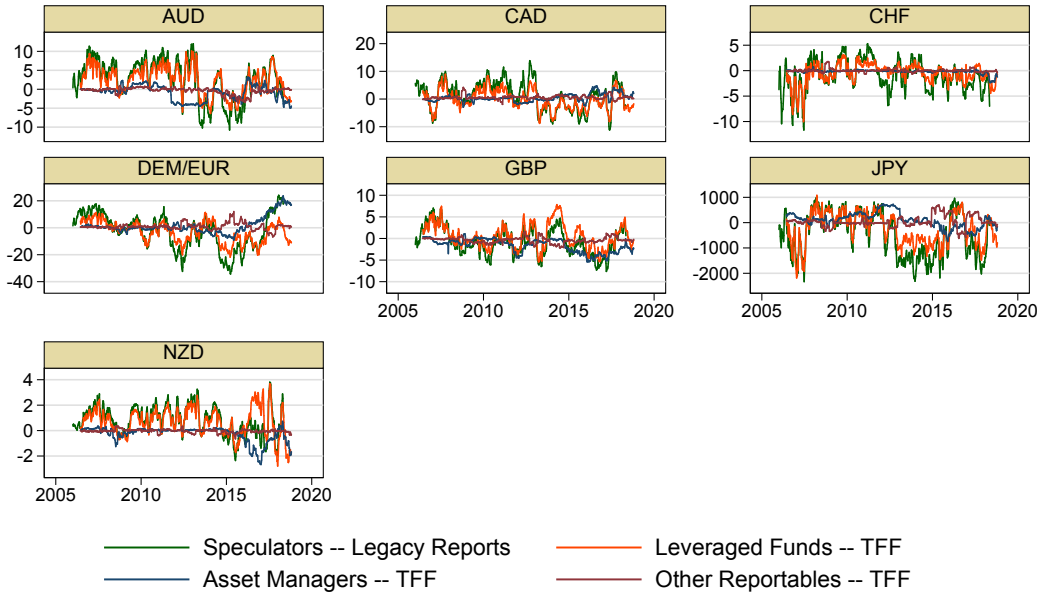
D.1 CFTC Data

Figure A1: Dealers and Hedgers



Note: The units are in billions of the non-USD currency where a positive number means that the hedgers or the dealers are long the non-USD currency.

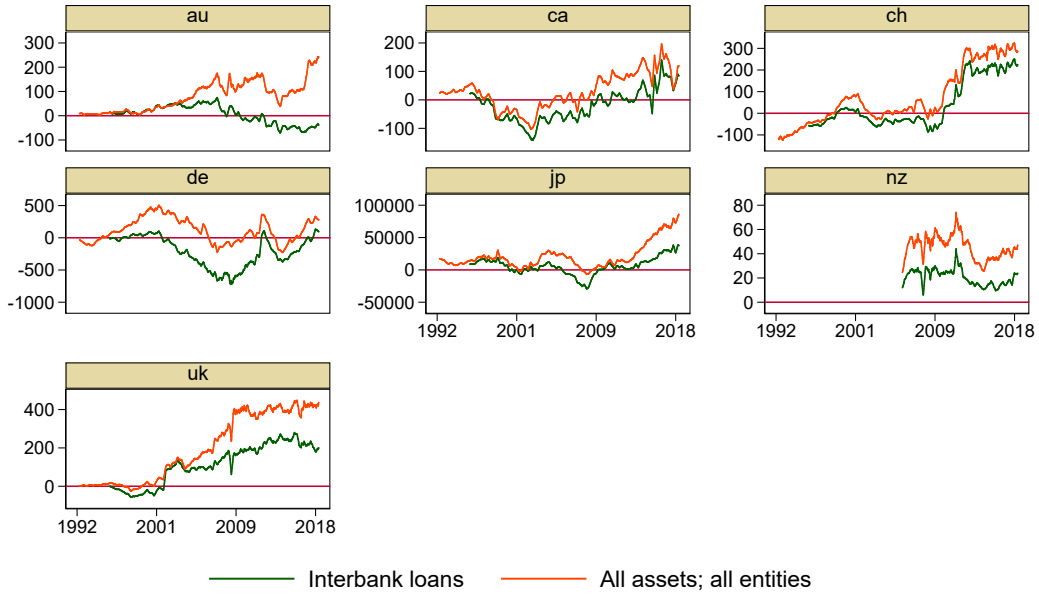
Figure A2: Leveraged Funds and Speculators



Note: The units are in billions of the non-USD currency where a positive number means that the respective category of traders are long the non-USD currency.

D.2 BIS Data

Figure A3: Financiers' Foreign Currency Net Assets



Note: The units are in billions of the foreign currency where a positive number means that the fianciers have positive amount of net assets in the currency of the respective country.

D.3 Testing the Euler – Weekly Frequency

D.3.1 Positions and Expected Excess Returns – Weekly Frequency

Table A1: Positions and Expected Excess Returns – Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	6.696^{***}	4.728^{***}	5.609^{***}	3.846^{***}	6.383^{***}	0.042^{***}	59.779^{***}
	(0.568)	(0.331)	(0.376)	(0.421)	(0.830)	(0.003)	(8.398)
# of Obs	467	287	283	287	285	501	52
Adj. R^2	0.22	0.38	0.41	0.22	0.16	0.34	0.57

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	6.655^{***}	2.250^{***}	6.425^{***}	0.939^{***}	2.779^{***}	0.017^{***}	33.620^{***}
	(0.769)	(0.208)	(0.386)	(0.088)	(0.417)	(0.001)	(3.002)
# of Obs	330	587	575	587	587	587	303
Adj. R^2	0.20	0.12	0.23	0.12	0.06	0.18	0.29

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.711^{***}	0.270^{***}	0.320^{***}	0.235^{***}	0.484^{***}	0.003^{***}	2.743^{***}
	(0.042)	(0.030)	(0.024)	(0.020)	(0.030)	(0.000)	(0.327)
# of Obs	596	632	470	494	632	632	52
Adj. R^2	0.22	0.18	0.22	0.11	0.24	0.15	0.55

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.200^{***}	0.228^{***}	0.392^{***}	0.052^{***}	0.396^{***}	0.002^{***}	1.449^{***}
	(0.015)	(0.012)	(0.030)	(0.005)	(0.022)	(0.000)	(0.114)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.17	0.40	0.22	0.14	0.32	0.34	0.27

Note: All of the regressions are estimated at weekly frequency. Estimates of β^1 from the regression $s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{1, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A2: Positions and Expected Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using All BIS Assets and Reporting and Counter-party Entities– Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	9.551^{***}	4.670^{***}	5.922^{***}	4.198^{***}	6.753^{***}	0.043^{***}	55.005^{***}
	(0.717)	(0.318)	(0.408)	(0.395)	(0.790)	(0.002)	(14.294)
B_t^F	0.280^{***}	-0.080^{***}	-0.287^{***}	-0.044^{***}	0.102^{**}	0.001^{***}	-0.338
	(0.041)	(0.029)	(0.110)	(0.011)	(0.040)	(0.000)	(0.634)
# of Obs	467	287	283	287	285	501	52
Adj. R^2	0.28	0.40	0.43	0.25	0.18	0.37	0.56

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	6.474^{***}	2.360^{***}	6.937^{***}	0.938^{***}	3.687^{***}	0.019^{***}	33.651^{***}
	(0.750)	(0.220)	(0.434)	(0.089)	(0.451)	(0.002)	(2.985)
B_t^F	0.267^{***}	-0.040	-0.050^{***}	-0.020^{***}	-0.160^{***}	-0.000^{***}	0.687^{*}
	(0.095)	(0.029)	(0.012)	(0.007)	(0.022)	(0.000)	(0.360)
# of Obs	330	587	575	587	587	587	303
Adj. R^2	0.22	0.12	0.26	0.13	0.11	0.20	0.29

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	3.829^{***}	1.859^{***}	2.014^{***}	0.917^{***}	3.664^{***}	0.017^{***}	20.186^{***}
	(0.273)	(0.090)	(0.122)	(0.133)	(0.216)	(0.001)	(4.877)
B_t^F	0.122^{***}	-0.041^{***}	0.140^{***}	0.043^{***}	0.050^{***}	0.001^{***}	-0.191
	(0.016)	(0.005)	(0.015)	(0.003)	(0.005)	(0.000)	(0.215)
# of Obs	710	746	465	711	740	741	52
Adj. R^2	0.24	0.50	0.51	0.32	0.34	0.35	0.63

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.084^{***}	0.775^{***}	2.799^{***}	0.247^{***}	1.172^{***}	0.007^{***}	5.138^{***}
	(0.104)	(0.075)	(0.218)	(0.031)	(0.160)	(0.001)	(0.461)
B_t^F	0.074^{***}	-0.008	-0.018^{**}	-0.006^{**}	-0.057^{***}	-0.000^{***}	0.251^{***}
	(0.013)	(0.010)	(0.008)	(0.002)	(0.008)	(0.000)	(0.069)
# of Obs	586	587	206	587	585	587	587
Adj. R^2	0.12	0.12	0.38	0.07	0.10	0.20	0.13

Note: All of the regressions are estimated at weekly frequency. Estimates of $\bar{\beta}^1$ and $\bar{\gamma}^1$ from the regression $s_t - \tilde{E}_t^F s_{t+n} + \bar{r}_t^n = \bar{\alpha}^1 + \bar{\beta}^1 X_t + \bar{\gamma}^1 B_t^F + \bar{\varepsilon}_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all reporting financial institutions in the BIS data with respect to all the counter-party entities within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A3: Positions and Expected Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using All BIS Assets and Reporting and Counter-party Entities – Weekly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.004^{***}	0.535^{***}	0.486^{***}	0.236^{***}	1.213^{***}	0.005^{***}	6.450^{***}
	(0.093)	(0.039)	(0.028)	(0.031)	(0.056)	(0.000)	(1.073)
B_t^F	-0.002	-0.026^{***}	0.080^{***}	0.019^{***}	0.025^{***}	0.000^{***}	-0.037
	(0.005)	(0.001)	(0.004)	(0.001)	(0.001)	(0.000)	(0.053)
# of Obs	710	746	470	494	746	746	52
Adj. R^2	0.22	0.47	0.69	0.51	0.43	0.32	0.77

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.338^{***}	0.268^{***}	0.773^{***}	0.058^{***}	0.666^{***}	0.003^{***}	2.086^{***}
	(0.032)	(0.022)	(0.044)	(0.010)	(0.046)	(0.000)	(0.176)
B_t^F	0.066^{***}	0.014^{***}	-0.012^{***}	0.003^{***}	-0.007^{***}	-0.000^{***}	0.164^{***}
	(0.006)	(0.003)	(0.001)	(0.001)	(0.002)	(0.000)	(0.018)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.25	0.26	0.40	0.07	0.29	0.34	0.26

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.394^{***}	0.267^{***}	0.226^{***}	0.100^{***}	0.653^{***}	0.003^{***}	4.007^{***}
	(0.056)	(0.025)	(0.016)	(0.019)	(0.031)	(0.000)	(0.595)
B_t^F	-0.028^{***}	-0.024^{***}	0.056^{***}	0.014^{***}	0.010^{***}	0.000^{***}	0.089^{**}
	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.036)
# of Obs	596	632	470	494	632	632	52
Adj. R^2	0.27	0.48	0.71	0.55	0.39	0.30	0.59

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.281^{***}	0.203^{***}	0.444^{***}	0.045^{***}	0.421^{***}	0.002^{***}	1.782^{***}
	(0.019)	(0.011)	(0.028)	(0.005)	(0.026)	(0.000)	(0.113)
B_t^F	0.032^{***}	0.010^{***}	-0.009^{***}	0.002^{***}	-0.004^{**}	-0.000^{***}	0.111^{***}
	(0.004)	(0.002)	(0.001)	(0.000)	(0.002)	(0.000)	(0.008)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.29	0.46	0.41	0.16	0.33	0.36	0.41

Note: All of the regressions are estimated at weekly frequency. Estimates of $\bar{\beta}^1$ and $\bar{\gamma}^1$ from the regression $s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^1 + \bar{\beta}^1 X_t + \bar{\gamma}^1 B_t^F + \bar{\varepsilon}_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all reporting financial institutions in the BIS data with respect to all the counter-party entities within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A4: Positions and Expected Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using Interbank Loans – Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	8.940^{***}	4.693^{***}	5.828^{***}	4.072^{***}	6.395^{***}	0.041^{***}	61.255^{***}
	(0.762)	(0.314)	(0.397)	(0.396)	(0.825)	(0.003)	(14.134)
B_t^F	0.604^{***}	-0.126^{***}	-0.358^{**}	-0.034^{***}	0.096^{**}	-0.000^{*}	0.228
	(0.096)	(0.037)	(0.148)	(0.010)	(0.047)	(0.000)	(1.209)
# of Obs	467	287	283	287	285	501	52
Adj. R^2	0.27	0.40	0.42	0.24	0.17	0.34	0.56

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	6.849^{***}	2.417^{***}	7.002^{***}	1.033^{***}	2.972^{***}	0.019^{***}	33.479^{***}
	(0.732)	(0.213)	(0.442)	(0.096)	(0.433)	(0.001)	(3.009)
B_t^F	-0.158^{**}	-0.094^{***}	-0.049^{***}	-0.028^{***}	-0.071^{**}	-0.000^{***}	0.544
	(0.069)	(0.029)	(0.012)	(0.006)	(0.034)	(0.000)	(0.463)
# of Obs	330	587	575	587	587	587	303
Adj. R^2	0.21	0.14	0.25	0.15	0.06	0.20	0.29

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	4.059^{***}	1.831^{***}	2.000^{***}	0.832^{***}	3.290^{***}	0.015^{***}	22.532^{***}
	(0.284)	(0.104)	(0.122)	(0.116)	(0.231)	(0.001)	(4.827)
B_t^F	0.347^{***}	-0.029^{***}	0.156^{***}	0.006^{**}	0.037^{***}	-0.000^{***}	-0.055
	(0.035)	(0.005)	(0.019)	(0.003)	(0.005)	(0.000)	(0.412)
# of Obs	542	578	465	576	578	575	52
Adj. R^2	0.35	0.47	0.48	0.11	0.31	0.30	0.63

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.121^{***}	0.801^{***}	2.814^{***}	0.283^{***}	0.927^{***}	0.007^{***}	5.165^{***}
	(0.116)	(0.073)	(0.218)	(0.034)	(0.154)	(0.001)	(0.467)
B_t^F	0.102^{***}	-0.027^{***}	-0.019^{**}	-0.011^{***}	-0.032^{***}	-0.000^{***}	0.441^{***}
	(0.023)	(0.010)	(0.008)	(0.002)	(0.012)	(0.000)	(0.104)
# of Obs	586	587	206	587	585	587	587
Adj. R^2	0.12	0.13	0.39	0.11	0.05	0.22	0.14

Note: All of the regressions are estimated at weekly frequency. Estimates of $\bar{\beta}^1$ and $\bar{\gamma}^1$ from the regression $s_t - \tilde{E}_t^F s_{t+n} + \bar{r}_t^n = \bar{\alpha}^1 + \bar{\beta}^1 X_t + \bar{\gamma}^1 B_t^F + \bar{\varepsilon}_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of all reporting banks in the BIS data with respect to all banks within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A5: Positions and Expected Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using Interbank Loans – Weekly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.613^{***}	0.498^{***}	0.487^{***}	0.176^{***}	1.178^{***}	0.004^{***}	6.672^{***}
	(0.108)	(0.045)	(0.031)	(0.033)	(0.055)	(0.000)	(1.050)
B_t^F	0.113^{***}	-0.027^{***}	0.088^{***}	0.010^{***}	0.021^{***}	-0.000^{***}	-0.046
	(0.017)	(0.002)	(0.006)	(0.001)	(0.001)	(0.000)	(0.103)
# of Obs	542	578	470	494	578	578	52
Adj. R^2	0.36	0.40	0.58	0.32	0.43	0.24	0.77

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.275^{***}	0.283^{***}	0.795^{***}	0.127^{***}	0.657^{***}	0.003^{***}	1.972^{***}
	(0.031)	(0.022)	(0.045)	(0.012)	(0.041)	(0.000)	(0.175)
B_t^F	0.041^{***}	0.011^{***}	-0.013^{***}	-0.006^{***}	-0.017^{***}	-0.000^{***}	0.235^{***}
	(0.007)	(0.004)	(0.001)	(0.001)	(0.003)	(0.000)	(0.026)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.14	0.24	0.40	0.16	0.33	0.46	0.26

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.954^{***}	0.293^{***}	0.228^{***}	0.021	0.659^{***}	0.002^{***}	3.740^{***}
	(0.075)	(0.030)	(0.018)	(0.021)	(0.031)	(0.000)	(0.600)
B_t^F	0.048^{***}	-0.022^{***}	0.061^{***}	0.009^{***}	0.010^{***}	-0.000^{***}	0.154^{*}
	(0.012)	(0.001)	(0.003)	(0.001)	(0.001)	(0.000)	(0.080)
# of Obs	542	578	470	494	578	578	52
Adj. R^2	0.27	0.38	0.56	0.42	0.40	0.25	0.58

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.249^{***}	0.207^{***}	0.459^{***}	0.078^{***}	0.427^{***}	0.002^{***}	1.690^{***}
	(0.019)	(0.011)	(0.029)	(0.007)	(0.023)	(0.000)	(0.114)
B_t^F	0.020^{***}	0.012^{***}	-0.009^{***}	-0.003^{***}	-0.014^{***}	-0.000^{***}	0.151^{***}
	(0.005)	(0.002)	(0.001)	(0.000)	(0.002)	(0.000)	(0.012)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.22	0.46	0.41	0.21	0.42	0.53	0.40

Note: All of the regressions are estimated at weekly frequency. Estimates of $\bar{\beta}^1$ and $\bar{\gamma}^1$ from the regression $s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^1 + \bar{\beta}^1 X_t + \bar{\gamma}^1 B_t^F + \bar{\varepsilon}_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of all reporting banks in the BIS data with respect to all banks within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

D.3.2 Positions and Realized Excess Returns – Weekly Frequency

Table A6: Positions and Realized Excess Returns – Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.844	-1.692^{*}	0.910	-1.166	3.884^{**}	-0.005	-36.158^{*}
	(1.229)	(0.964)	(1.039)	(1.019)	(1.607)	(0.006)	(21.423)
# of Obs	711	287	283	287	285	746	53
Adj. R^2	0.01	0.03	0.00	0.01	0.03	0.00	0.12

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.734	0.266	-0.841	-0.609^{**}	-0.007	-0.006	-1.816
	(2.530)	(0.617)	(1.177)	(0.251)	(1.044)	(0.004)	(12.127)
# of Obs	330	587	575	587	587	587	303
Adj. R^2	-0.00	-0.00	0.00	0.03	-0.00	0.01	-0.00

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	
X_t	-0.758	-0.609^{**}	-0.234	-0.962^{*}	0.856	0.000	
	(0.792)	(0.252)	(0.297)	(0.502)	(0.735)	(0.003)	
# of Obs	711	747	470	494	747	747	54
Adj. R^2	0.03	0.09	0.01	0.18	0.06	-0.00	0.71

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.141	-0.157	0.155	0.051	0.873^{***}	-0.002	2.049^{**}
	(0.256)	(0.212)	(0.225)	(0.073)	(0.219)	(0.002)	(0.930)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.01	0.02	0.01	0.01	0.18	0.04	0.08

Note: All of the regressions are estimated at weekly frequency. Estimates of β^1 from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{1, 24\}$ months. Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for overlapping observations. The realized excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A7: Positions and Realized Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using All BIS Assets and Reporting and Counter-party Entities– Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.173	-1.730^{*}	1.210	-1.768^{*}	4.085^{**}	-0.004	75.075^{***}
	(1.720)	(0.977)	(1.091)	(0.953)	(1.750)	(0.006)	(22.392)
B_t^F	0.056	-0.052	-0.275	0.075^{***}	0.055	0.000	7.674^{***}
	(0.088)	(0.079)	(0.257)	(0.029)	(0.093)	(0.000)	(1.177)
# of Obs	711	287	283	287	285	746	53
Adj. R^2	0.01	0.03	0.01	0.07	0.03	-0.00	0.67

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.491	0.570	-0.590	-0.607^{**}	-0.789	-0.005	-1.793
	(2.522)	(0.685)	(1.155)	(0.252)	(1.210)	(0.005)	(12.126)
B_t^F	0.358	-0.110	-0.025	0.028	0.138^{**}	-0.000	0.504
	(0.273)	(0.087)	(0.029)	(0.020)	(0.069)	(0.000)	(0.929)
# of Obs	330	587	575	587	587	587	303
Adj. R^2	0.01	0.01	0.00	0.03	0.02	0.01	-0.00

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.993^{*}	-0.513	1.076^{**}	-1.122^{***}	1.423^{*}	0.001	19.143^{***}
	(1.131)	(0.621)	(0.539)	(0.424)	(0.779)	(0.004)	(3.343)
B_t^F	0.012	-0.071^{**}	-0.206^{**}	-0.011	0.072^{***}	0.000	2.742^{***}
	(0.051)	(0.032)	(0.085)	(0.014)	(0.024)	(0.000)	(0.307)
# of Obs	711	747	465	711	740	742	54
Adj. R^2	0.05	0.06	0.10	0.04	0.09	-0.00	0.80

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.349	0.321	0.729	-0.289	-0.194	-0.002	3.950
	(0.598)	(0.494)	(0.816)	(0.212)	(0.946)	(0.004)	(2.870)
B_t^F	0.137	-0.079	-0.022	0.022	0.064	-0.000	0.628
	(0.091)	(0.079)	(0.026)	(0.018)	(0.066)	(0.000)	(0.409)
# of Obs	586	587	206	587	585	587	587
Adj. R^2	0.03	0.03	0.01	0.04	0.02	0.01	0.04

Note: All of the regressions are estimated at weekly frequency. Estimates of $\bar{\beta}^2$ and $\bar{\gamma}^2$ from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^2 + \bar{\beta}^2 X_t + \bar{\gamma}^2 B_t^F + \bar{\varepsilon}_t^2$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all reporting financial institutions in the BIS data with respect to all the counter-party entities within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A8: Positions and Realized Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using All BIS Assets and Reporting and Counter-party Entities – Weekly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.503	-0.371	0.035	-1.247^{**}	0.862^{***}	-0.001	12.343^{***}
	(1.079)	(0.384)	(0.327)	(0.547)	(0.332)	(0.003)	(2.467)
B_t^F	0.043	-0.063^{**}	-0.070	0.003	0.057^{***}	-0.000	0.839^{***}
	(0.043)	(0.030)	(0.061)	(0.015)	(0.016)	(0.000)	(0.160)
# of Obs	711	747	470	494	747	747	54
Adj. R^2	0.14	0.16	0.04	0.18	0.26	-0.00	0.66

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.589^{*}	0.113	1.021^{***}	-0.063	0.749^{*}	-0.003^{*}	5.002^{***}
	(0.312)	(0.264)	(0.292)	(0.138)	(0.434)	(0.002)	(1.496)
B_t^F	0.284^{***}	-0.064	-0.034^{***}	0.027^{**}	0.027	-0.000	0.649^{***}
	(0.071)	(0.054)	(0.011)	(0.013)	(0.048)	(0.000)	(0.189)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.30	0.08	0.26	0.14	0.08	0.08	0.27

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	
X_t	0.321	-0.532^{***}	-0.279	-1.147^{**}	1.536^{**}	0.001	
	(0.876)	(0.196)	(0.319)	(0.514)	(0.646)	(0.003)	
B_t^F	0.089^{**}	-0.064^{**}	0.027	0.019	0.038^{**}	0.000	
	(0.037)	(0.025)	(0.047)	(0.013)	(0.017)	(0.000)	
# of Obs	711	747	470	494	747	747	54
Adj. R^2	0.11	0.32	0.02	0.26	0.24	-0.00	0.74

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.140	-0.040	0.337^{**}	0.014	0.729^{***}	-0.002	3.394^{***}
	(0.176)	(0.186)	(0.165)	(0.069)	(0.181)	(0.002)	(0.718)
B_t^F	0.113^{**}	-0.049^{*}	-0.032^{***}	0.011	0.023	-0.000	0.450^{***}
	(0.052)	(0.029)	(0.007)	(0.007)	(0.017)	(0.000)	(0.119)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.13	0.14	0.50	0.09	0.23	0.04	0.44

Note: All of the regressions are estimated at weekly frequency. Estimates of $\bar{\beta}^2$ and $\bar{\gamma}^2$ from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^2 + \bar{\beta}^2 X_t + \bar{\gamma}^2 B_t^F + \bar{\varepsilon}_t^2$ for $n \in \{12, 28\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all reporting financial institutions in the BIS data with respect to all the counter-party entities within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A9: Positions and Realized Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using Interbank Loans – Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.144	-1.720^{*}	1.120	-1.490	3.906^{**}	-0.002	59.061^{***}
	(1.455)	(0.967)	(1.069)	(0.968)	(1.601)	(0.006)	(21.050)
B_t^F	0.477^{**}	-0.099	-0.342	0.048^{*}	0.167^{*}	0.000	14.257^{***}
	(0.208)	(0.102)	(0.370)	(0.025)	(0.099)	(0.001)	(2.424)
# of Obs	543	287	283	287	285	577	53
Adj. R^2	0.03	0.03	0.01	0.04	0.04	-0.00	0.62

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.430	0.332	-0.340	-0.622^{**}	-0.051	-0.004	-1.976
	(2.456)	(0.650)	(1.130)	(0.263)	(1.111)	(0.005)	(12.164)
B_t^F	0.246	-0.037	-0.043	0.004	0.016	-0.000	0.620
	(0.200)	(0.087)	(0.029)	(0.016)	(0.072)	(0.000)	(1.103)
# of Obs	330	587	575	587	587	587	303
Adj. R^2	0.00	-0.00	0.01	0.03	-0.00	0.02	-0.00

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.255	-0.470	1.294^{**}	-1.359^{**}	1.381^{*}	0.001	14.425^{***}
	(0.831)	(0.626)	(0.560)	(0.587)	(0.791)	(0.004)	(3.128)
B_t^F	0.307^{**}	-0.126^{***}	-0.351^{***}	-0.013	0.095^{***}	0.000	5.237^{***}
	(0.137)	(0.041)	(0.100)	(0.014)	(0.028)	(0.000)	(0.569)
# of Obs	542	578	465	576	578	575	54
Adj. R^2	0.11	0.13	0.15	0.10	0.14	-0.00	0.79

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.517	0.164	0.774	-0.297	0.267	-0.002	3.702
	(0.544)	(0.458)	(0.807)	(0.216)	(0.809)	(0.004)	(2.907)
B_t^F	0.232^{**}	-0.033	-0.031	0.002	-0.033	-0.000	0.860
	(0.112)	(0.073)	(0.025)	(0.013)	(0.066)	(0.000)	(0.641)
# of Obs	586	587	206	587	585	587	587
Adj. R^2	0.05	0.00	0.02	0.02	0.00	0.03	0.04

Note: All of the regressions are estimated at weekly frequency. Estimates of $\bar{\beta}^2$ and $\bar{\gamma}^2$ from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^2 + \bar{\beta}^2 X_t + \bar{\gamma}^2 B_t^F + \bar{\varepsilon}_t^2$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of all reporting banks in the BIS data with respect to all banks within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A10: Positions and Realized Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using Interbank Loans – Weekly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.544	-0.224	0.190	-1.000^{*}	1.013^{***}	0.000	11.197^{***}
	(0.579)	(0.412)	(0.300)	(0.548)	(0.296)	(0.003)	(2.025)
B_t^F	0.442^{***}	-0.114^{***}	-0.181^{**}	-0.009	0.078^{***}	0.000	1.645^{***}
	(0.123)	(0.029)	(0.074)	(0.010)	(0.018)	(0.000)	(0.303)
# of Obs	542	578	470	494	578	578	54
Adj. R^2	0.41	0.36	0.18	0.19	0.40	-0.00	0.68

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.313	0.037	1.090^{***}	0.025	0.962^{**}	-0.003	4.476^{***}
	(0.380)	(0.271)	(0.287)	(0.166)	(0.400)	(0.002)	(1.670)
B_t^F	0.173^{*}	-0.046	-0.036^{***}	0.001	-0.021	-0.000^{**}	0.885^{***}
	(0.105)	(0.056)	(0.012)	(0.009)	(0.053)	(0.000)	(0.324)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.14	0.02	0.27	-0.00	0.07	0.15	0.25

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	
X_t	1.341^{***}	-0.473^{***}	-0.149	-0.870	1.792^{**}	0.002	
	(0.472)	(0.164)	(0.268)	(0.576)	(0.695)	(0.002)	
B_t^F	0.541^{***}	-0.106^{***}	-0.057	-0.004	0.062^{***}	-0.000	
	(0.080)	(0.011)	(0.068)	(0.012)	(0.014)	(0.000)	
# of Obs	542	578	470	494	578	578	54
Adj. R^2	0.65	0.58	0.04	0.18	0.43	0.05	0.75

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.187	-0.108	0.398^{**}	0.097	0.916^{***}	-0.001	2.988^{***}
	(0.272)	(0.193)	(0.185)	(0.088)	(0.229)	(0.002)	(0.709)
B_t^F	0.132^{*}	-0.030	-0.033^{***}	-0.005	-0.019	-0.000^{**}	0.587^{***}
	(0.072)	(0.026)	(0.007)	(0.005)	(0.028)	(0.000)	(0.197)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.21	0.05	0.53	0.04	0.20	0.17	0.37

Note: All of the regressions are estimated at weekly frequency. Estimates of $\bar{\beta}^2$ and $\bar{\gamma}^2$ from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^2 + \bar{\beta}^2 X_t + \bar{\gamma}^2 B_t^F + \bar{\varepsilon}_t^2$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of all reporting banks in the BIS data with respect to all banks within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

D.3.3 Positions and Expected Exchange Rate Changes – Weekly Frequency

Table A11: Positions and Expected Exchange Rate Changes – Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	7.040^{***}	5.001^{***}	6.187^{***}	3.995^{***}	7.509^{***}	0.043^{***}	59.643^{***}
	(0.590)	(0.267)	(0.327)	(0.308)	(0.659)	(0.002)	(8.391)
# of Obs	467	502	499	502	502	502	52
Adj. R^2	0.24	0.45	0.41	0.22	0.25	0.36	0.56

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	3.257^{***}	2.245^{***}	6.370^{***}	0.930^{***}	2.791^{***}	0.017^{***}	15.736^{***}
	(0.256)	(0.207)	(0.393)	(0.089)	(0.413)	(0.001)	(1.275)
# of Obs	587	587	587	587	587	587	587
Adj. R^2	0.14	0.12	0.22	0.12	0.06	0.18	0.16

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	2.632^{***}	1.826^{***}	2.831^{***}	0.528^{***}	2.895^{***}	0.018^{***}	22.742^{***}
	(0.182)	(0.088)	(0.120)	(0.089)	(0.231)	(0.001)	(2.811)
# of Obs	711	746	743	746	746	746	52
Adj. R^2	0.20	0.44	0.36	0.02	0.24	0.31	0.63

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.975^{***}	0.750^{***}	2.311^{***}	0.239^{***}	0.875^{***}	0.006^{***}	4.616^{***}
	(0.092)	(0.070)	(0.132)	(0.032)	(0.147)	(0.001)	(0.437)
# of Obs	587	587	587	587	587	587	587
Adj. R^2	0.10	0.12	0.24	0.07	0.05	0.15	0.11

Note: All of the regressions are estimated at weekly frequency. Estimates of β^1 from the regression $s_t - \tilde{E}_t^F s_{t+n} = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected exchange rate change are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A12: Positions and Expected Exchange Rate Changes – Weekly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.328^{***}	0.525^{***}	0.894^{***}	-0.067^{*}	0.887^{***}	0.006^{***}	7.223^{***}
	(0.062)	(0.034)	(0.048)	(0.037)	(0.063)	(0.000)	(0.574)
# of Obs	711	746	743	746	746	746	52
Adj. R^2	0.33	0.37	0.23	0.00	0.20	0.25	0.79

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.291^{***}	0.279^{***}	0.802^{***}	0.055^{***}	0.455^{***}	0.002^{***}	1.378^{***}
	(0.024)	(0.020)	(0.040)	(0.009)	(0.044)	(0.000)	(0.132)
# of Obs	587	587	587	587	587	587	587
Adj. R^2	0.15	0.21	0.34	0.05	0.16	0.21	0.13

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.966^{***}	0.341^{***}	0.469^{***}	0.152^{***}	0.616^{***}	0.004^{***}	3.167^{***}
	(0.049)	(0.024)	(0.025)	(0.020)	(0.040)	(0.000)	(0.323)
# of Obs	597	632	629	632	632	632	52
Adj. R^2	0.33	0.34	0.23	0.04	0.31	0.33	0.62

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.306^{***}	0.245^{***}	0.512^{***}	0.052^{***}	0.357^{***}	0.001^{***}	1.343^{***}
	(0.016)	(0.012)	(0.030)	(0.005)	(0.021)	(0.000)	(0.094)
# of Obs	587	587	587	587	587	587	587
Adj. R^2	0.33	0.42	0.33	0.13	0.28	0.22	0.27

Note: All of the regressions are estimated at weekly frequency. Estimates of β^1 from the regression $s_t - \tilde{E}_t^F s_{t+n} = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected exchange rate change are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

D.3.4 Positions and Realized Exchange Rate Changes – Weekly Frequency

Table A13: Positions and Realized Exchange Rate Changes – Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.568	-1.605^{**}	1.425^{*}	-1.513^{**}	2.216^{*}	-0.003	-37.029^{*}
	(1.208)	(0.763)	(0.861)	(0.655)	(1.240)	(0.006)	(21.268)
# of Obs	712	747	744	747	747	747	54
Adj. R^2	0.00	0.02	0.01	0.02	0.01	-0.00	0.12

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.255	0.261	-0.400	-0.618^{**}	0.004	-0.006	2.848
	(0.740)	(0.620)	(1.202)	(0.250)	(1.050)	(0.004)	(3.938)
# of Obs	587	587	587	587	587	587	587
Adj. R^2	-0.00	-0.00	-0.00	0.03	-0.00	0.01	0.00

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.876^{**}	-0.585	0.763	-1.021^{**}	0.009	0.002	-21.635^{**}
	(0.859)	(0.647)	(0.514)	(0.410)	(0.771)	(0.004)	(8.898)
# of Obs	712	747	744	747	747	747	54
Adj. R^2	0.04	0.01	0.01	0.04	-0.00	0.00	0.29

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.077	0.103	0.346	-0.298	0.232	-0.003	2.612
	(0.498)	(0.442)	(0.903)	(0.206)	(0.750)	(0.003)	(2.562)
# of Obs	587	587	587	587	587	587	587
Adj. R^2	-0.00	-0.00	0.00	0.02	-0.00	0.01	0.01

Note: All of the regressions are estimated at weekly frequency. Estimates of β^1 from the regression $s_t - s_{t+n} = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{1, 3\}$ months. Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for overlapping observations. The realized exchange rate changes are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A14: Positions and Realized Exchange Rate Changes – Weekly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.734^{**}	-0.428	-0.238	-0.969^{**}	-0.037	0.000	0.161
	(0.804)	(0.410)	(0.368)	(0.380)	(0.474)	(0.002)	(1.818)
# of Obs	712	747	744	747	747	747	54
Adj. R^2	0.11	0.03	0.00	0.13	-0.00	-0.00	-0.02

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.041	0.059	0.833^{**}	0.059	1.184^{***}	-0.003	2.748^{**}
	(0.364)	(0.273)	(0.415)	(0.129)	(0.406)	(0.002)	(1.346)
# of Obs	563	563	563	563	563	563	563
Adj. R^2	-0.00	-0.00	0.07	0.00	0.12	0.04	0.05

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	
X_t	-0.539	-0.595^{***}	-0.164	-0.734^{**}	0.957	0.002	
	(0.673)	(0.225)	(0.281)	(0.350)	(0.645)	(0.002)	
# of Obs	712	747	744	747	747	747	54
Adj. R^2	0.02	0.10	0.00	0.14	0.08	0.01	0.72

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.032	-0.113	0.233	0.087	0.875^{***}	-0.002	2.084^{**}
	(0.261)	(0.222)	(0.228)	(0.075)	(0.202)	(0.002)	(0.828)
# of Obs	511	511	511	511	511	511	511
Adj. R^2	-0.00	0.01	0.02	0.04	0.19	0.03	0.09

Note: All of the regressions are estimated at weekly frequency. Estimates of β^1 from the regression $s_t - s_{t+n} = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{12, 24\}$ months. Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for overlapping observations. The realized exchange rate changes are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

D.3.5 Explaining Positions with Expected Excess Returns – Weekly Frequency

Table A15: Explaining Positions with Expected Excess Returns ($n \in \{1, 3\}$) – Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.033^{***}	0.081^{***}	0.073^{***}	0.057^{***}	0.026^{***}	8.210^{***}	0.010^{***}
	(0.003)	(0.006)	(0.005)	(0.005)	(0.003)	(0.601)	(0.001)
# of Obs	467	287	283	287	285	501	52
Adj. R^2	0.22	0.38	0.41	0.22	0.16	0.34	0.57

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.031^{***}	0.054^{***}	0.037^{***}	0.130^{***}	0.021^{***}	10.693^{***}	0.009^{***}
	(0.004)	(0.006)	(0.003)	(0.014)	(0.003)	(0.946)	(0.001)
# of Obs	330	587	575	587	587	587	303
Adj. R^2	0.20	0.12	0.23	0.12	0.06	0.18	0.29

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.070^{***}	0.245^{***}	0.179^{***}	0.050^{***}	0.082^{***}	16.258^{***}	0.028^{***}
	(0.006)	(0.011)	(0.008)	(0.009)	(0.004)	(1.030)	(0.003)
# of Obs	710	746	465	711	740	741	52
Adj. R^2	0.16	0.44	0.40	0.03	0.23	0.26	0.63

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.095^{***}	0.156^{***}	0.134^{***}	0.290^{***}	0.052^{***}	27.962^{***}	0.024^{***}
	(0.011)	(0.017)	(0.015)	(0.039)	(0.008)	(2.598)	(0.003)
# of Obs	586	587	206	587	585	587	587
Adj. R^2	0.08	0.12	0.37	0.07	0.04	0.15	0.11

Note: All of the regressions are estimated at weekly frequency. Estimates of $\tilde{\beta}^1$ from regression $X_t = \tilde{\alpha}^1 + \tilde{\beta}^1(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n) + \tilde{\varepsilon}_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A16: Explaining Positions with Expected Excess Returns ($n \in \{12, 24\}$) – Weekly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.217^{***}	0.584^{***}	0.509^{***}	0.354^{***}	0.217^{***}	33.412^{***}	0.112^{***}
	(0.019)	(0.031)	(0.028)	(0.035)	(0.015)	(2.952)	(0.009)
# of Obs	710	746	470	494	746	746	52
Adj. R^2	0.22	0.29	0.31	0.15	0.17	0.14	0.77

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.300^{***}	0.763^{***}	0.377^{***}	0.959^{***}	0.453^{***}	119.222^{***}	0.087^{***}
	(0.044)	(0.057)	(0.035)	(0.138)	(0.032)	(6.342)	(0.008)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.05	0.23	0.26	0.06	0.28	0.28	0.14

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.308^{***}	0.654^{***}	0.700^{***}	0.459^{***}	0.501^{***}	61.381^{***}	0.203^{***}
	(0.027)	(0.056)	(0.050)	(0.051)	(0.033)	(5.600)	(0.019)
# of Obs	596	632	470	494	632	632	52
Adj. R^2	0.22	0.18	0.22	0.11	0.24	0.15	0.55

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.866^{***}	1.781^{***}	0.571^{***}	2.731^{***}	0.805^{***}	222.261^{***}	0.190^{***}
	(0.070)	(0.093)	(0.056)	(0.271)	(0.059)	(9.891)	(0.010)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.17	0.40	0.22	0.14	0.32	0.34	0.27

Note: All of the regressions are estimated at weekly frequency. Estimates of $\tilde{\beta}^1$ from regression $X_t = \tilde{\alpha}^1 + \tilde{\beta}^1(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n) + \tilde{\varepsilon}_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

D.3.6 Explaining Positions with Expected Excess Returns and Controlling for Lagged Positions– Weekly Frequency

Table A17: Explaining Positions with Expected Excess Returns ($n = 1$) – Weekly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.009^{***}	0.021^{***}	0.030^{***}	0.018^{***}	0.010^{***}	2.824^{***}	0.002^{**}
	(0.001)	(0.003)	(0.003)	(0.002)	(0.001)	(0.331)	(0.001)
X_{t-1}	0.916^{***}	0.944^{***}	0.800^{***}	0.944^{***}	0.976^{***}	0.861^{***}	0.746^{***}
	(0.073)	(0.061)	(0.063)	(0.064)	(0.082)	(0.052)	(0.145)
X_{t-2}	-0.060	-0.052	-0.090	-0.215^{**}	-0.255^{**}	-0.072	0.060
	(0.097)	(0.082)	(0.082)	(0.086)	(0.109)	(0.065)	(0.219)
X_{t-3}	-0.026	-0.113	0.027	0.093	0.139	-0.038	0.078
	(0.095)	(0.092)	(0.081)	(0.086)	(0.104)	(0.066)	(0.210)
X_{t-4}	0.088	0.110^{*}	0.096^{*}	0.078	0.074	0.094^{**}	-0.075
	(0.067)	(0.066)	(0.054)	(0.065)	(0.080)	(0.046)	(0.158)
# of Obs	467	287	283	287	285	501	50
Adj. R^2	0.93	0.93	0.93	0.90	0.92	0.88	0.85

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.009^{***}	0.013^{***}	0.012^{***}	0.022^{***}	0.008^{***}	2.682^{***}	0.003^{***}
	(0.002)	(0.002)	(0.001)	(0.003)	(0.001)	(0.275)	(0.000)
X_{t-1}	1.077^{***}	1.096^{***}	0.904^{***}	1.087^{***}	0.978^{***}	0.960^{***}	1.102^{***}
	(0.070)	(0.043)	(0.057)	(0.047)	(0.056)	(0.046)	(0.074)
X_{t-2}	-0.219^{**}	-0.062	-0.046	-0.163^{**}	-0.016	-0.027	-0.282^{***}
	(0.101)	(0.060)	(0.072)	(0.066)	(0.081)	(0.073)	(0.102)
X_{t-3}	-0.040	-0.180^{***}	-0.068	-0.091	-0.152^{**}	-0.081	-0.015
	(0.092)	(0.062)	(0.065)	(0.060)	(0.074)	(0.069)	(0.077)
X_{t-4}	0.071	0.094^{**}	0.098^{**}	0.140^{***}	0.139^{***}	0.083^{**}	0.077^{*}
	(0.055)	(0.041)	(0.046)	(0.040)	(0.047)	(0.040)	(0.046)
# of Obs	330	587	575	587	587	587	303
Adj. R^2	0.87	0.96	0.90	0.98	0.94	0.95	0.92

Note: All of the regressions are estimated at weekly frequency. Estimates of $\tilde{\beta}^1$ from regression $X_t = \tilde{\alpha}^1 + \tilde{\beta}^1(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n) + \tilde{\varepsilon}_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A18: Explaining Positions with Expected Excess Returns ($n = 3$) – Weekly Frequency

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.016^{***}	0.060^{***}	0.063^{***}	0.021^{***}	0.030^{***}	4.713^{***}	0.006^{**}
	(0.002)	(0.005)	(0.006)	(0.003)	(0.003)	(0.536)	(0.002)
X_{t-1}	0.974^{***}	0.980^{***}	0.910^{***}	1.010^{***}	0.946^{***}	0.941^{***}	0.722^{***}
	(0.069)	(0.039)	(0.046)	(0.041)	(0.040)	(0.046)	(0.145)
X_{t-2}	-0.085	-0.135^{**}	-0.119^{*}	-0.152^{**}	-0.155^{***}	-0.101^{*}	0.059
	(0.096)	(0.055)	(0.066)	(0.061)	(0.060)	(0.061)	(0.215)
X_{t-3}	-0.026	-0.077	-0.072	0.025	0.011	-0.054	0.074
	(0.096)	(0.061)	(0.075)	(0.061)	(0.054)	(0.062)	(0.206)
X_{t-4}	0.074	0.096^{**}	0.102^{**}	0.078^{*}	0.076^{**}	0.082^{**}	-0.077
	(0.068)	(0.042)	(0.047)	(0.043)	(0.037)	(0.042)	(0.155)
# of Obs	707	743	465	711	740	738	50
Adj. R^2	0.93	0.92	0.90	0.93	0.88	0.87	0.85

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.027^{***}	0.035^{***}	0.037^{***}	0.057^{***}	0.023^{***}	6.551^{***}	0.007^{***}
	(0.004)	(0.005)	(0.007)	(0.008)	(0.003)	(0.742)	(0.001)
X_{t-1}	1.101^{***}	1.106^{***}	1.058^{***}	1.107^{***}	0.985^{***}	0.989^{***}	1.081^{***}
	(0.052)	(0.043)	(0.102)	(0.047)	(0.056)	(0.047)	(0.044)
X_{t-2}	-0.158^{**}	-0.066	-0.255^{**}	-0.168^{**}	-0.018	-0.035	-0.095
	(0.075)	(0.061)	(0.128)	(0.068)	(0.082)	(0.075)	(0.062)
X_{t-3}	-0.112	-0.183^{***}	-0.036	-0.095	-0.155^{**}	-0.088	-0.070
	(0.069)	(0.062)	(0.086)	(0.061)	(0.074)	(0.071)	(0.057)
X_{t-4}	0.123^{***}	0.092^{**}	0.086	0.135^{***}	0.139^{***}	0.074^{*}	0.008
	(0.044)	(0.042)	(0.054)	(0.041)	(0.047)	(0.041)	(0.042)
# of Obs	586	587	206	587	585	587	587
Adj. R^2	0.95	0.96	0.90	0.98	0.94	0.95	0.93

Note: All of the regressions are estimated at weekly frequency. Estimates of $\tilde{\beta}^1$ from regression $X_t = \tilde{\alpha}^1 + \tilde{\beta}^1(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n) + \tilde{\varepsilon}_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A19: Explaining Positions with Expected Excess Returns ($n = 12$) – Weekly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.028^{***}	0.086^{***}	0.121^{***}	0.051^{***}	0.057^{***}	6.864^{***}	0.040^{***}
	(0.005)	(0.016)	(0.016)	(0.012)	(0.007)	(1.285)	(0.009)
X_{t-1}	1.022^{***}	1.098^{***}	1.050^{***}	1.033^{***}	1.032^{***}	1.018^{***}	0.660^{***}
	(0.068)	(0.040)	(0.049)	(0.047)	(0.039)	(0.046)	(0.136)
X_{t-2}	-0.100	-0.173^{***}	-0.166^{**}	-0.195^{***}	-0.185^{***}	-0.116^{*}	0.019
	(0.099)	(0.059)	(0.074)	(0.072)	(0.062)	(0.064)	(0.201)
X_{t-3}	-0.026	-0.079	-0.078	0.043	0.010	-0.059	0.078
	(0.099)	(0.067)	(0.082)	(0.074)	(0.058)	(0.065)	(0.197)
X_{t-4}	0.040	0.062	0.042	0.048	0.031	0.051	-0.135
	(0.070)	(0.046)	(0.051)	(0.051)	(0.038)	(0.043)	(0.148)
# of Obs	707	743	470	494	743	743	50
Adj. R^2	0.92	0.91	0.88	0.90	0.86	0.86	0.87

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.073^{***}	0.102^{***}	0.087^{***}	0.165^{***}	0.096^{***}	16.116^{***}	0.019^{***}
	(0.013)	(0.019)	(0.013)	(0.029)	(0.012)	(2.822)	(0.003)
X_{t-1}	1.142^{***}	1.116^{***}	0.963^{***}	1.140^{***}	0.946^{***}	1.006^{***}	1.100^{***}
	(0.055)	(0.051)	(0.060)	(0.050)	(0.060)	(0.051)	(0.052)
X_{t-2}	-0.180^{**}	-0.077	-0.078	-0.184^{**}	-0.020	-0.024	-0.127^{*}
	(0.083)	(0.073)	(0.081)	(0.074)	(0.090)	(0.081)	(0.069)
X_{t-3}	-0.096	-0.199^{***}	-0.075	-0.089	-0.130	-0.092	-0.076
	(0.075)	(0.073)	(0.073)	(0.067)	(0.083)	(0.077)	(0.062)
X_{t-4}	0.095^{**}	0.103^{**}	0.067	0.107^{**}	0.104^{**}	0.039	0.030
	(0.047)	(0.050)	(0.050)	(0.045)	(0.052)	(0.045)	(0.046)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.95	0.96	0.89	0.97	0.92	0.94	0.93

Note: All of the regressions are estimated at weekly frequency. Estimates of $\tilde{\beta}^1$ from regression $X_t = \tilde{\alpha}^1 + \tilde{\beta}^1(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n) + \tilde{\varepsilon}_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A20: Explaining Positions with Expected Excess Returns ($n = 24$) – Weekly Frequency

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.028^{***}	0.066^{***}	0.134^{***}	0.051^{***}	0.100^{***}	10.493^{***}	0.027
	(0.008)	(0.023)	(0.024)	(0.018)	(0.015)	(2.430)	(0.019)
X_{t-1}	1.040^{***}	1.140^{***}	1.099^{***}	1.048^{***}	1.064^{***}	1.025^{***}	0.828^{***}
	(0.070)	(0.042)	(0.049)	(0.047)	(0.042)	(0.049)	(0.138)
X_{t-2}	-0.103	-0.189^{***}	-0.177^{**}	-0.199^{***}	-0.228^{***}	-0.117^{*}	0.071
	(0.102)	(0.064)	(0.075)	(0.073)	(0.070)	(0.070)	(0.236)
X_{t-3}	-0.026	-0.093	-0.083	0.045	0.047	-0.056	0.074
	(0.101)	(0.075)	(0.083)	(0.075)	(0.066)	(0.069)	(0.214)
X_{t-4}	0.031	0.072	0.030	0.042	0.003	0.042	-0.147
	(0.071)	(0.050)	(0.052)	(0.051)	(0.042)	(0.046)	(0.162)
# of Obs	596	632	470	494	632	632	50
Adj. R^2	0.92	0.91	0.87	0.90	0.87	0.86	0.84

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.080^{***}	0.189^{***}	0.103^{***}	0.230^{***}	0.119^{***}	23.618^{***}	0.026^{***}
	(0.018)	(0.035)	(0.022)	(0.055)	(0.019)	(5.010)	(0.004)
X_{t-1}	1.170^{***}	1.122^{***}	1.000^{***}	1.168^{***}	0.993^{***}	1.025^{***}	1.121^{***}
	(0.054)	(0.052)	(0.060)	(0.050)	(0.060)	(0.051)	(0.052)
X_{t-2}	-0.189^{**}	-0.078	-0.084	-0.193^{**}	-0.026	-0.026	-0.135^{*}
	(0.085)	(0.075)	(0.083)	(0.075)	(0.092)	(0.082)	(0.070)
X_{t-3}	-0.092	-0.193^{***}	-0.077	-0.086	-0.136	-0.094	-0.074
	(0.077)	(0.073)	(0.075)	(0.068)	(0.084)	(0.077)	(0.063)
X_{t-4}	0.063	0.077	0.050	0.083^{*}	0.072	0.023	-0.001
	(0.047)	(0.050)	(0.052)	(0.046)	(0.053)	(0.046)	(0.046)
# of Obs	498	486	499	499	482	499	499
Adj. R^2	0.95	0.96	0.88	0.97	0.92	0.94	0.93

Note: All of the regressions are estimated at weekly frequency. Estimates of $\tilde{\beta}^1$ from regression $X_t = \tilde{\alpha}^1 + \tilde{\beta}^1(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n) + \tilde{\varepsilon}_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

D.4 Testing the Euler – Monthly Frequency

D.4.1 Positions and Expected Excess Returns – Monthly Frequency

Table A21: Positions and Expected Excess Returns – Monthly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	4.75^{***}	3.41^{***}	3.33^{***}	2.16^{***}	3.86^{***}	0.03^{***}	46.66^{**}
	(1.00)	(0.56)	(0.56)	(0.66)	(1.21)	(0.00)	(15.15)
# of Obs	110	65	64	65	65	115	12
Adj. R^2	0.15	0.28	0.29	0.13	0.08	0.24	0.53

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	4.62^{***}	1.37^{***}	3.95^{***}	0.54^{***}	1.37^{*}	0.01^{***}	19.55^{***}
	(1.22)	(0.34)	(0.62)	(0.16)	(0.73)	(0.00)	(5.15)
# of Obs	75	134	132	134	134	134	69
Adj. R^2	0.18	0.07	0.12	0.05	0.02	0.08	0.16

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.77^{***}	1.36^{***}	1.38^{***}	0.11	1.84^{***}	0.01^{***}	18.63^{***}
	(0.31)	(0.16)	(0.19)	(0.15)	(0.35)	(0.00)	(5.06)
# of Obs	166	171	106	163	169	170	12
Adj. R^2	0.11	0.35	0.27	-0.00	0.13	0.17	0.63

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.43^{***}	0.46^{***}	2.46^{***}	0.11^{*}	0.38	0.00^{***}	2.04^{***}
	(0.15)	(0.12)	(0.47)	(0.06)	(0.27)	(0.00)	(0.74)
# of Obs	134	134	30	134	134	134	134
Adj. R^2	0.03	0.07	0.42	0.01	0.01	0.07	0.03

Note: All of the regressions are estimated at monthly frequency. Estimates of β^1 from the regression $s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A22: Positions and Expected Excess Returns – Monthly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.93^{***}	0.40^{***}	0.48^{***}	0.33^{***}	0.61^{***}	0.00^{***}	6.06^{***}
	(0.12)	(0.08)	(0.07)	(0.07)	(0.10)	(0.00)	(0.96)
# of Obs	166	171	107	113	171	171	12
Adj. R^2	0.18	0.21	0.23	0.09	0.11	0.10	0.81

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.09^{*}	0.23^{***}	0.58^{***}	0.04^{*}	0.55^{***}	0.00^{***}	1.04^{***}
	(0.05)	(0.04)	(0.08)	(0.02)	(0.09)	(0.00)	(0.33)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.01	0.18	0.20	0.01	0.24	0.20	0.06

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.69^{***}	0.22^{***}	0.28^{***}	0.19^{***}	0.44^{***}	0.00^{***}	2.56^{***}
	(0.09)	(0.06)	(0.05)	(0.05)	(0.06)	(0.00)	(0.60)
# of Obs	140	145	107	113	145	145	12
Adj. R^2	0.20	0.12	0.18	0.07	0.21	0.13	0.56

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.17^{***}	0.20^{***}	0.36^{***}	0.04^{***}	0.38^{***}	0.00^{***}	1.29^{***}
	(0.03)	(0.02)	(0.06)	(0.01)	(0.05)	(0.00)	(0.25)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.13	0.36	0.20	0.08	0.29	0.28	0.21

Note: All of the regressions are estimated at monthly frequency. Estimates of β^1 from the regression $s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A23: Positions and Expected Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using All BIS Assets and Reporting and Counter-party Entities – Monthly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	6.660^{***}	3.392^{***}	3.495^{***}	2.335^{***}	4.008^{***}	0.029^{***}	44.676
	(1.267)	(0.542)	(0.656)	(0.614)	(1.173)	(0.004)	(25.014)
B_t^F	0.192^{**}	-0.069	-0.133	-0.031^{*}	0.046	0.001^{***}	-0.135
	(0.075)	(0.049)	(0.199)	(0.017)	(0.084)	(0.000)	(1.071)
# of Obs	110	65	64	65	65	115	12
Adj. R^2	0.17	0.28	0.29	0.15	0.07	0.28	0.48

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	4.507^{***}	1.552^{***}	4.413^{***}	0.537^{***}	2.142^{***}	0.011^{***}	19.459^{***}
	(1.223)	(0.378)	(0.681)	(0.164)	(0.776)	(0.003)	(5.180)
B_t^F	0.122	-0.070	-0.063^{***}	-0.022^{*}	-0.133^{***}	-0.000	0.429
	(0.128)	(0.050)	(0.021)	(0.013)	(0.045)	(0.000)	(0.593)
# of Obs	75	134	132	134	134	134	69
Adj. R^2	0.18	0.08	0.17	0.06	0.08	0.10	0.16

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	2.886^{***}	1.438^{***}	1.116^{***}	0.519^{**}	2.632^{***}	0.012^{***}	17.198^{*}
	(0.508)	(0.159)	(0.182)	(0.239)	(0.357)	(0.002)	(8.538)
B_t^F	0.095^{***}	-0.046^{***}	0.147^{***}	0.040^{***}	0.046^{***}	0.001^{***}	-0.097
	(0.030)	(0.008)	(0.023)	(0.005)	(0.009)	(0.000)	(0.358)
# of Obs	166	171	106	163	169	170	12
Adj. R^2	0.16	0.44	0.49	0.36	0.25	0.29	0.60

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.584^{***}	0.507^{***}	3.224^{***}	0.113^{*}	0.657^{**}	0.004^{***}	2.621^{***}
	(0.170)	(0.135)	(0.308)	(0.058)	(0.280)	(0.001)	(0.762)
B_t^F	0.055^{**}	-0.018	0.118^{***}	-0.006	-0.048^{***}	-0.000^{**}	0.271^{**}
	(0.022)	(0.018)	(0.024)	(0.005)	(0.016)	(0.000)	(0.115)
# of Obs	134	134	30	134	134	134	134
Adj. R^2	0.05	0.07	0.67	0.01	0.07	0.11	0.07

Note: All of the regressions are estimated at monthly frequency. Estimates of $\bar{\beta}^1$ and $\bar{\gamma}^1$ from the regression $s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^1 + \bar{\beta}^1 X_t + \bar{\gamma}^1 B_t^F + \bar{\varepsilon}_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all reporting financial institutions in the BIS data with respect to all the counter-party entities within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A24: Positions and Expected Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using All BIS Assets and Reporting and Counter-party Entities – Monthly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.874^{***}	0.447^{***}	0.339^{***}	0.169^{***}	1.049^{***}	0.004^{***}	5.549^{**}
	(0.191)	(0.076)	(0.049)	(0.061)	(0.107)	(0.001)	(1.826)
B_t^F	-0.005	-0.027^{***}	0.079^{***}	0.019^{***}	0.025^{***}	0.000^{***}	-0.035
	(0.011)	(0.003)	(0.006)	(0.002)	(0.003)	(0.000)	(0.093)
# of Obs	166	171	107	113	171	171	12
Adj. R^2	0.18	0.44	0.70	0.53	0.39	0.31	0.80

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.238^{***}	0.207^{***}	0.627^{***}	0.027	0.579^{***}	0.002^{***}	1.595^{***}
	(0.056)	(0.042)	(0.082)	(0.019)	(0.096)	(0.000)	(0.341)
B_t^F	0.061^{***}	0.012^{*}	-0.014^{***}	0.003	-0.005	-0.000^{***}	0.182^{***}
	(0.010)	(0.006)	(0.002)	(0.002)	(0.004)	(0.000)	(0.034)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.23	0.21	0.39	0.02	0.24	0.25	0.25

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.384^{***}	0.234^{***}	0.183^{***}	0.079^{*}	0.613^{***}	0.003^{***}	3.996^{***}
	(0.116)	(0.051)	(0.032)	(0.040)	(0.062)	(0.000)	(0.991)
B_t^F	-0.028^{***}	-0.024^{***}	0.055^{***}	0.014^{***}	0.010^{***}	0.000^{***}	0.097
	(0.007)	(0.003)	(0.004)	(0.001)	(0.001)	(0.000)	(0.060)
# of Obs	140	145	107	113	145	145	12
Adj. R^2	0.24	0.46	0.71	0.55	0.37	0.30	0.60

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.249^{***}	0.177^{***}	0.392^{***}	0.033^{***}	0.397^{***}	0.001^{***}	1.670^{***}
	(0.038)	(0.022)	(0.056)	(0.010)	(0.055)	(0.000)	(0.242)
B_t^F	0.032^{***}	0.009^{***}	-0.010^{***}	0.002^{**}	-0.003	-0.000^{**}	0.126^{***}
	(0.007)	(0.003)	(0.001)	(0.001)	(0.003)	(0.000)	(0.017)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.25	0.41	0.42	0.09	0.29	0.29	0.39

Note: All of the regressions are estimated at monthly frequency. Estimates of $\bar{\beta}^1$ and $\bar{\gamma}^1$ from the regression $s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^1 + \bar{\beta}^1 X_t + \bar{\gamma}^1 B_t^F + \bar{\varepsilon}_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all reporting financial institutions in the BIS data with respect to all the counter-party entities within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A25: Positions and Expected Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using Interbank Loans – Monthly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	6.625^{***}	3.402^{***}	3.497^{***}	2.250^{***}	3.835^{***}	0.025^{***}	48.956^{*}
	(1.304)	(0.534)	(0.602)	(0.625)	(1.221)	(0.004)	(25.459)
B_t^F	0.519^{***}	-0.107^{*}	-0.253	-0.021	0.048	-0.000	0.338
	(0.169)	(0.062)	(0.246)	(0.016)	(0.135)	(0.000)	(2.139)
# of Obs	110	65	64	65	65	115	12
Adj. R^2	0.19	0.29	0.30	0.13	0.07	0.24	0.48

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	4.749^{***}	1.550^{***}	4.504^{***}	0.643^{***}	1.573^{**}	0.011^{***}	19.421^{***}
	(1.149)	(0.362)	(0.692)	(0.174)	(0.761)	(0.003)	(5.206)
B_t^F	-0.095	-0.106^{**}	-0.063^{***}	-0.030^{**}	-0.073	-0.000^{*}	0.364
	(0.116)	(0.053)	(0.021)	(0.012)	(0.069)	(0.000)	(0.726)
# of Obs	75	134	132	134	134	134	69
Adj. R^2	0.18	0.10	0.16	0.10	0.02	0.11	0.15

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	3.361^{***}	1.448^{***}	1.125^{***}	0.233	2.285^{***}	0.010^{***}	18.917^{*}
	(0.525)	(0.195)	(0.186)	(0.199)	(0.365)	(0.002)	(8.694)
B_t^F	0.319^{***}	-0.032^{***}	0.157^{***}	0.010^{**}	0.034^{***}	-0.000^{**}	0.042
	(0.067)	(0.009)	(0.032)	(0.005)	(0.009)	(0.000)	(0.719)
# of Obs	127	132	106	132	132	131	12
Adj. R^2	0.29	0.40	0.41	0.05	0.22	0.21	0.59

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.654^{***}	0.512^{***}	3.282^{***}	0.153^{**}	0.466^{*}	0.004^{***}	2.658^{***}
	(0.190)	(0.130)	(0.308)	(0.062)	(0.277)	(0.001)	(0.764)
B_t^F	0.104^{***}	-0.031	0.124^{***}	-0.011^{***}	-0.032	-0.000^{***}	0.455^{***}
	(0.039)	(0.019)	(0.024)	(0.004)	(0.024)	(0.000)	(0.167)
# of Obs	134	134	30	134	134	134	134
Adj. R^2	0.09	0.08	0.68	0.07	0.02	0.14	0.08

Note: All of the regressions are estimated at monthly frequency. Estimates of $\bar{\beta}^1$ and $\bar{\gamma}^1$ from the regression $s_t - \tilde{E}_t^F s_{t+n} + \bar{r}_t^n = \bar{\alpha}^1 + \bar{\beta}^1 X_t + \bar{\gamma}^1 B_t^F + \bar{\varepsilon}_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of all reporting banks in the BIS data with respect to all banks within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A26: Positions and Expected Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using Interbank Loans – Monthly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.527^{***}	0.413^{***}	0.348^{***}	0.080	1.025^{***}	0.003^{***}	5.774^{**}
	(0.230)	(0.089)	(0.056)	(0.064)	(0.102)	(0.001)	(1.819)
B_t^F	0.114^{***}	-0.027^{***}	0.086^{***}	0.011^{***}	0.021^{***}	-0.000^{***}	-0.042
	(0.036)	(0.003)	(0.011)	(0.002)	(0.003)	(0.000)	(0.184)
# of Obs	127	132	107	113	132	132	12
Adj. R^2	0.32	0.35	0.55	0.33	0.40	0.19	0.79

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.190^{***}	0.216^{***}	0.652^{***}	0.099^{***}	0.585^{***}	0.002^{***}	1.477^{***}
	(0.056)	(0.043)	(0.084)	(0.026)	(0.086)	(0.000)	(0.341)
B_t^F	0.042^{***}	0.012	-0.014^{***}	-0.006^{***}	-0.017^{***}	-0.000^{***}	0.258^{***}
	(0.013)	(0.008)	(0.002)	(0.002)	(0.006)	(0.000)	(0.047)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.13	0.20	0.40	0.13	0.30	0.37	0.24

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.953^{***}	0.256^{***}	0.191^{***}	-0.014	0.627^{***}	0.002^{***}	3.752^{***}
	(0.160)	(0.061)	(0.037)	(0.043)	(0.061)	(0.000)	(0.882)
B_t^F	0.053^{**}	-0.022^{***}	0.059^{***}	0.009^{***}	0.010^{***}	-0.000^{**}	0.175
	(0.026)	(0.003)	(0.007)	(0.001)	(0.002)	(0.000)	(0.120)
# of Obs	127	132	107	113	132	132	12
Adj. R^2	0.26	0.34	0.52	0.41	0.39	0.21	0.58

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.221^{***}	0.179^{***}	0.409^{***}	0.069^{***}	0.409^{***}	0.002^{***}	1.572^{***}
	(0.040)	(0.021)	(0.058)	(0.015)	(0.049)	(0.000)	(0.246)
B_t^F	0.021^{**}	0.013^{***}	-0.010^{***}	-0.003^{***}	-0.014^{***}	-0.000^{***}	0.169^{***}
	(0.010)	(0.004)	(0.001)	(0.001)	(0.004)	(0.000)	(0.026)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.18	0.42	0.42	0.16	0.39	0.47	0.37

Note: All of the regressions are estimated at monthly frequency. Estimates of $\bar{\beta}^1$ and $\bar{\gamma}^1$ from the regression $s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^1 + \bar{\beta}^1 X_t + \bar{\gamma}^1 B_t^F + \bar{\varepsilon}_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of all reporting banks in the BIS data with respect to all banks within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

D.4.2 Positions and Realized Excess Returns – Monthly Frequency

Table A27: Positions and Realized Excess Returns – Monthly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.05	-1.61	1.02	-1.21	5.18^{**}	-0.01	-30.36
	(1.76)	(1.20)	(1.26)	(1.30)	(2.10)	(0.01)	(21.52)
# of Obs	110	65	64	65	65	115	12
Adj. R^2	-0.01	0.01	-0.01	-0.00	0.04	-0.00	0.09

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.26	0.25	-0.98	-0.70^{**}	-0.47	-0.01^{*}	2.61
	(2.94)	(0.66)	(1.45)	(0.32)	(1.17)	(0.01)	(12.93)
# of Obs	75	134	132	134	134	134	69
Adj. R^2	-0.01	-0.01	-0.00	0.03	-0.01	0.02	-0.01

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-2.17^{**}	-0.99	0.66	-1.07^{**}	0.40	0.00	-21.11^{**}
	(0.98)	(0.69)	(0.61)	(0.49)	(0.82)	(0.00)	(8.51)
# of Obs	166	171	106	163	169	170	12
Adj. R^2	0.04	0.03	0.00	0.03	-0.00	-0.01	0.28

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.03	0.16	0.84	-0.28	-0.06	-0.00	1.92
	(0.56)	(0.46)	(1.01)	(0.23)	(0.82)	(0.00)	(2.59)
# of Obs	134	134	30	134	134	134	134
Adj. R^2	-0.01	-0.01	-0.01	0.02	-0.01	0.00	-0.00

Note: All of the regressions are estimated at monthly frequency. Estimates of β^2 from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \alpha^2 + \beta^2 X_t + \varepsilon_{t+n}^2$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in panels (A) and (B), and Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for overlapping observations in panels (C) and (D). The realized excess returns are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A28: Positions and Realized Excess Returns – Monthly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY
X_t	-1.94^{**}	-0.53	-0.13	-1.33^{**}	-0.03	-0.00
	(0.91)	(0.45)	(0.39)	(0.53)	(0.46)	(0.00)
# of Obs	166	171	107	113	171	171
Adj. R^2	0.11	0.03	-0.01	0.19	-0.01	-0.00

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.14	-0.03	1.00^{**}	0.03	0.89^{*}	-0.00	2.82
	(0.41)	(0.31)	(0.42)	(0.14)	(0.46)	(0.00)	(1.87)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	-0.01	-0.01	0.09	-0.01	0.05	0.05	0.04

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY
X_t	-0.97	-0.67^{***}	-0.19	-1.03^{**}	0.78	0.00
	(0.80)	(0.21)	(0.31)	(0.51)	(0.72)	(0.00)
# of Obs	140	145	107	113	145	145
Adj. R^2	0.05	0.10	-0.00	0.18	0.04	0.02

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.12	-0.15	0.21	0.05	0.90^{***}	-0.00	2.07^{*}
	(0.26)	(0.20)	(0.20)	(0.08)	(0.23)	(0.00)	(1.05)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	-0.00	0.01	0.01	0.01	0.17	0.03	0.08

Note: All of the regressions are estimated at monthly frequency. Estimates of β^2 from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \alpha^2 + \beta^2 X_t + \varepsilon_{t+n}^2$ for $n \in \{12, 24\}$ months. Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for overlapping observations. The realized excess returns are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A29: Positions and Realized Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using All BIS Assets and Reporting and Counter-party Entities– Monthly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.454	−1.624	1.554	−1.593	5.376**	−0.007	57.980**
	(2.215)	(1.199)	(1.294)	(1.208)	(2.226)	(0.009)	(19.407)
B_t^F	0.151	−0.075	−0.430	0.067*	0.060	0.000	5.985***
	(0.125)	(0.085)	(0.285)	(0.034)	(0.117)	(0.000)	(0.913)
# of Obs	110	65	64	65	65	115	12
Adj. R^2	-0.01	0.00	0.01	0.03	0.03	-0.01	0.70

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.863	0.640	−0.552	−0.703**	−1.062	−0.008	2.527
	(2.952)	(0.702)	(1.376)	(0.319)	(1.332)	(0.006)	(13.047)
B_t^F	0.440	−0.149*	−0.059*	0.012	0.101	−0.000	0.385
	(0.328)	(0.087)	(0.035)	(0.022)	(0.070)	(0.000)	(1.150)
# of Obs	75	134	132	134	134	134	69
Adj. R^2	-0.00	0.01	0.01	0.02	0.00	0.02	-0.03

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	−1.889	−0.855	1.034*	−1.170**	1.825**	0.001	19.984***
	(1.254)	(0.638)	(0.601)	(0.459)	(0.860)	(0.005)	(4.555)
B_t^F	0.024	−0.074**	−0.209**	−0.009	0.083***	0.000	2.784***
	(0.052)	(0.033)	(0.092)	(0.015)	(0.026)	(0.000)	(0.371)
# of Obs	166	171	106	163	169	170	12
Adj. R^2	0.04	0.07	0.09	0.03	0.11	-0.01	0.83

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.392	0.385	1.923**	−0.285	−0.498	−0.002	3.520
	(0.679)	(0.494)	(0.854)	(0.238)	(1.051)	(0.004)	(2.881)
B_t^F	0.151	−0.088	0.167***	0.019	0.076	−0.000	0.751*
	(0.104)	(0.081)	(0.060)	(0.019)	(0.070)	(0.000)	(0.437)
# of Obs	134	134	30	134	134	134	134
Adj. R^2	0.02	0.02	0.19	0.02	0.01	0.00	0.04

Note: All of the regressions are estimated at monthly frequency. Estimates of $\bar{\beta}^2$ and $\bar{\gamma}^2$ from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^2 + \bar{\beta}^2 X_t + \bar{\gamma}^2 B_t^F + \bar{\varepsilon}_t^2$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all reporting financial institutions in the BIS data with respect to all the counter-party entities within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A30: Positions and Realized Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using All BIS Assets and Reporting and Counter-party Entities – Monhly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY
X_t	-1.302	-0.414	-0.000	-1.349^{**}	1.044^{***}	-0.002
	(1.088)	(0.405)	(0.340)	(0.577)	(0.331)	(0.003)
B_t^F	0.054	-0.063^{**}	-0.072	0.002	0.061^{***}	-0.000
	(0.043)	(0.031)	(0.064)	(0.015)	(0.018)	(0.000)
# of Obs	166	171	107	113	171	171
Adj. R^2	0.12	0.16	0.03	0.18	0.27	-0.01

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.562^{*}	0.118	1.107^{***}	-0.059	0.729	-0.003	4.851^{***}
	(0.331)	(0.274)	(0.290)	(0.139)	(0.450)	(0.002)	(1.668)
B_t^F	0.284^{***}	-0.067	-0.034^{***}	0.026^{*}	0.025	-0.000	0.672^{***}
	(0.073)	(0.056)	(0.012)	(0.013)	(0.048)	(0.000)	(0.206)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.30	0.07	0.28	0.11	0.06	0.05	0.26

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY
X_t	0.409	-0.632^{***}	-0.235	-1.169^{**}	1.579^{**}	0.003
	(0.828)	(0.164)	(0.332)	(0.523)	(0.625)	(0.003)
B_t^F	0.125^{***}	-0.067^{**}	0.024	0.017	0.046^{**}	0.000
	(0.042)	(0.026)	(0.044)	(0.013)	(0.019)	(0.000)
# of Obs	140	145	107	113	145	145
Adj. R^2	0.18	0.33	-0.00	0.24	0.29	0.02

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.169	-0.039	0.314^{*}	0.013	0.751^{***}	-0.002	3.485^{***}
	(0.184)	(0.178)	(0.180)	(0.069)	(0.174)	(0.002)	(0.836)
B_t^F	0.118^{**}	-0.050	-0.032^{***}	0.010	0.023	-0.000	0.468^{***}
	(0.052)	(0.031)	(0.007)	(0.007)	(0.017)	(0.000)	(0.124)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.13	0.13	0.51	0.07	0.22	0.03	0.45

Note: All of the regressions are estimated at monthly frequency. Estimates of $\bar{\beta}^2$ and $\bar{\gamma}^2$ from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^2 + \bar{\beta}^2 X_t + \bar{\gamma}^2 B_t^F + \bar{\varepsilon}_t^2$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all reporting financial institutions in the BIS data with respect to all the counter-party entities within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A31: Positions and Realized Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using Interbank Loans – Monthly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.734	−1.613	1.314	−1.389	5.093**	−0.006	43.912**
	(1.832)	(1.189)	(1.270)	(1.238)	(2.100)	(0.010)	(16.519)
B_t^F	0.768**	−0.123	−0.445	0.041	0.189*	0.001	10.944***
	(0.310)	(0.114)	(0.418)	(0.029)	(0.111)	(0.001)	(1.534)
# of Obs	110	65	64	65	65	115	12
Adj. R^2	0.02	0.01	-0.01	0.00	0.04	-0.00	0.62

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.710	0.361	−0.302	−0.676**	−0.354	−0.007	2.344
	(2.853)	(0.686)	(1.335)	(0.329)	(1.225)	(0.005)	(13.019)
B_t^F	0.391*	−0.065	−0.077**	−0.007	−0.043	−0.000	0.737
	(0.231)	(0.086)	(0.034)	(0.018)	(0.078)	(0.000)	(1.478)
# of Obs	75	134	132	134	134	134	69
Adj. R^2	-0.00	-0.01	0.02	0.02	-0.01	0.03	-0.03

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	−1.114	−0.803	1.243**	−1.485**	1.821**	0.002	15.564***
	(0.990)	(0.643)	(0.606)	(0.619)	(0.880)	(0.005)	(2.948)
B_t^F	0.333**	−0.124***	−0.361***	−0.013	0.107***	0.000	5.404***
	(0.153)	(0.043)	(0.105)	(0.014)	(0.030)	(0.001)	(0.617)
# of Obs	127	132	106	132	132	131	12
Adj. R^2	0.10	0.14	0.15	0.09	0.15	-0.01	0.83

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.518	0.230	1.944**	−0.286	0.015	−0.002	3.337
	(0.578)	(0.470)	(0.915)	(0.244)	(0.905)	(0.004)	(2.934)
B_t^F	0.254**	−0.044	0.165**	0.001	−0.026	−0.000	1.049
	(0.116)	(0.076)	(0.067)	(0.015)	(0.073)	(0.000)	(0.696)
# of Obs	134	134	30	134	134	134	134
Adj. R^2	0.05	-0.01	0.17	0.01	-0.01	0.02	0.04

Note: All of the regressions are estimated at monthly frequency. Estimates of $\bar{\beta}^2$ and $\bar{\gamma}^2$ from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^2 + \bar{\beta}^2 X_t + \bar{\gamma}^2 B_t^F + \bar{\varepsilon}_t^2$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of all reporting banks in the BIS data with respect to all banks within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

Table A32: Positions and Realized Excess Returns; Financiers' Foreign Currency Asset Holdings Proxied Using Interbank Loans – Monthly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY
X_t	-0.371	-0.240	0.150	-1.134^{*}	1.186^{***}	0.000
	(0.593)	(0.447)	(0.316)	(0.591)	(0.310)	(0.003)
B_t^F	0.469^{***}	-0.114^{***}	-0.184^{**}	-0.008	0.083^{***}	0.000
	(0.129)	(0.030)	(0.079)	(0.010)	(0.020)	(0.000)
# of Obs	127	132	107	113	132	132
Adj. R^2	0.40	0.36	0.17	0.20	0.42	-0.01

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.282	0.046	1.173^{***}	0.036	0.947^{**}	-0.002	4.382^{**}
	(0.422)	(0.286)	(0.276)	(0.163)	(0.378)	(0.002)	(1.812)
B_t^F	0.174	-0.050	-0.036^{***}	-0.000	-0.022	-0.000^{**}	0.935^{***}
	(0.110)	(0.058)	(0.012)	(0.009)	(0.053)	(0.000)	(0.349)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.13	0.01	0.29	-0.02	0.05	0.12	0.24

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY
X_t	1.296^{***}	-0.504^{***}	-0.102	-0.920	1.742^{***}	0.003
	(0.445)	(0.158)	(0.277)	(0.589)	(0.635)	(0.002)
B_t^F	0.545^{***}	-0.105^{***}	-0.060	-0.005	0.065^{***}	-0.000
	(0.084)	(0.011)	(0.067)	(0.012)	(0.015)	(0.000)
# of Obs	127	132	107	113	132	132
Adj. R^2	0.67	0.58	0.02	0.18	0.45	0.04

(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.203	-0.101	0.373^{*}	0.102	0.951^{***}	-0.001	3.107^{***}
	(0.271)	(0.183)	(0.201)	(0.091)	(0.247)	(0.002)	(0.818)
B_t^F	0.134^{*}	-0.031	-0.033^{***}	-0.005	-0.020	-0.000^{*}	0.619^{***}
	(0.071)	(0.027)	(0.007)	(0.005)	(0.029)	(0.000)	(0.201)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.21	0.03	0.54	0.03	0.19	0.16	0.38

Note: All of the regressions are estimated at monthly frequency. Estimates of $\bar{\beta}^2$ and $\bar{\gamma}^2$ from the regression $s_t - s_{t+n} + \tilde{r}_t^n = \bar{\alpha}^2 + \bar{\beta}^2 X_t + \bar{\gamma}^2 B_t^F + \bar{\varepsilon}_t^2$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency. B_t^F is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of all reporting banks in the BIS data with respect to all banks within the given country. If $B_t^F > 0$, then the financiers have positive net foreign currency assets.

D.4.3 Positions and Expected Exchange Rate Changes – Monthly Frequency

Table A33: Positions and Expected Exchange Rate Changes – Monthly Frequency

(A) Expectations Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	4.75^{***}	3.41^{***}	3.33^{***}	2.16^{***}	3.86^{***}	0.03^{***}	46.66^{**}
	(1.00)	(0.56)	(0.56)	(0.66)	(1.21)	(0.00)	(15.15)
# of Obs	110	65	64	65	65	115	12
Adj. R^2	0.15	0.28	0.29	0.13	0.08	0.24	0.53

(B) Expectations Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	4.62^{***}	1.37^{***}	3.95^{***}	0.54^{***}	1.37^{*}	0.01^{***}	19.55^{***}
	(1.22)	(0.34)	(0.62)	(0.16)	(0.73)	(0.00)	(5.15)
# of Obs	75	134	132	134	134	134	69
Adj. R^2	0.18	0.07	0.12	0.05	0.02	0.08	0.16

(C) Expectations Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	1.77^{***}	1.36^{***}	1.38^{***}	0.11	1.84^{***}	0.01^{***}	18.63^{***}
	(0.31)	(0.16)	(0.19)	(0.15)	(0.35)	(0.00)	(5.06)
# of Obs	166	171	106	163	169	170	12
Adj. R^2	0.11	0.35	0.27	-0.00	0.13	0.17	0.63

(D) Expectations Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.43^{***}	0.46^{***}	2.46^{***}	0.11^{*}	0.38	0.00^{***}	2.04^{***}
	(0.15)	(0.12)	(0.47)	(0.06)	(0.27)	(0.00)	(0.74)
# of Obs	134	134	30	134	134	134	134
Adj. R^2	0.03	0.07	0.42	0.01	0.01	0.07	0.03

Note: All of the regressions are estimated at monthly frequency. Estimates of β^1 from the regression $s_t - \tilde{E}_t^F s_{t+n} = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected exchange rate changes are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A34: Positions and Expected Exchange Rate Changes – Monthly Frequency

(A) Expectations Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.93^{***}	0.40^{***}	0.48^{***}	0.33^{***}	0.61^{***}	0.00^{***}	6.06^{***}
	(0.12)	(0.08)	(0.07)	(0.07)	(0.10)	(0.00)	(0.96)
# of Obs	166	171	107	113	171	171	12
Adj. R^2	0.18	0.21	0.23	0.09	0.11	0.10	0.81

(B) Expectations Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.09^{*}	0.23^{***}	0.58^{***}	0.04^{*}	0.55^{***}	0.00^{***}	1.04^{***}
	(0.05)	(0.04)	(0.08)	(0.02)	(0.09)	(0.00)	(0.33)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.01	0.18	0.20	0.01	0.24	0.20	0.06

(C) Expectations Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.69^{***}	0.22^{***}	0.28^{***}	0.19^{***}	0.44^{***}	0.00^{***}	2.56^{***}
	(0.09)	(0.06)	(0.05)	(0.05)	(0.06)	(0.00)	(0.60)
# of Obs	140	145	107	113	145	145	12
Adj. R^2	0.20	0.12	0.18	0.07	0.21	0.13	0.56

(D) Expectations Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.17^{***}	0.20^{***}	0.36^{***}	0.04^{***}	0.38^{***}	0.00^{***}	1.29^{***}
	(0.03)	(0.02)	(0.06)	(0.01)	(0.05)	(0.00)	(0.25)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.13	0.36	0.20	0.08	0.29	0.28	0.21

Note: All of the regressions are estimated at monthly frequency. Estimates of β^1 from the regression $s_t - \tilde{E}_t^F s_{t+n} = \alpha^1 + \beta^1 X_t + \varepsilon_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected exchange rate changes are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

D.4.4 Positions and Realized Exchange Rate Changes – Monthly Frequency

Table A35: Positions and Realized Exchange Rate Changes – Monthly Frequency

(A) Changes Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.69	-1.88^{*}	1.62	-1.61^{*}	3.09^{*}	-0.01	-30.55
	(1.74)	(0.99)	(1.12)	(0.97)	(1.78)	(0.01)	(21.58)
# of Obs	110	115	114	115	115	115	12
Adj. R^2	-0.01	0.03	0.01	0.01	0.01	-0.00	0.09

(B) Changes Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.35	0.25	-0.78	-0.71^{**}	-0.46	-0.01^{*}	2.35
	(0.90)	(0.67)	(1.45)	(0.32)	(1.17)	(0.01)	(4.27)
# of Obs	134	134	134	134	134	134	134
Adj. R^2	-0.01	-0.01	-0.01	0.03	-0.01	0.02	-0.01

(C) Changes Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-1.90^{*}	-0.96	0.80	-1.05^{**}	0.18	0.00	-21.26^{**}
	(0.97)	(0.67)	(0.57)	(0.45)	(0.87)	(0.00)	(8.61)
# of Obs	166	171	170	171	171	171	12
Adj. R^2	0.03	0.03	0.01	0.03	-0.01	-0.00	0.28

(D) Changes Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.04	0.16	0.08	-0.29	-0.03	-0.00	1.94
	(0.56)	(0.46)	(0.91)	(0.23)	(0.82)	(0.00)	(2.62)
# of Obs	134	134	134	134	134	134	134
Adj. R^2	-0.01	-0.01	-0.01	0.02	-0.01	0.00	-0.00

Note: All of the regressions are estimated at monthly frequency. Estimates of β^2 from the regression $s_t - s_{t+n} = \alpha^2 + \beta^2 X_t + \varepsilon^2_{t+n}$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in panels (A) and (B), and Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for overlapping observations in panels (C) and (D). The realized exchange rate changes are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A36: Positions and Realized Exchange Rate Changes – Monthly Frequency

(A) Changes Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY
X_t	-1.64^{*}	-0.50	-0.24	-1.02^{**}	0.07	0.00
	(0.85)	(0.43)	(0.37)	(0.41)	(0.47)	(0.00)
# of Obs	166	171	170	171	171	171
Adj. R^2	0.09	0.03	-0.00	0.14	-0.01	-0.01

(B) Changes Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	0.02	0.07	0.98^{**}	0.06	1.16^{***}	-0.00	2.54^{*}
	(0.40)	(0.29)	(0.42)	(0.13)	(0.39)	(0.00)	(1.38)
# of Obs	129	129	129	129	129	129	129
Adj. R^2	-0.01	-0.01	0.10	-0.00	0.11	0.03	0.04

(C) Changes Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY
X_t	-0.71	-0.59^{***}	-0.07	-1.12^{***}	0.89	0.00^{*}
	(0.69)	(0.17)	(0.36)	(0.36)	(0.64)	(0.00)
# of Obs	140	145	144	145	145	145
Adj. R^2	0.03	0.09	-0.01	0.26	0.06	0.06

(D) Changes Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
X_t	-0.02	-0.10	0.29	0.09	0.90^{***}	-0.00	2.09^{**}
	(0.26)	(0.21)	(0.20)	(0.08)	(0.21)	(0.00)	(0.93)
# of Obs	117	117	117	117	117	117	117
Adj. R^2	-0.01	-0.00	0.02	0.03	0.19	0.02	0.08

Note: All of the regressions are estimated at monthly frequency. Estimates of β^2 from the regression $s_t - s_{t+n} = \alpha^2 + \beta^2 X_t + \varepsilon^2_{t+n}$ for $n \in \{12, 24\}$ months. Newey-West heteroskedasticity and autocorrelation consistent standard errors to account for overlapping observations. The realized exchange rate changes are in percentage changes and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

D.4.5 Explaining Positions with Expected Excess Returns – Monthly Frequency

Table A37: Explaining Positions with Expected Excess Returns ($n \in \{1, 3\}$) – Monthly Frequency

(A) Over the Next Month (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.03^{***}	0.08^{***}	0.09^{***}	0.06^{***}	0.02^{***}	9.12^{***}	0.01^{***}
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(1.62)	(0.00)
# of Obs	110	65	64	65	65	115	12
Adj. R^2	0.15	0.28	0.29	0.13	0.08	0.24	0.53

(B) Over the Next Month (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.04^{***}	0.06^{***}	0.03^{***}	0.11^{***}	0.02^{**}	9.49^{***}	0.01^{***}
	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)	(2.71)	(0.00)
# of Obs	75	134	132	134	134	134	69
Adj. R^2	0.18	0.07	0.12	0.05	0.02	0.08	0.16

(C) Over the Next Quarter (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.06^{***}	0.26^{***}	0.20^{***}	0.01	0.07^{***}	15.70^{***}	0.04^{***}
	(0.01)	(0.03)	(0.03)	(0.02)	(0.01)	(2.52)	(0.01)
# of Obs	166	171	106	163	169	170	12
Adj. R^2	0.11	0.35	0.27	-0.00	0.13	0.17	0.63

(D) Over the Next Quarter (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.08^{***}	0.16^{***}	0.18^{***}	0.18^{**}	0.04	23.07^{***}	0.02^{**}
	(0.03)	(0.04)	(0.04)	(0.09)	(0.02)	(7.31)	(0.01)
# of Obs	134	134	30	134	134	134	134
Adj. R^2	0.03	0.07	0.42	0.01	0.01	0.07	0.03

Note: All of the regressions are estimated at monthly frequency. Estimates of $\tilde{\beta}^1$ from regression $X_t = \tilde{\alpha}^1 + \tilde{\beta}^1(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n) + \tilde{\varepsilon}_t^1$ for $n \in \{1, 3\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

Table A38: Explaining Positions with Expected Excess Returns ($n \in \{12, 24\}$) – Monthly Frequency

(A) Over the Next Year (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.20^{***}	0.54^{***}	0.50^{***}	0.31^{***}	0.18^{***}	30.49^{***}	0.14^{***}
	(0.04)	(0.07)	(0.07)	(0.08)	(0.03)	(6.68)	(0.02)
# of Obs	166	171	107	113	171	171	12
Adj. R^2	0.18	0.21	0.23	0.09	0.11	0.10	0.81

(B) Over the Next Year (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.19^{*}	0.82^{***}	0.36^{***}	0.58^{*}	0.45^{***}	110.97^{***}	0.07^{***}
	(0.10)	(0.12)	(0.10)	(0.31)	(0.08)	(17.59)	(0.02)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.01	0.18	0.20	0.01	0.24	0.20	0.06

(C) Over the Next Two Years (Before Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.30^{***}	0.57^{***}	0.67^{***}	0.38^{***}	0.49^{***}	58.66^{***}	0.23^{***}
	(0.06)	(0.13)	(0.11)	(0.11)	(0.07)	(11.62)	(0.04)
# of Obs	140	145	107	113	145	145	12
Adj. R^2	0.20	0.12	0.18	0.07	0.21	0.13	0.56

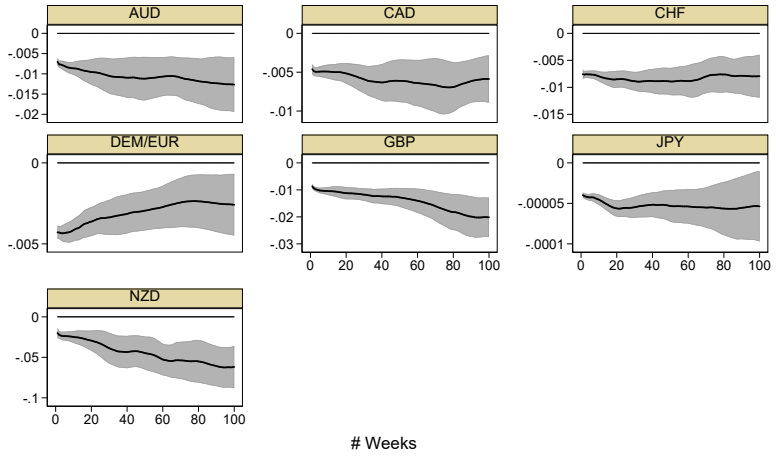
(D) Over the Next Two Years (After Feb 7, 2007)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n$	0.78^{***}	1.86^{***}	0.56^{***}	2.14^{***}	0.78^{***}	215.64^{***}	0.17^{***}
	(0.14)	(0.19)	(0.13)	(0.60)	(0.13)	(24.83)	(0.02)
# of Obs	114	111	114	114	110	114	114
Adj. R^2	0.13	0.36	0.20	0.08	0.29	0.28	0.21

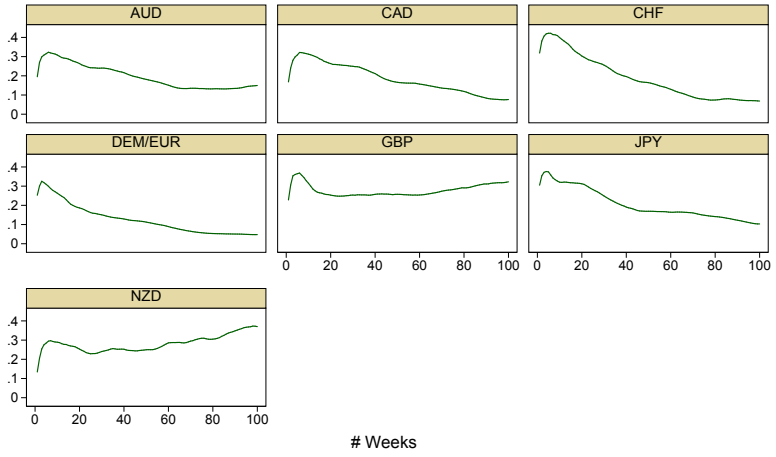
Note: All of the regressions are estimated at monthly frequency. Estimates of $\tilde{\beta}^1$ from regression $X_t = \tilde{\alpha}^1 + \tilde{\beta}^1(s_t - \tilde{E}_t^F s_{t+n} + \tilde{r}_t^n) + \tilde{\varepsilon}_t^1$ for $n \in \{12, 24\}$ months. Heteroskedasticity consistent standard errors in parentheses. The expected excess returns are in percentages and annualized while X_t is the long minus short position of the hedgers (minus the speculators) in billions of the non-USD currency where a positive number means that the hedgers are long the non-USD currency.

D.5 Explaining Realized Exchange Rate Changes

Figure A4: Explaining Exchange Rate Changes at Higher Frequencies



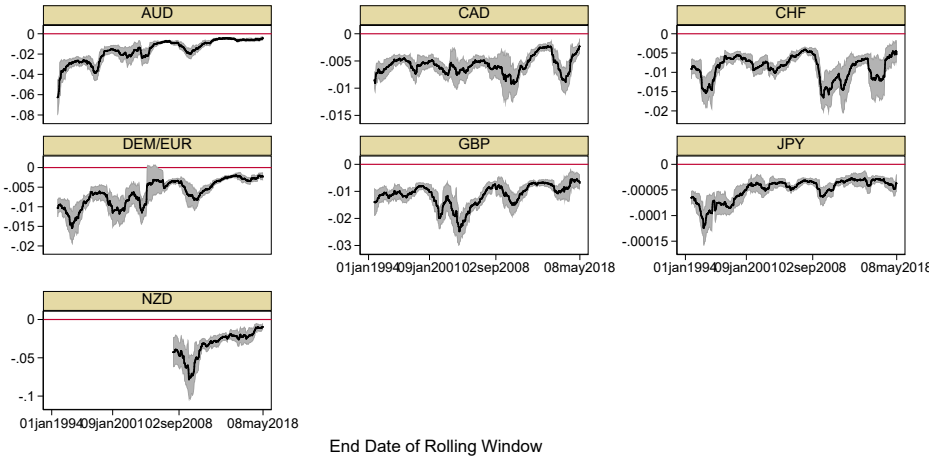
(a) Coefficient on $mX_t^S - mX_{t-j}^S$



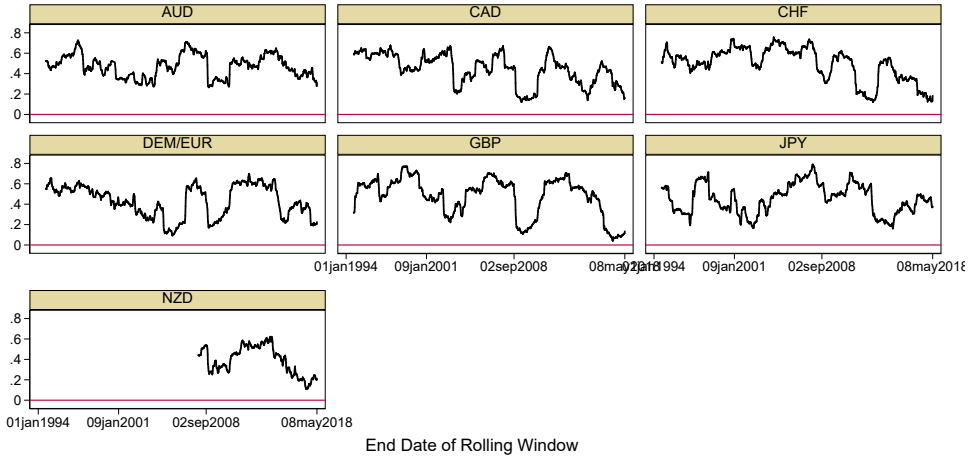
(b) Adjusted R^2

Note: Estimates of $\beta^{3,j}$ from the weekly regression $s_t - s_{t-j} = \alpha^3 + \beta^{3,j}(mX_t^S - mX_{t-j}^S) + \varepsilon_t^3$ for j ranging from 1 to 100 weeks. Gray bands are two standard errors around the point estimates based on Newey-West heteroskedasticity and autocorrelation consistent standard errors. mX_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency.

Figure A5: Rolling regressions, 4-week changes



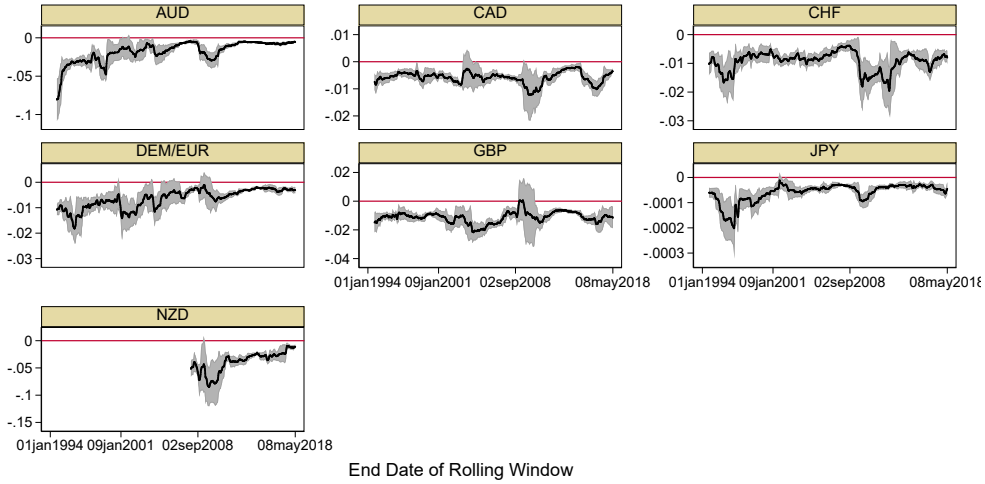
(a) Coefficient on $mX_t^S - mX_{t-j}^S$



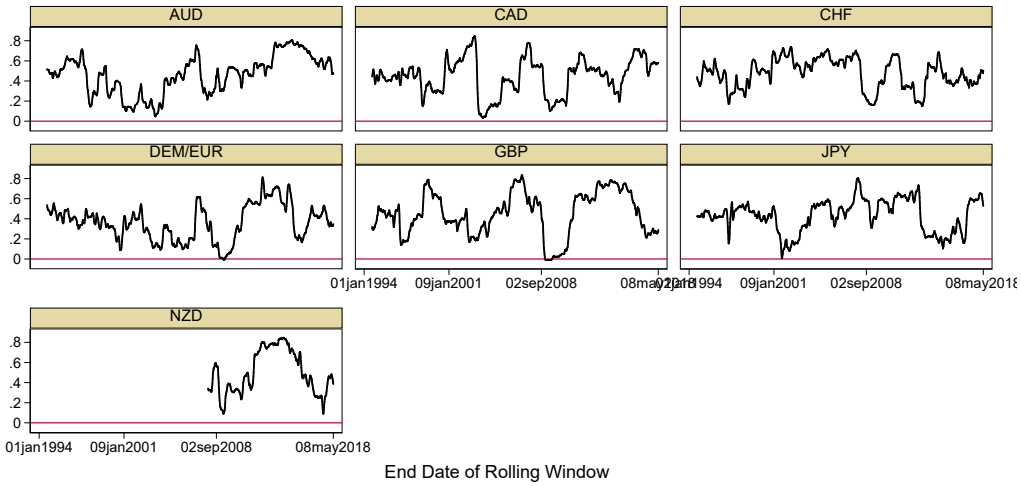
(b) Adjusted R^2

Note: Rolling estimates over 100-week windows of $\beta^{3,j}$ from the weekly regression $s_t - s_{t-j} = \alpha^3 + \beta^{3,j}(mX_t^S - mX_{t-j}^S) + \varepsilon_t^3$ for j being 4 weeks. Gray bands are two standard errors around the point estimates based on Newey-West heteroskedasticity and autocorrelation consistent standard errors. mX_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency.

Figure A6: Rolling regressions, 12-week changes



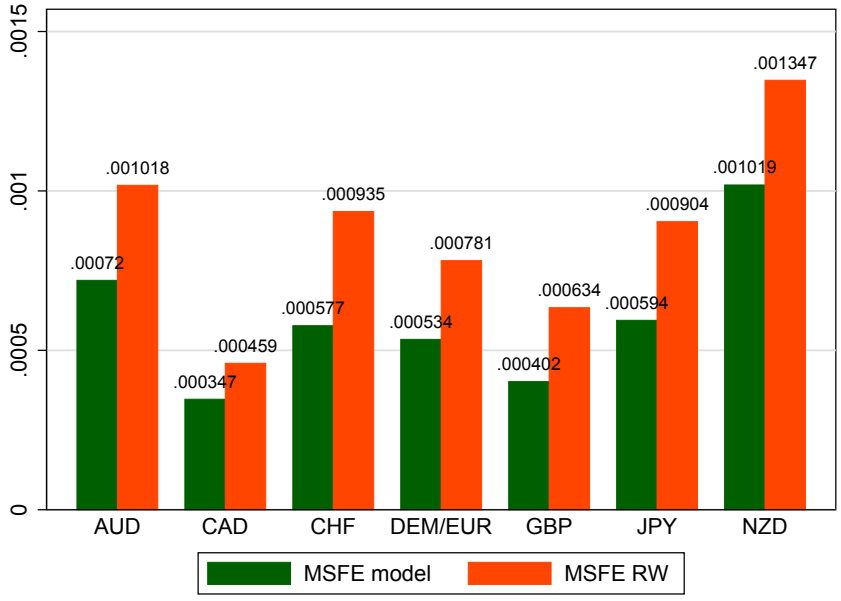
(a) Coefficient on $mX_t^S - mX_{t-j}^S$



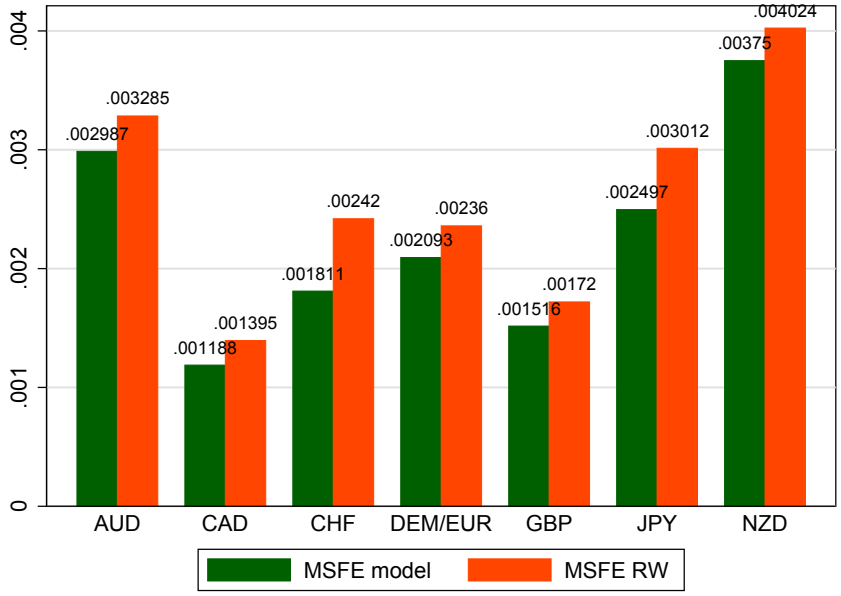
(b) Adjusted R^2

Note: Rolling estimates over 100-week windows of $\beta^{3,j}$ from the weekly regression $s_t - s_{t-j} = \alpha^3 + \beta^{3,j}(mX_t^S - mX_{t-j}^S) + \varepsilon_t^3$ for j being 12 weeks. Gray bands are two standard errors around the point estimates based on Newey-West heteroskedasticity and autocorrelation consistent standard errors. mX_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency.

Figure A7: Out-Of-Sample Results with Realized Regressors, 4 and 12-week changes



(a) MSFE 4 week exchange rate change



(b) MSFE 12 week exchange rate change

Note: We estimate the weekly regression $s_t - s_{t-j} = \alpha^o + \beta^{o,j}(mX_t^S - mX_{t-j}^S) + \varepsilon_t^o$ for j being 4 and 12 weeks using 100 week rolling window. The "out-of-sample" forecast is calculated as $\widehat{(s_{t+j} - s_t)} = \alpha_t^o + \beta_t^{o,j}(mX_{t+j}^S - mX_t^S)$, where the sub-script on the parameters indicates that they are estimated using data up to period t. MSFE model=$\sum_{t=1}^{t=N-j}(1/N)((s_{t+j} - s_t) - \widehat{(s_{t+j} - s_t)})^2$ and MSFE RW=$\sum_{t=1}^{t=N-j}(1/N)((s_{t+j} - s_t))^2$. mX_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency.

D.5.1 Testing the Supply-Demand Equation – Monthly Data

Table A39: Testing the Supply-Demand Equation: Monthly Changes

(A) Only Positions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.884^{***}	-0.448^{***}	-0.680^{***}	-0.339^{***}	-1.035^{***}	-0.004^{***}	-3.391^{***}
	(0.091)	(0.044)	(0.056)	(0.031)	(0.097)	(0.000)	(0.662)
# of Obs	184	198	190	198	198	248	80
Adj. R^2	0.28	0.24	0.37	0.29	0.35	0.35	0.28

(B) With All Variables, $n = j = 1$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.788^{***}	-0.395^{***}	-0.660^{***}	-0.339^{***}	-0.952^{***}	-0.003^{***}	-3.157^{***}
	(0.098)	(0.052)	(0.058)	(0.029)	(0.100)	(0.000)	(0.637)
$\Delta\tilde{r}_t^n$	-1.949^{*}	-0.005	-0.552	-1.128	-0.740	-1.197	0.420
	(1.067)	(0.414)	(0.835)	(0.729)	(0.713)	(0.812)	(1.145)
$\Delta\tilde{E}_t^F s_{t+n}$	0.524^{***}	0.391^{***}	0.127	0.378^{***}	0.411^{***}	0.476^{***}	0.323^{*}
	(0.135)	(0.123)	(0.126)	(0.095)	(0.104)	(0.094)	(0.167)
# of Obs	184	198	190	198	198	248	80
Adj. R^2	0.48	0.32	0.38	0.40	0.47	0.51	0.33

Note: Estimates of $\{\beta^3, \psi^3, \lambda^3\}$ from the monthly regression $s_t - s_{t-j} = \alpha^3 + \beta^3(mX_t^S - mX_{t-j}^S) + \psi^3(\tilde{r}_t^n - \tilde{r}_{t-j}^n) + \lambda^3(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n}) + \varepsilon_t^3$ for $n = j = 1$ with or without restricting $\psi^3 = \lambda^3 = 0$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses. The realized exchange rate changes and the changes in expectations are multiplied by 100 (in percentage points) while the interest rate differential changes are in percentages and annualized. mX_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency.

Table A40: Testing the Supply-Demand Equation: Bi-Annual Changes

(A) Only Positions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-1.586^{***}	-0.698^{***}	-0.912^{***}	-0.318^{**}	-2.149^{***}	-0.007^{***}	-7.166^{***}
	(0.372)	(0.141)	(0.165)	(0.130)	(0.409)	(0.002)	(1.445)
# of Obs	231	233	199	205	232	236	104
Adj. R^2	0.18	0.09	0.12	0.06	0.34	0.15	0.39

(B) With All Variables, $n = j = 24$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.659^{*}	-0.301^{***}	-0.832^{***}	-0.169^{**}	-0.884^{***}	-0.004^{***}	-3.824^{***}
	(0.353)	(0.083)	(0.116)	(0.069)	(0.111)	(0.001)	(1.161)
$\Delta\tilde{r}_t^n$	-1.646^{**}	-0.788^{***}	-2.587^{***}	-3.179^{***}	-2.287^{***}	-2.401^{***}	-2.269^{**}
	(0.681)	(0.182)	(0.477)	(0.480)	(0.313)	(0.904)	(1.065)
$\Delta\tilde{E}_t^F s_{t+n}$	1.277^{***}	1.226^{***}	1.249^{***}	1.265^{***}	1.173^{***}	1.042^{***}	0.937^{***}
	(0.093)	(0.039)	(0.119)	(0.096)	(0.068)	(0.090)	(0.125)
# of Obs	231	233	199	205	232	236	104
Adj. R^2	0.86	0.92	0.78	0.85	0.91	0.84	0.78

Note: Estimates of $\{\beta^3, \psi^3, \lambda^3\}$ from the monthly regression $s_t - s_{t-j} = \alpha^3 + \beta^3(mX_t^S - mX_{t-j}^S) + \psi^3(\tilde{r}_t^n - \tilde{r}_{t-j}^n) + \lambda^3(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n}) + \varepsilon_t^3$ for $n = j = 24$ with or without restricting $\psi^3 = \lambda^3 = 0$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses. The realized exchange rate changes and the changes in expectations are multiplied by 100 (in percentage points) while the interest rate differential changes are in percentages and annualized. mX_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency.

Table A41: Testing the Supply-Demand Equation; Foreign Consumers' Asset Holdings in the Foreign Currency Proxied Using All BIS Assets and Reporting and Counter-party Entities

(A) With All Variables, $n = j = 1$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.582^{***}	-0.396^{***}	-0.627^{***}	-0.337^{***}	-0.740^{***}	-0.003^{***}	-2.348^{***}
	(0.098)	(0.053)	(0.059)	(0.029)	(0.098)	(0.000)	(0.547)
$\Delta\tilde{r}_t^n$	-1.297	-0.011	-0.471	-1.116	-0.692	-1.136	1.018
	(0.914)	(0.410)	(0.801)	(0.745)	(0.737)	(0.812)	(0.945)
$\Delta\tilde{E}_t^F s_{t+n}$	0.485^{***}	0.390^{***}	0.148	0.349^{***}	0.420^{***}	0.507^{***}	0.433^{***}
	(0.097)	(0.124)	(0.111)	(0.101)	(0.087)	(0.090)	(0.143)
$\Delta\tilde{B}_t^{*F}$	-0.213^{***}	0.006	-0.062^{**}	-0.012^{*}	-0.073^{***}	-0.000^{**}	-0.551^{***}
	(0.037)	(0.018)	(0.025)	(0.007)	(0.018)	(0.000)	(0.108)
# of Obs	184	198	190	198	198	248	80
Adj. R^2	0.59	0.32	0.42	0.41	0.56	0.52	0.49

(B) With All Variables, $n = j = 3$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.590^{***}	-0.389^{***}	-0.651^{***}	-0.329^{***}	-0.711^{***}	-0.004^{***}	-1.628^{***}
	(0.071)	(0.046)	(0.051)	(0.034)	(0.077)	(0.000)	(0.328)
$\Delta\tilde{r}_t^n$	-0.500	0.070	1.005^{**}	-0.504	-1.197^{***}	-0.645	-0.284
	(0.370)	(0.234)	(0.446)	(0.571)	(0.419)	(0.548)	(0.620)
$\Delta\tilde{E}_t^F s_{t+n}$	0.651^{***}	0.649^{***}	0.549^{***}	0.658^{***}	0.621^{***}	0.720^{***}	0.671^{***}
	(0.042)	(0.075)	(0.049)	(0.044)	(0.064)	(0.046)	(0.078)
$\Delta\tilde{B}_t^{*F}$	-0.059^{***}	0.015	-0.034^{***}	-0.005	-0.014	-0.000^{**}	-0.090
	(0.022)	(0.010)	(0.009)	(0.003)	(0.012)	(0.000)	(0.057)
# of Obs	295	302	130	294	300	300	143
Adj. R^2	0.74	0.66	0.83	0.69	0.71	0.77	0.69

Note: Estimates of $\{\bar{\alpha}^3, \bar{\psi}^3, \bar{\lambda}^3, \bar{\gamma}_t^3\}$ from the monthly regression $s_t - s_{t-j} = \bar{\alpha}^3 + \bar{\beta}^3\left(mX_t^S - mX_{t-j}^S\right) + \bar{\psi}^3\left(\tilde{r}_t^n - \tilde{r}_{t-j}^n\right) + \bar{\lambda}^3\left(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n}\right) + \bar{\gamma}_t^3\left(\tilde{B}_t^{*F} - \tilde{B}_{t-j}^{*F}\right) + \bar{\varepsilon}_t^3$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses. The realized exchange rate changes and the changes in expectations are multiplied by 100 (in percentage points) while the interest rate differential changes are in percentages and annualized. X_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency. $\tilde{B}_t^{*F}$ is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all the counter-party entities within the given country with respect to all reporting financial institutions in the BIS data. If $\tilde{B}_t^{*F} > 0$ then the foreign consumers have positive net foreign currency assets with respect to that currency.

Table A42: Testing the Supply-Demand Equation; Foreign Consumers' Asset Holdings in the Foreign Currency Proxied Using All BIS Assets and Reporting and Counter-party Entities

(A) With All Variables, $n = j = 12$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.467^{***}	-0.287^{***}	-0.680^{***}	-0.139^{***}	-0.530^{***}	-0.003^{***}	-2.936^{***}
	(0.130)	(0.070)	(0.081)	(0.025)	(0.066)	(0.001)	(0.390)
$\Delta\tilde{r}_t^n$	-0.746^{**}	-0.328^{*}	-1.025^{***}	-1.795^{***}	-1.385^{***}	-0.868	-1.566^{**}
	(0.368)	(0.171)	(0.369)	(0.413)	(0.225)	(0.563)	(0.692)
$\Delta\tilde{E}_t^F s_{t+n}$	1.000^{***}	1.041^{***}	0.973^{***}	1.022^{***}	0.981^{***}	0.885^{***}	0.849^{***}
	(0.049)	(0.059)	(0.076)	(0.063)	(0.071)	(0.061)	(0.071)
$\Delta\tilde{B}_t^{*F}$	-0.027^{*}	0.021^{**}	-0.020^{*}	-0.002	0.009	-0.000	-0.046
	(0.016)	(0.009)	(0.010)	(0.003)	(0.007)	(0.000)	(0.059)
# of Obs	268	270	210	216	269	273	115
Adj. R^2	0.89	0.90	0.83	0.86	0.87	0.83	0.91

(B) With All Variables, $n = j = 24$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.702^{**}	-0.304^{***}	-0.815^{***}	-0.128^{*}	-0.885^{***}	-0.004^{***}	-3.741^{***}
	(0.305)	(0.079)	(0.105)	(0.069)	(0.113)	(0.001)	(1.120)
$\Delta\tilde{r}_t^n$	-1.603^{**}	-0.832^{***}	-2.384^{***}	-3.044^{***}	-2.237^{***}	-2.172^{**}	-1.385
	(0.700)	(0.233)	(0.603)	(0.469)	(0.275)	(0.887)	(0.836)
$\Delta\tilde{E}_t^F s_{t+n}$	1.283^{***}	1.208^{***}	1.247^{***}	1.195^{***}	1.200^{***}	1.024^{***}	1.030^{***}
	(0.088)	(0.066)	(0.130)	(0.071)	(0.080)	(0.095)	(0.143)
$\Delta\tilde{B}_t^{*F}$	-0.015	0.010	-0.019	-0.009^{*}	0.009	-0.000	-0.251^{***}
	(0.028)	(0.020)	(0.021)	(0.005)	(0.007)	(0.000)	(0.079)
# of Obs	231	233	199	205	232	236	104
Adj. R^2	0.86	0.92	0.79	0.86	0.91	0.84	0.81

Note: Estimates of $\{\bar{\alpha}^3, \bar{\psi}^3, \bar{\lambda}^3, \bar{\gamma}_t^3\}$ from the monthly regression $s_t - s_{t-j} = \bar{\alpha}^3 + \bar{\beta}^3\left(mX_t^S - mX_{t-j}^S\right) + \bar{\psi}^3\left(\tilde{r}_t^n - \tilde{r}_{t-j}^n\right) + \bar{\lambda}^3\left(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n}\right) + \bar{\gamma}_t^3\left(\tilde{B}_t^{*F} - \tilde{B}_{t-j}^{*F}\right) + \bar{\varepsilon}_t^3$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses. The realized exchange rate changes and the changes in expectations are multiplied by 100 (in percentage points) while the interest rate differential changes are in percentages and annualized. X_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency. $\tilde{B}_t^{*F}$ is in billions of the non-USD currency and is calculated as the net total positions (claims minus liabilities), denominated in the currency of the respective country, of all the counter-party entities within the given country with respect to all reporting financial institutions in the BIS data. If $\tilde{B}_t^{*F} > 0$ then the foreign consumers have positive net foreign currency assets with respect to that currency.

Table A43: Testing the Supply-Demand Equation; Foreign Consumers' Asset Holdings in the Foreign Currency Proxied Using Interbank Loans

(A) With All Variables, $n = j = 1$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.757^{***}	-0.394^{***}	-0.654^{***}	-0.318^{***}	-0.863^{***}	-0.003^{***}	-2.691^{***}
	(0.103)	(0.052)	(0.058)	(0.028)	(0.100)	(0.000)	(0.586)
$\Delta\tilde{r}_t^n$	-1.985^{*}	-0.053	-0.525	-0.989^{*}	-0.833	-1.246	0.928
	(1.043)	(0.403)	(0.846)	(0.587)	(0.758)	(0.826)	(1.064)
$\Delta\tilde{E}_t^F s_{t+n}$	0.487^{***}	0.395^{***}	0.139	0.413^{***}	0.433^{***}	0.483^{***}	0.371^{**}
	(0.121)	(0.121)	(0.121)	(0.087)	(0.097)	(0.094)	(0.156)
$\Delta\tilde{B}_t^{*F}$	-0.134^{**}	0.025	-0.032	0.026^{***}	-0.046^{*}	-0.000	-0.517^{***}
	(0.058)	(0.017)	(0.029)	(0.010)	(0.025)	(0.000)	(0.131)
# of Obs	184	198	190	198	198	248	80
Adj. R^2	0.50	0.33	0.38	0.45	0.49	0.51	0.41

(B) With All Variables, $n = j = 3$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.614^{***}	-0.374^{***}	-0.648^{***}	-0.318^{***}	-0.700^{***}	-0.004^{***}	-1.591^{***}
	(0.074)	(0.047)	(0.052)	(0.033)	(0.080)	(0.000)	(0.320)
$\Delta\tilde{r}_t^n$	-0.660	-0.141	1.023^{**}	-0.871	-1.232^{***}	-1.095^{*}	-0.159
	(0.438)	(0.475)	(0.434)	(0.668)	(0.450)	(0.601)	(0.631)
$\Delta\tilde{E}_t^F s_{t+n}$	0.648^{***}	0.651^{***}	0.558^{***}	0.658^{***}	0.620^{***}	0.679^{***}	0.677^{***}
	(0.050)	(0.081)	(0.049)	(0.047)	(0.063)	(0.050)	(0.079)
$\Delta\tilde{B}_t^{*F}$	-0.030	0.023^{**}	-0.032^{***}	0.001	-0.004	-0.000	-0.141^{**}
	(0.027)	(0.011)	(0.012)	(0.004)	(0.011)	(0.000)	(0.066)
# of Obs	256	263	130	263	263	262	143
Adj. R^2	0.73	0.66	0.82	0.69	0.71	0.77	0.70

Note: Estimates of $\{\bar{\alpha}^3, \bar{\psi}^3, \bar{\lambda}^3, \bar{\gamma}_t^3\}$ from the monthly regression $s_t - s_{t-j} = \bar{\alpha}^3 + \bar{\beta}^3\left(mX_t^S - mX_{t-j}^S\right) + \bar{\psi}^3\left(\tilde{r}_t^n - \tilde{r}_{t-j}^n\right) + \bar{\lambda}^3\left(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n}\right) + \bar{\gamma}_t^3\left(\tilde{B}_t^{*F} - \tilde{B}_{t-j}^{*F}\right) + \bar{\varepsilon}_t^3$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses. The realized exchange rate changes and the changes in expectations are multiplied by 100 (in percentage points) while the interest rate differential changes are in percentages and annualized. X_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency. $\tilde{B}_t^{*F}$ is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of the banks within the given country with respect to all reporting banks in the BIS data. If $\tilde{B}_t^{*F} > 0$ then the foreign consumers have positive net foreign currency assets.

Table A44: Testing the Supply-Demand Equation; Foreign Consumers' Asset Holdings in the Foreign Currency Proxied Using Interbank Loans

(A) With All Variables, $n = j = 12$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.448^{***}	-0.278^{***}	-0.661^{***}	-0.157^{***}	-0.493^{***}	-0.003^{***}	-2.827^{***}
	(0.137)	(0.070)	(0.078)	(0.024)	(0.063)	(0.000)	(0.404)
$\Delta\tilde{r}_t^n$	-0.934^{**}	-0.436^{*}	-1.066^{***}	-1.847^{***}	-1.379^{***}	-1.511^{***}	-1.425^{**}
	(0.389)	(0.240)	(0.372)	(0.407)	(0.258)	(0.490)	(0.650)
$\Delta\tilde{E}_t^F s_{t+n}$	0.981^{***}	1.057^{***}	0.984^{***}	1.056^{***}	0.977^{***}	0.854^{***}	0.854^{***}
	(0.050)	(0.058)	(0.076)	(0.068)	(0.070)	(0.053)	(0.068)
$\Delta\tilde{B}_t^{*F}$	-0.029	0.024^{***}	-0.019^{*}	0.004	0.009	0.000	-0.107^{*}
	(0.029)	(0.008)	(0.010)	(0.004)	(0.006)	(0.000)	(0.055)
# of Obs	230	232	210	216	231	235	115
Adj. R^2	0.90	0.90	0.83	0.86	0.88	0.86	0.91

(B) With All Variables, $n = j = 24$

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$m\Delta X_t^S$	-0.651^{**}	-0.291^{***}	-0.819^{***}	-0.166^{**}	-0.843^{***}	-0.004^{***}	-3.645^{***}
	(0.307)	(0.080)	(0.107)	(0.082)	(0.113)	(0.001)	(1.118)
$\Delta\tilde{r}_t^n$	-1.698^{**}	-0.846^{**}	-2.480^{***}	-3.170^{***}	-2.025^{***}	-2.042^{**}	-1.647
	(0.701)	(0.385)	(0.558)	(0.477)	(0.386)	(0.900)	(1.081)
$\Delta\tilde{E}_t^F s_{t+n}$	1.275^{***}	1.221^{***}	1.256^{***}	1.262^{***}	1.203^{***}	1.009^{***}	1.010^{***}
	(0.110)	(0.058)	(0.123)	(0.101)	(0.071)	(0.080)	(0.147)
$\Delta\tilde{B}_t^{*F}$	-0.002	0.005	-0.011	-0.000	0.018^{*}	0.000	-0.314^{***}
	(0.056)	(0.023)	(0.018)	(0.005)	(0.010)	(0.000)	(0.114)
# of Obs	219	221	199	205	220	224	104
Adj. R^2	0.86	0.92	0.78	0.85	0.92	0.86	0.80

Note: Estimates of $\{\bar{\alpha}^3, \bar{\psi}^3, \bar{\lambda}^3, \bar{\gamma}_t^3\}$ from the monthly regression $s_t - s_{t-j} = \bar{\alpha}^3 + \bar{\beta}^3\left(mX_t^S - mX_{t-j}^S\right) + \bar{\psi}^3\left(\tilde{r}_t^n - \tilde{r}_{t-j}^n\right) + \bar{\lambda}^3\left(\tilde{E}_t^F s_{t+n} - \tilde{E}_{t-j}^F s_{t-j+n}\right) + \bar{\gamma}_t^3\left(\tilde{B}_t^{*F} - \tilde{B}_{t-j}^{*F}\right) + \bar{\varepsilon}_t^3$. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses. The realized exchange rate changes and the changes in expectations are multiplied by 100 (in percentage points) while the interest rate differential changes are in percentages and annualized. mX_t^S is the long minus short position of the speculators (minus the hedgers) in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency. $\tilde{B}_t^{*F}$ is in billions of the non-USD currency and is calculated as the net total interbank loans (claims minus liabilities), denominated in the currency of the respective country, of the banks within the given country with respect to all reporting banks in the BIS data. If $\tilde{B}_t^{*F} > 0$ then the foreign consumers have positive net foreign currency assets.

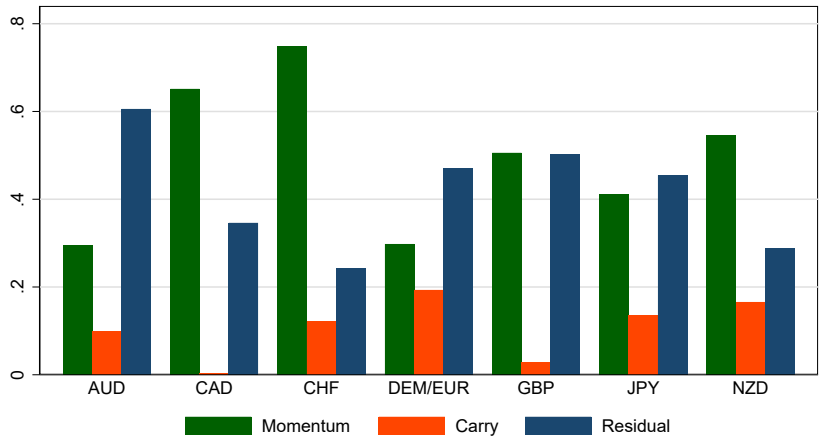
D.6 Investment Strategy of Speculators in Futures Market

Table A45: Prevalence of Momentum-Based Speculator Demand

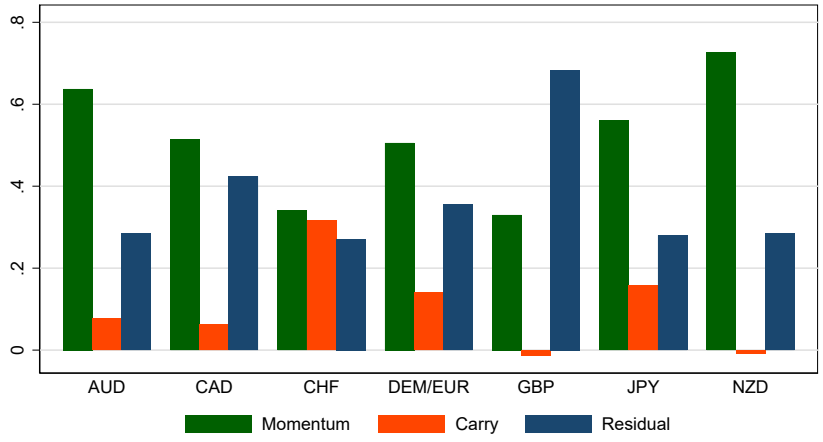
	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_{t-30} - s_{t-1}$	6.647^{*}	2.236	19.494^{***}	32.559^{**}	11.119^{***}	2615.681^{***}	-0.128
	(4.029)	(9.216)	(4.859)	(13.372)	(3.183)	(563.921)	(1.048)
$s_{t-60} - s_{t-1}$	6.681^{**}	14.111^{*}	21.291^{***}	9.058	11.704^{***}	2199.367^{***}	3.048^{***}
	(3.358)	(7.207)	(3.962)	(12.295)	(3.007)	(582.754)	(0.985)
$s_{t-90} - s_{t-1}$	6.103^{*}	14.336^{***}	12.401^{***}	14.239	2.451	1008.590^{*}	2.143^{**}
	(3.408)	(5.539)	(3.775)	(11.525)	(2.966)	(558.883)	(0.876)
$s_{t-120} - s_{t-1}$	11.999^{***}	18.926^{***}	15.342^{***}	20.866^{**}	5.484^{***}	1254.034^{***}	2.955^{***}
	(2.499)	(3.571)	(2.834)	(8.814)	(1.961)	(384.139)	(0.647)
$s_{t-365} - s_{t-1}$	10.525^{***}	16.484^{***}	4.782^{***}	40.051^{***}	7.036^{***}	2506.901^{***}	2.301^{***}
	(0.801)	(0.877)	(1.254)	(2.915)	(0.685)	(155.752)	(0.233)
$\tilde{r}^{3}_{t-1}$	1.318^{***}	-1.319^{***}	1.292^{***}	-10.495^{***}	-0.069	54.398	-0.012
	(0.265)	(0.240)	(0.492)	(1.426)	(0.159)	(47.607)	(0.041)
$\tilde{r}^{12}_{t-1}$	-0.886^{***}	1.656^{***}	-0.753	9.334^{***}	0.347^{**}	-60.091	0.035
	(0.271)	(0.267)	(0.479)	(1.426)	(0.162)	(46.590)	(0.065)
# of Obs	1226	1275	656	995	1226	1251	578
Adj. R^2	0.47	0.54	0.70	0.42	0.40	0.54	0.52
				Only Momentum Terms			
Adj. R^2	0.43	0.50	0.52	0.32	0.40	0.50	0.41

Note: Estimates of $\{\beta^s_{30}, \beta^s_{90}, \beta^s_{120}, \beta^s_{365}, \beta^i_3, \beta^i_{12}\}$ from the weekly regression $X^S_t = \alpha^s + \beta^s_{30}\Delta^{-1}_{30}s_{t-1} + \beta^s_{90}\Delta^{-1}_{90}s_{t-1} + \beta^s_{120}\Delta^{-1}_{120}s_{t-1} + \beta^s_{365}\Delta^{-1}_{365}s_{t-1} + \beta^i_3\tilde{r}^3_{t-1} + \beta^i_{12}\tilde{r}^{12}_{t-1} + \varepsilon^s_t$. mX^S_t is the speculators' long minus short positions in billions of the non-USD currency where a positive number means that the speculators are long the non-USD currency. $\Delta^{-1}_k s_{t-1} = s_{t-k-1} - s_{t-1}$ and k is days. The regressions are weekly. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses.

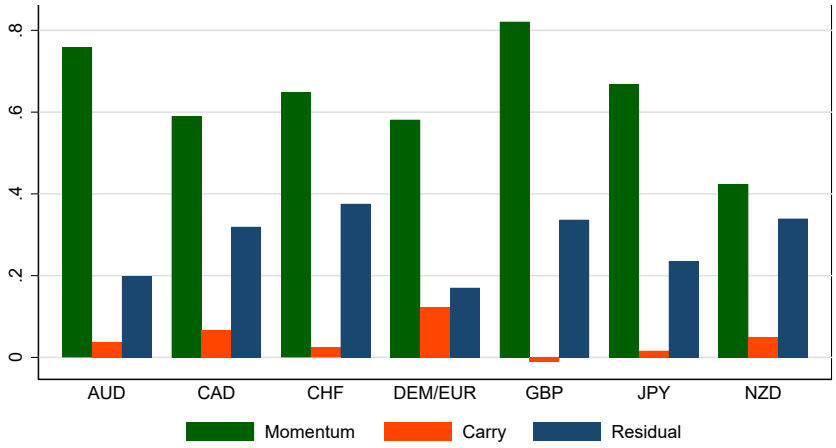
Figure A8: Fraction of Variation in Positions Explained by Trading Strategies, By Pair



(a) Pre-Crisis



(b) Crisis



(c) Post-Crisis

Table A46: Predicting Exchange Rate Surprises With Exchange Rate Change over the Past Month

(A) 1M Ahead ($n = 1$)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	-0.595^{***}	-0.564^{***}	-0.194^{*}	-0.431^{***}	-0.347^{***}	-0.487^{***}	-0.495^{***}
	(0.121)	(0.128)	(0.104)	(0.102)	(0.103)	(0.096)	(0.106)
# of Obs	255	255	255	255	255	255	255
Adj. R^2	0.13	0.12	0.02	0.07	0.06	0.11	0.10

(B) 24M Ahead ($n = 24$)

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	-0.661^{*}	-0.832^{**}	-0.439^{**}	-0.633^{**}	-0.347^{*}	-0.694^{**}	-0.586
	(0.345)	(0.408)	(0.198)	(0.250)	(0.186)	(0.299)	(0.385)
# of Obs	264	264	264	264	264	264	264
Adj. R^2	0.01	0.02	0.01	0.01	0.00	0.02	0.01

Note: Estimates of β_n^4 from the monthly regression $\tilde{E}_t^F s_{t+n} - s_{t+n} = \alpha_n^4 + \beta_n^4(s_t - s_{t-1}) + \varepsilon_{t+n}^4$, where $s_t - s_{t-1}$ is the log exchange rate change over the last month. Heteroskedasticity consistent standard errors in parentheses.

Table A47: Exchange Rate Surprises, 1M Ahead

(A) Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}^F_t s_{t+1} - \tilde{E}^F_{t-2} s_{t+1}$	-0.212^{**}	-0.160^{*}	-0.073	-0.133^{*}	-0.185^{**}	-0.267^{***}	-0.303^{***}
	(0.089)	(0.088)	(0.084)	(0.077)	(0.089)	(0.065)	(0.080)
# of Obs	255	255	255	255	255	255	255
Adj. R^2	0.03	0.01	0.00	0.01	0.02	0.06	0.06

(B) Monthly Exchange Rate Change and Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}^F_t s_{t+1} - \tilde{E}^F_{t-2} s_{t+1}$	-0.024	0.038	-0.013	0.021	-0.077	-0.121	-0.162^{**}
	(0.082)	(0.091)	(0.082)	(0.088)	(0.094)	(0.074)	(0.082)
$s_t - s_{t-1}$	-0.578^{***}	-0.587^{***}	-0.187^{*}	-0.446^{***}	-0.302^{***}	-0.413^{***}	-0.392^{***}
	(0.132)	(0.144)	(0.095)	(0.114)	(0.109)	(0.111)	(0.112)
# of Obs	255	255	255	255	255	255	255
Adj. R^2	0.13	0.12	0.01	0.07	0.06	0.12	0.11

Note: Estimates of $\{\beta^5_n, \psi^5_n\}$ from the monthly regression $\tilde{E}^F_t s_{t+n} - s_{t+n} = \alpha^5_n + \beta^5_n (s_t - s_{t-1}) + \psi^5_n (\tilde{E}^F_t s_{t+n} - \tilde{E}^F_{t-j} s_{t+n}) + \varepsilon^5_{t+n}$ for $n = 1$ with or without restricting $\beta^5_n = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Newey-West heteroskedasticity and autocorrelation consistent standard errors in parentheses.

Table A48: Individual-Level Exchange Rate Surprises, 1M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	-0.541^{***}	-0.457^{***}	-0.100^{***}	-0.244^{***}	-0.255^{***}	-0.324^{***}	-0.386^{***}
	(0.037)	(0.035)	(0.032)	(0.033)	(0.034)	(0.061)	(0.034)
# of Obs	4523	4099	3803	4253	4239	4302	4031
Adj. R^2	0.20	0.19	0.21	0.08	0.08	0.08	0.15

(B) Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}_t^{F,i} s_{t+1} - \tilde{E}_{t-2}^{F,i} s_{t+1}$	0.010	0.064^{***}	0.120^{***}	0.110^{***}	0.077^{***}	-0.012	-0.007
	(0.020)	(0.017)	(0.016)	(0.017)	(0.016)	(0.026)	(0.017)
# of Obs	4523	4099	3803	4253	4239	4302	4031
Adj. R^2	0.11	0.13	0.22	0.08	0.06	0.04	0.09

(C) Monthly Exchange Rate Change and Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}_t^{F,i} s_{t+1} - \tilde{E}_{t-2}^{F,i} s_{t+1}$	0.157^{***}	0.193^{***}	0.165^{***}	0.205^{***}	0.153^{***}	0.070^{***}	0.105^{***}
	(0.020)	(0.018)	(0.016)	(0.018)	(0.016)	(0.021)	(0.018)
$s_t - s_{t-1}$	-0.662^{***}	-0.591^{***}	-0.213^{***}	-0.412^{***}	-0.360^{***}	-0.371^{***}	-0.463^{***}
	(0.035)	(0.033)	(0.031)	(0.033)	(0.034)	(0.059)	(0.033)
# of Obs	4523	4099	3803	4253	4239	4302	4031
Adj. R^2	0.23	0.22	0.23	0.13	0.11	0.09	0.16

Note: Estimates of $\{\beta_n^5, \psi_n^5\}$ from the monthly regression $\tilde{E}_t^{F,i} s_{t+n} - s_{t+n} = \alpha_{n,i}^5 + \beta_n^5 (s_t - s_{t-1}) + \psi_n^5 (\tilde{E}_t^{F,i} s_{t+n} - \tilde{E}_{t-j}^F s_{t+n}) + \varepsilon_{t+n}^5$ for $n = 1$ with or without restricting $\beta_n^5 = 0$ or $\psi_n^5 = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Driscoll-Kraay standard errors in parentheses.

Table A49: Individual-Level Exchange Rate Surprises, 3M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	-0.594^{***}	-0.562^{***}	-0.210^{***}	-0.357^{***}	-0.423^{***}	-0.500^{***}	-0.541^{***}
	(0.052)	(0.056)	(0.047)	(0.059)	(0.056)	(0.046)	(0.061)
# of Obs	4486	4024	3725	4194	4178	4240	3993
Adj. R^2	0.11	0.14	0.11	0.05	0.04	0.07	0.10

(B) Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}_t^{F,i} s_{t+3} - \tilde{E}_{t-9}^{F,i} s_{t+3}$	0.112^{***}	0.108^{***}	0.121^{***}	0.145^{***}	0.185^{***}	0.061^{***}	0.087^{***}
	(0.034)	(0.020)	(0.025)	(0.031)	(0.019)	(0.013)	(0.031)
# of Obs	4486	4024	3725	4194	4178	4240	3993
Adj. R^2	0.07	0.11	0.13	0.08	0.09	0.03	0.06

(C) Monthly Exchange Rate Change and Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}_t^{F,i} s_{t+3} - \tilde{E}_{t-9}^{F,i} s_{t+3}$	0.138^{***}	0.131^{***}	0.131^{***}	0.166^{***}	0.212^{***}	0.084^{***}	0.114^{***}
	(0.035)	(0.020)	(0.025)	(0.032)	(0.018)	(0.013)	(0.031)
$s_t - s_{t-1}$	-0.661^{***}	-0.619^{***}	-0.261^{***}	-0.457^{***}	-0.552^{***}	-0.560^{***}	-0.604^{***}
	(0.057)	(0.056)	(0.048)	(0.067)	(0.058)	(0.048)	(0.062)
# of Obs	4486	4024	3725	4194	4178	4240	3993
Adj. R^2	0.15	0.18	0.14	0.12	0.15	0.09	0.13

Note: Estimates of $\{\beta_n^5, \psi_n^5\}$ from the monthly regression $\tilde{E}_t^{F,i} s_{t+n} - s_{t+n} = \alpha_{n,i}^5 + \beta_n^5 (s_t - s_{t-1}) + \psi_n^5 (\tilde{E}_t^{F,i} s_{t+n} - \tilde{E}_{t-j}^F s_{t+n}) + \varepsilon_{t+n}^5$ for $n = 3$ with or without restricting $\beta_n^5 = 0$ or $\psi_n^5 = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Driscoll-Kraay standard errors in parentheses.

Table A50: Individual-Level Exchange Rate Surprises, 12M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	-0.319	-0.334^{***}	-0.137	-0.186	-0.220^{***}	-0.729^{***}	-0.407^{**}
	(0.194)	(0.114)	(0.101)	(0.153)	(0.083)	(0.087)	(0.200)
# of Obs	2271	1948	1748	2054	2041	2077	1851
Adj. R^2	0.07	0.09	0.08	0.04	0.01	0.07	0.05

(B) Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}_t^{F,i} s_{t+12} - \tilde{E}_{t-12}^{F,i} s_{t+12}$	0.074	0.112	0.319^{***}	0.271^{***}	0.318^{***}	0.222^{***}	0.162
	(0.102)	(0.071)	(0.054)	(0.072)	(0.067)	(0.040)	(0.140)
# of Obs	2271	1948	1748	2054	2041	2077	1851
Adj. R^2	0.07	0.09	0.18	0.12	0.11	0.10	0.07

(C) Monthly Exchange Rate Change and Forecast Revisions

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$\tilde{E}_t^{F,i} s_{t+12} - \tilde{E}_{t-12}^{F,i} s_{t+12}$	0.087	0.128^{*}	0.319^{***}	0.276^{***}	0.325^{***}	0.236^{***}	0.174
	(0.096)	(0.071)	(0.054)	(0.070)	(0.066)	(0.039)	(0.133)
$s_t - s_{t-1}$	-0.355^{**}	-0.398^{***}	-0.125	-0.260^{*}	-0.314^{***}	-0.809^{***}	-0.464^{**}
	(0.165)	(0.103)	(0.105)	(0.151)	(0.078)	(0.096)	(0.179)
# of Obs	2271	1948	1748	2054	2041	2077	1851
Adj. R^2	0.08	0.11	0.18	0.12	0.12	0.14	0.08

Note: Estimates of $\{\beta_n^5, \psi_n^5\}$ from the monthly regression $\tilde{E}_t^{F,i} s_{t+n} - s_{t+n} = \alpha_{n,i}^5 + \beta_n^5 (s_t - s_{t-1}) + \psi_n^5 (\tilde{E}_t^{F,i} s_{t+n} - \tilde{E}_{t-j}^{F} s_{t+n}) + \varepsilon_{t+n}^5$ for $n = 12$ with or without restricting $\beta_n^5 = 0$ or $\psi_n^5 = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Driscoll-Kraay standard errors in parentheses.

Table A51: Individual-Level Exchange Rate Surprises, 24M Ahead, and Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	-0.690^{***}	-0.736^{***}	-0.449^{***}	-0.493^{***}	-0.269^{***}	-0.746^{***}	-0.587^{**}
	(0.226)	(0.158)	(0.115)	(0.134)	(0.103)	(0.220)	(0.295)
# of Obs	2287	1943	1766	2049	2035	2068	1864
Adj. R^2	0.18	0.26	0.30	0.15	0.13	0.08	0.16

Note: Estimates of β_n^4 from the monthly regression $\tilde{E}_t^{F,i} s_{t+n} - s_{t+n} = \alpha_{n,i}^4 + \beta_n^4 (s_t - s_{t-1}) + \varepsilon_{t+n}^4$ for $n = 24$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Driscoll-Kraay standard errors in parentheses.

Table A52: Exchange Rate Expectations, 1M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.445^{***}	0.479^{***}	0.349^{***}	0.382^{***}	0.395^{***}	0.457^{***}	0.451^{***}
	(0.033)	(0.029)	(0.039)	(0.030)	(0.037)	(0.027)	(0.034)
# of Obs	255	255	255	255	255	255	255
Adj. R^2	0.46	0.62	0.41	0.45	0.51	0.58	0.46

(B) Monthly Exchange Rate Change and RER

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.429^{***}	0.473^{***}	0.322^{***}	0.370^{***}	0.413^{***}	0.454^{***}	0.434^{***}
	(0.032)	(0.029)	(0.035)	(0.028)	(0.035)	(0.027)	(0.032)
RER_t	0.030^{***}	0.012^{***}	0.051^{***}	0.022^{***}	-0.026^{***}	0.005	0.033^{***}
	(0.004)	(0.003)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
# of Obs	255	255	255	255	255	255	255
Adj. R^2	0.54	0.63	0.54	0.48	0.54	0.58	0.54

Note: Estimates of $\{\beta_n^6, \psi_n^6\}$ from the monthly regression $s_t - \tilde{E}_t^F s_{t+n} = \alpha_n^6 + \beta_n^6(s_t - s_{t-1}) + \psi_n^6 rer_t + \varepsilon_{n,t}^6$ for $n = 1$ with or without restricting $\psi_n^6 = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Heteroskedasticity consistent standard errors in parentheses.

Table A53: Exchange Rate Expectations, 24M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.654^{***}	0.602^{***}	0.620^{***}	0.592^{***}	0.537^{***}	0.645^{***}	0.638^{***}
	(0.143)	(0.092)	(0.175)	(0.146)	(0.090)	(0.114)	(0.165)
# of Obs	285	285	285	285	285	285	285
Adj. R^2	0.07	0.15	0.07	0.07	0.15	0.09	0.06

(B) Monthly Exchange Rate Change and RER

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.472^{***}	0.491^{***}	0.385^{***}	0.416^{***}	0.392^{***}	0.609^{***}	0.441^{***}
	(0.066)	(0.059)	(0.072)	(0.081)	(0.075)	(0.111)	(0.079)
RER_t	0.343^{***}	0.199^{***}	0.456^{***}	0.339^{***}	0.219^{***}	0.079^{***}	0.378^{***}
	(0.010)	(0.007)	(0.019)	(0.017)	(0.018)	(0.020)	(0.012)
# of Obs	285	285	285	285	285	285	285
Adj. R^2	0.82	0.74	0.77	0.66	0.53	0.13	0.71

Note: Estimates of $\{\beta_n^6, \psi_n^6\}$ from the monthly regression $s_t - \tilde{E}_t^F s_{t+n} = \alpha_n^6 + \beta_n^6(s_t - s_{t-1}) + \psi_n^6 rer_t + \varepsilon_{n,t}^6$ for $n = 24$ with or without restricting $\psi_n^6 = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Heteroskedasticity consistent standard errors in parentheses.

Table A54: Individual-Level Exchange Rate Expectations, 1M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.333^{***}	0.383^{***}	0.270^{***}	0.305^{***}	0.328^{***}	0.370^{***}	0.316^{***}
	(0.018)	(0.016)	(0.012)	(0.010)	(0.012)	(0.015)	(0.020)
# of Obs	4743	4259	3957	4426	4411	4472	4242
Adj. R^2	0.86	0.93	0.96	0.81	0.91	0.85	0.87

(B) Monthly Exchange Rate Change and RER

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.319^{***}	0.379^{***}	0.247^{***}	0.299^{***}	0.346^{***}	0.369^{***}	0.304^{***}
	(0.018)	(0.016)	(0.011)	(0.011)	(0.012)	(0.015)	(0.020)
RER_t	0.030^{***}	0.006^{***}	0.047^{***}	0.013^{***}	-0.030^{***}	0.000	0.029^{***}
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
# of Obs	4743	4259	3957	4426	4411	4472	4242
Adj. R^2	0.87	0.93	0.97	0.82	0.91	0.85	0.88

Note: Estimates of $\{\beta_n^6, \psi_n^6\}$ from the monthly regression $s_t - \tilde{E}_t^{F,i} s_{t+n} = \alpha_{n,i}^6 + \beta_n^6 (s_t - s_{t-1}) + \psi_n^6 rer_t + \varepsilon_{n,t}^6$ for $n = 1$ with or without restricting $\psi_n^6 = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Driscoll-Kraay standard errors in parentheses.

Table A55: Individual-Level Exchange Rate Expectations, 3M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.364^{***}	0.421^{***}	0.323^{***}	0.341^{***}	0.337^{***}	0.425^{***}	0.333^{***}
	(0.024)	(0.018)	(0.016)	(0.016)	(0.017)	(0.018)	(0.029)
# of Obs	4743	4259	3957	4426	4411	4472	4242
Adj. R^2	0.71	0.89	0.92	0.63	0.87	0.69	0.74

(B) Monthly Exchange Rate Change and RER

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.329^{***}	0.405^{***}	0.271^{***}	0.316^{***}	0.351^{***}	0.424^{***}	0.300^{***}
	(0.022)	(0.019)	(0.014)	(0.015)	(0.017)	(0.019)	(0.028)
RER_t	0.073^{***}	0.030^{***}	0.104^{***}	0.051^{***}	-0.024^{***}	0.001	0.075^{***}
	(0.006)	(0.004)	(0.006)	(0.008)	(0.006)	(0.008)	(0.007)
# of Obs	4743	4259	3957	4426	4411	4472	4242
Adj. R^2	0.80	0.90	0.94	0.68	0.87	0.69	0.81

Note: Estimates of $\{\beta_n^6, \psi_n^6\}$ from the monthly regression $s_t - \tilde{E}_t^{F,i} s_{t+n} = \alpha_{n,i}^6 + \beta_n^6 (s_t - s_{t-1}) + \psi_n^6 rer_t + \varepsilon_{n,t}^6$ for $n = 3$ with or without restricting $\psi_n^6 = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Driscoll-Kraay standard errors in parentheses.

Table A56: Individual-Level Exchange Rate Expectations, 12M Ahead

(A) Monthly Exchange Rate Change

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.427^{***}	0.473^{***}	0.460^{***}	0.432^{***}	0.381^{***}	0.551^{***}	0.399^{***}
	(0.050)	(0.020)	(0.036)	(0.053)	(0.025)	(0.023)	(0.048)
# of Obs	4743	4259	3957	4426	4411	4472	4242
Adj. R^2	0.36	0.72	0.66	0.24	0.67	0.27	0.37

(B) Monthly Exchange Rate Change and RER

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.331^{***}	0.412^{***}	0.308^{***}	0.330^{***}	0.334^{***}	0.524^{***}	0.302^{***}
	(0.029)	(0.019)	(0.028)	(0.029)	(0.031)	(0.030)	(0.031)
RER_t	0.199^{***}	0.116^{***}	0.305^{***}	0.203^{***}	0.079^{***}	0.045	0.221^{***}
	(0.021)	(0.011)	(0.027)	(0.029)	(0.024)	(0.038)	(0.028)
# of Obs	4743	4259	3957	4426	4411	4472	4242
Adj. R^2	0.76	0.86	0.87	0.55	0.71	0.28	0.69

Note: Estimates of $\{\beta_n^6, \psi_n^6\}$ from the monthly regression $s_t - \tilde{E}_t^{F,i} s_{t+n} = \alpha_{n,i}^6 + \beta_n^6 (s_t - s_{t-1}) + \psi_n^6 rer_t + \varepsilon_{n,t}^6$ for $n = 12$ with or without restricting $\psi_n^6 = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Driscoll-Kraay standard errors in parentheses.

Table A57: Individual-Level Exchange Rate Expectations, 24M Ahead

(A) Monthly Exchange Rate Change

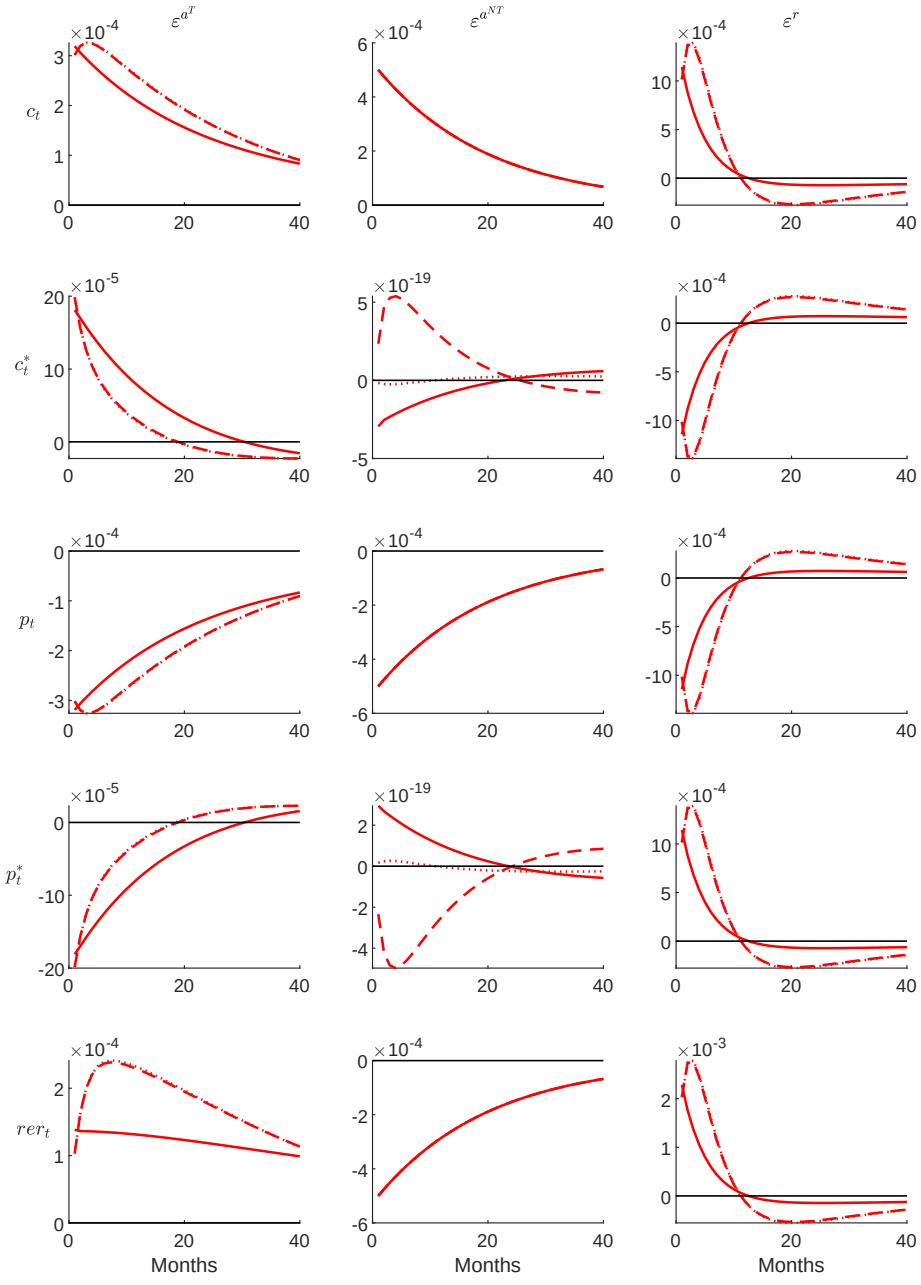
	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.547^{***}	0.522^{***}	0.525^{***}	0.494^{***}	0.462^{***}	0.589^{***}	0.510^{***}
	(0.073)	(0.030)	(0.057)	(0.076)	(0.026)	(0.030)	(0.065)
# of Obs	4743	4259	3957	4426	4411	4472	4242
Adj. R^2	0.21	0.57	0.45	0.14	0.48	0.15	0.20

(B) Monthly Exchange Rate Change and RER

	AUD	CAD	CHF	DEM/EUR	GBP	JPY	NZD
$s_t - s_{t-1}$	0.393^{***}	0.420^{***}	0.286^{***}	0.329^{***}	0.338^{***}	0.516^{***}	0.346^{***}
	(0.034)	(0.036)	(0.044)	(0.039)	(0.031)	(0.048)	(0.025)
RER_t	0.319^{***}	0.193^{***}	0.479^{***}	0.331^{***}	0.206^{***}	0.124	0.371^{***}
	(0.029)	(0.011)	(0.041)	(0.037)	(0.032)	(0.074)	(0.035)
# of Obs	4743	4259	3957	4426	4411	4472	4242
Adj. R^2	0.82	0.87	0.86	0.67	0.70	0.21	0.74

Note: Estimates of $\{\beta_n^6, \psi_n^6\}$ from the monthly regression $s_t - \tilde{E}_t^{F,i} s_{t+n} = \alpha_{n,i}^6 + \beta_n^6 (s_t - s_{t-1}) + \psi_n^6 rer_t + \varepsilon_{n,t}^6$ for $n = 24$ with or without restricting $\psi_n^6 = 0$. $s_t - s_{t-1}$ is the log exchange rate change over the last month. Driscoll-Kraay standard errors in parentheses.

Figure A9: Model Impulse Responses (continued)



$\eta = -0.6; m = 0.02$ $\eta = 0; m = 0.02$ $\eta = -0.6; m = 0$

Other model parameters: $\beta = 0.9966; \mu = 1; \mu^s = 0.6; \gamma = 0.5; \rho = 10; \rho_{a^T} = 0.95; \rho_{a^{T*}} = 0.95; \rho_r = 0.8; \rho_r* = 0.8$

Table A58: De-Trended Nominal Exchange Rate Moments, Actual Data

	AUD	CAD	CHF	DEM/EUR	JPY	NZD	GBP	Average
α^s	0.985	0.994	0.963	0.967	0.969	0.977	0.965	0.974
p-val for H_0: $\alpha = 1$	0.092	0.249	0.000	0.005	0.000	0.020	0.003	
Half-life	3.941	10.836	2.029	2.129	2.399	2.674	1.736	3.678
p-val for H_0: HL $= \infty$	0.190	0.408	0.003	0.013	0.008	0.038	0.006	
Up-life	0.575	1.362	0.000	0.302	1.063	0.839	0.387	0.647
p-val for H_0: UL $= \infty$	0.190	0.408	0.003	0.013	0.008	0.038	0.006	
Quarter-life	7.508	20.330	3.035	3.262	3.546	4.544	3.130	6.479
p-val for H_0: QL $= \infty$	0.190	0.408	0.003	0.013	0.008	0.038	0.006	
UL/HL	0.146	0.126	0.000	0.142	0.443	0.314	0.223	0.199
p-val for H_0: UL/HL$= 0$	0.059	0.262	0.391	0.121	0.212	0.054	0.061	
$2HL - QL$	0.374	1.342	1.023	0.995	1.252	0.804	0.341	0.876
p-val for H_0: 2HL$-$QL$= 0$	0.270	0.215	0.106	0.081	0.065	0.116	0.278	

Figure A10: De-Trended Nominal Exchange Rate Hump Shape, Actual Data

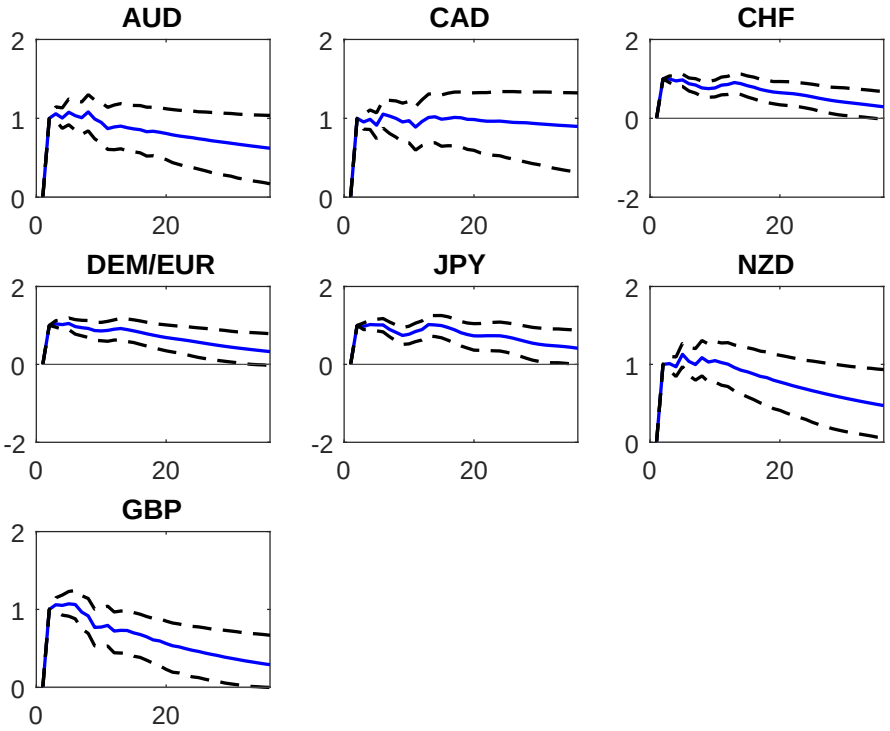
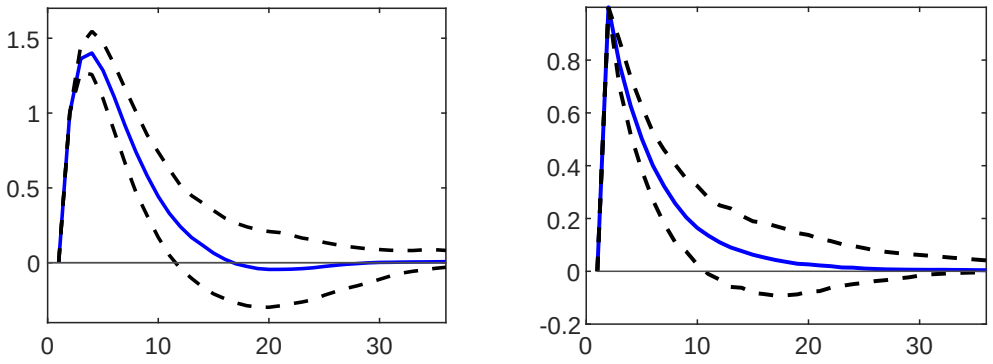


Figure A11: Model Implied Nominal Exchange Rate Dynamics



(a) $\eta = -0.6$ (b) $\eta = 0$