A Third of a Century of Currency Expectations Data: The Carry Trade and the Risk Premium

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Abstract: For four decades economists have been finding that the forward discount is a very biased forecast of future changes in the exchange rate. The carry trade makes money, on average. For just as long, they have been debating the appropriate interpretation of the bias. Is it evidence of an exchange risk premium? Under that interpretation, a currency that sells at a forward discount does so not because it is expected to depreciate in the future but because it is perceived as risky. Using data on survey-based expectations over 32 years across 17 currencies, we reject that interpretation of the forward bias. We find that when investors sell a currency at a forward discount, it is indeed because they expect it to depreciate. But we also find concrete evidence of a risk premium, in that expected return differentials are correlated with the VIX measure of risk -- even though the risk premium can't explain forward bias.

Keywords: forward rate unbiasedness, efficient markets hypothesis, risk premium, survey data, rational expectations.

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1. INTRODUCTION

A key puzzle in international macroeconomics is the systematic failure of the forward rate to predict future movements in the spot exchange rate. The outcome is usually interpreted by appealing to the presence of an exchange risk premium. But the difficulty in relating measured risk premiums to observable macroeconomic variables that are considered determinants of risk has meant that dispensing with one puzzle leads to yet another puzzle.

Similarly, interest differentials are biased predictors of future changes in the exchange rate. (Either proposition implies the other, if covered interest parity holds. That is, if the forward discount equals the interest differential.) Typically the interest differential and forward discount fail to predict even the direction of exchange rate changes. One can make money on average by going short in the low-interest-rate currency and going long in the high-interest-rate currency, the strategy known as the carry trade. This *seeming* violation of uncovered interest parity is one of the most robust stylized facts in the discipline.[1]

We emphasize the word "seeming" because in fact most empirical papers assessing uncovered interest parity are actually joint tests of uncovered interest parity and the validity of the rational expectations methodology.[2] Frankel has termed this composite the "unbiasedness hypothesis". UIP is defined as the equalization across countries of

[1] There are numerous surveys of the literature, including Hodrick (1987), Froot and Thaler (1990) and Engel (1996, 2014) and Sarno (2005)..

[2] We use the term "rational expectations methodology" to describe the proposition that *ex ante* expectations can be inferred from *ex post* outcomes up to an expectational error term that is statistically uncorrelated with information available today. We prefer this terminology because rejection of the proposition would not require that market participants are irrational, but would allow such interpretations as the "peso problem" or learning within a finite sample (e.g., Lewis, 1989).

investor-expected returns, that is, the equalization of interest rates adjusted for exchange rate changes expected by market participants. The hypothesis of forward market unbiasedness is consistent with the combination of UIP, rational expectations and covered interest parity. These distinctions, while straightforward, are critical for understanding why the forward rate might not be of much use in predicting the future spot rate. It could be because of an exchange risk premium; or it could be because expectations are on average biased within finite samples.

In this paper, we eschew the approach of imposing the rational expectations hypothesis, and instead use survey-based measures of exchange rate expectations to proxy for market expectations. Early contributions in this vein were Dominguez (1986), Frankel and Froot (1987), Froot and Frankel (1989), and Ito (1990).[3] The empirical results presented in this paper are based on a data set derived from *FXForecasts*, the successor to *Currency Forecasters' Digest* and *Financial Times Currency Forecaster*. This data set has the advantage of spanning nearly a third of a century for eight currencies, from 1986 to 2018.[4] To our knowledge, this is the longest sample period over which survey data have been used to analyze the foreign exchange market.

To anticipate the results, we find that the forward discount does positively correlate with *expected* depreciation as measured by survey data, in a manner consistent with uncovered interest parity. In contrast, confirming that our sample is not atypical, the usual relationship holds for *ex post* exchange rate changes, over the corresponding sample periods – that is the forward discount tends to point in the wrong direction for

[3] Takagi (1991) surveys the early use of the survey data. Also Engel (1996).
[4] For a shorter sample, we examine data for 16 currencies.

subsequent changes in exchange rates.

These results are consistent with systematic errors in exchange rate expectations. We show that for many cases (particularly where the results differ substantially between regressions using the actual *ex post* realized changes and *ex ante* expected changes) the bias in expectations is significant.

We do find that there is an exchange risk premium identified using survey data, but it behaves much differently than that implied by the standard rational expectations methodology. This is a finding that is more clearly highlighted when using a longer sample period. In particular, the risk premia based on survey data are much more persistent than the risk premia obtained using the conventional approach. Reassuringly, the evidence suggests negative risk premia for the Japanese yen and Swiss franc (relative to the US dollar), both of which are widely considered "safe haven" currencies.

The paper is organized in the following fashion. In section 2, we discuss the uncovered interest parity condition, combined with the rational expectations hypothesis (sometimes called the risk-neutral efficient markets hypothesis, or "RNEMH"), and in section 3, UIP is evaluated empirically, under the conventional rational expectations methodology as well as the methodology that uses survey data to measure expectations. Section 4 examines the contrasting behavior of the exchange risk premium, measured using rational expectations versus using survey data. Section 5 concludes.

2. The Unbiasedness Hypothesis and the Risk Neutral Efficient Markets Hypothesis

Let s_t be the price of foreign currency in units of domestic currency at time t, $f_{t,t+k}$

is the forward value of s for a contract expiring k periods in the future (both in logs). Suppose the forward rate (in logs, f) differs from the investor-expected future spot rate (denoted by the e superscript) by a premium that compensates for the perceived riskiness of holding domestic versus foreign assets. The risk premium, η, is defined by:

$$f_{t,t+k} = s^{e}_{t,t+k} + \eta_{t+k} . \qquad (1)$$

Subtracting the log spot rate at time t from both sides, and rearranging yields:

$$s^{e}_{t,t+k} - s_t = \left(f_{t,t+k} - s_t\right) - \eta_{t+k} . \qquad (2)$$

Expected depreciation equals the forward discount, minus the risk premium.

If covered interest parity holds,

$$f_{t,t+k} - s_t = (i_{t,k} - i^{*}_{t,k}) . \qquad (3)$$

and the risk premium is zero, then equation (2) becomes the familiar uncovered interest parity condition:

$$\Delta s^{e}_{t,t+k} = (i_{t,k} - i^{*}_{t,k}) \qquad (4)$$

where $i_{t+,k}$ is the k-period yield on the domestic instrument, and $i^{*}{}_{t+k}$ is the corresponding yield on the foreign instrument.

The forward discount equals expected depreciation if the risk premium is zero.[5] This is sometimes termed the forward rate efficient markets hypothesis. Equations (2) and (4) are not directly testable, however, in the absence of observations on market expectations of future exchange rate movements. To make this hypothesis testable, it is standardly tested jointly with the assumption of rational expectations. Using the rational

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[5] Some approximations or simplifying assumptions have been made in order to arrive at this logarithmic expression. There may, for example, also be a "convesity term." See Engel (1996) and Frankel (1982).

expectations methodology, future realizations of s_{t+k} will equal the value expected at time t plus a white-noise error term ξ_{t+k} that is uncorrelated with all information known at t, including the interest differential and the spot exchange rate:

$$s_{t+k} = s^{re}_{t,t+k} + \xi_{t+k}\,, \qquad (5)$$

where the "re" superscript denotes the rational expectations measure of "expected". Then, applying the expression (2) one obtains the following relationship,

$$\Delta s_{t,t+k} = \left(f_{t,t+k} - s_t\right) - \eta_{t,t+k} + \xi_{t+k}\,, \qquad (6)$$

where the left-hand side of equation (6) is the realized percentage change in the exchange rate from t to t+k. According to the forward rate efficient markets hypothesis, the error term is orthogonal to the right-hand side variable while the risk premium is possibly zero or is at least also orthogonal.

In a regression context, the estimated parameter on the forward premium will have a probability limit of unity in the following regression:

$$\Delta s_{t,t+k} = \beta_0 + \beta_1 \left(f_{t,t+k} - s_t\right) + \varepsilon_{t+k}\,. \qquad (7)$$

If the joint hypothesis holds, then the disturbance in equation (7) becomes simply the rational expectations forecast error $\xi_{t,t+k}$, which by definition is orthogonal to all information known at time t, including the forward discount.

Forward rate unbiasedness is a weaker condition than the risk neutral efficient markets hypothesis. All that is required for forward rate unbiasedness is that any risk premium and/or non-rational expectations error be uncorrelated with the forward discount, while the risk neutral efficient markets hypothesis requires in addition that no other regressors known at time t should have explanatory power.[6]

Estimates of equation (7) typically reject the unbiasedness restriction on the slope parameter, using values for k that range up to one year. For instance, the survey by Froot and Thaler (1990) finds an average estimate for β of -0.88.[7] This result means that on average, one can make an excess profit by borrowing in the low interest rate currency and lending in the high interest rate currency, known as the carry trade.

One can relax the assumption regarding rational expectations methodology, and replace it with the assumption that survey-based expectations are an informative measure for market expectations. More precisely, the survey data can be measured with error, provided the error is uncorrelated with the other variables.[8] Hence, instead of equation (7), estimate.

$$\Delta\hat{s}^{e}_{t,t+k} = \beta_0^{'} + \beta_1^{'}\left(f_{t,t+k} - s_t\right) + \tilde{\varepsilon}_{t+k}\,. \qquad (8)$$

where $\hat{s}^{e}_{t,t+k} \equiv \hat{s}^{e}_{t,t+k} - s_t$ is the expected depreciation implied by survey data. Under the null hypothesis of uncovered interest parity, the probability limit of β′ equals unity as long as the error term is uncorrelated with the interest differential.

Froot and Frankel (1989) demonstrate that the standard tests for bias yield radically different results when one uses survey-based forecasts of exchange rate depreciation. They find that most of the variation of the forward discount appears to be

6 The constant term may reflect a constant risk premium demanded by investors on foreign versus domestic assets. Default risk could play a similar role, although the latter possibility is less familiar because tests of UIP (as well as CIP) generally use returns on assets issued in offshore markets by borrowers with comparably high credit ratings. Alternatively, the constant term could reflect a convexity term, arising from the use of logs [which in turn arises as a way to address the so-called Siegel Paradox].

7 Similar results are cited in surveys by MacDonald and Taylor (1992) and Isard (1995).

8 This is the same as what we require of the rational expectations methodology: that the *ex post* change in the exchange rate measures *ex ante* expectations with an error that may be large but that is uncorrelated with the other variables.

related to expected depreciation, rather than a time varying risk premium, thereby lending credence to UIP. Chinn and Frankel (1994) confirm the extent of forward rate bias in a larger set of currencies (17, versus 5 in Froot and Frankel), using forecasts provided by the *Currency Forecasters' Digest* (*CFD*).[9]

3. Empirics

In this section, we compare the results from the standard unbiasedness tests and the test for UIP using survey data.

3.1 Unbiasedness

We first consider the results of estimating equation (7):

$$\Delta s_{t,t+k} = \beta_0 + \beta_1 \left(f_{t,t+k} - s_t\right) + \varepsilon_{t+k}. \qquad (7)$$

Table 1 reports the results from estimating the standard *ex post* UIP regression (UIP incorporating rational expectations), often known as the "Fama regression" (1984), though it was first tested by Tryon (1979). While data are available at the 1, 3, 6 and 12 month horizons, only results for the three and 12 months horizons are reported. Under the maintained hypothesis, the errors should be serially uncorrelated at the one month horizon. At the multi-month horizons, even under the null of rational expectations, there should be moving average serial correlation of order k-1i.e., order 2 and order 11 for the

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[9] Bacchetta and van Wincoop (2009) would argue that the object we identify as the risk premium need not be a true exchange risk premium. In their case, infrequent portfolio decisions account for the gap between the forward rate and the expected spot rate. Another objection often leveled against survey based measures of exchange rate expectations is that the forecasters derive their response from interest rate parity. In their survey of New York City forex traders, Cheung and Chinn (2001) found that at horizons of up to 6 months, "economic fundamentals" (broadly defined) only accounted for about a third of the factors affecting exchange rate movements. That share rises up to 87% over the horizon greater than six months.

three month and 12 month horizon regressions, respectively.10 However, we report the estimates using Newey-West standard errors, as there appears to be serial correlation, according to the Durbin Watson statistics, above and beyond that implied by overlapping horizons.

In the rightmost seven columns of Table 1.1 and 1.2 are presented the estimates for the euro legacy currencies. The time series is necessarily truncated, of course, because these currencies were superseded by the euro. or the legacy currencies the sample ends in such a way that the last forecasted exchange rate is 1998M12. That means that at the three month horizon, the sample ends at 1998M09. For the euro, the sample begins at 1999M01 and ends at 2018M05 (for three month) and 2017M08 (for one year). Slightly over half the point estimates are negative. One can reject the null of a coefficient of unity about three quarters of the time. In the other cases, the samples are too short and the standard errors too large.[11]

A few coefficients are significantly positive, those pertaining to the currencies of Italy and Spain – countries that exhibited relatively high inflation during the pre-euro sample period -- and Sweden. This finding is consistent with the finding in Chinn and Meredith (2004) and Chinn and Frankel (1994) that the currencies of higher- inflation countries tended better to conform to the unbiasedness hypothesis at short horizons. In this earlier sample, all the adjusted R-squared statistics are quite low.

The bias is evident for the newest currency in the data set – the euro. In this case,

10 Hansen and Hodrik (1980) and Frankel (1980),,

[11] In earlier studies, the Fama coefficients were typically almost uniformly less than zero. Estimates incorporating the sharp exchange rate movements surrounding the EMS crises of the early 1990s evidence less of these negative coefficients; this pattern is consistent with the findings of Flood and Rose (2002).

the standard errors are sufficiently large at the 3 month and 12 months horizon that one cannot reject the null of a coefficient of unity.

Columns of 9-17 of Tables 1.1 and 1.2 report the estimates for currencies estimated over the full sample. The results are much in line with those reported elsewhere in the literature. The slope coefficients are almost always below one, particularly at the 12 month horizon, and significantly so. The Swedish krone at the three month horizon is the lone instance where the coefficient is above unity.[12]

3.2 Uncovered Interest Parity

We now turn to estimating the UIP relationship directly, in the sense that we drop the assumption of rational expectations, and replacethe actually realized depreciation with a measure of expected depreciation. These results of estimating *ex ante* uncovered interest parity stand in stark contrast to those from *ex post* UIP.

To do this, we use extended versions of the data used in Chinn and Frankel (1994), which incorporated data only up to 1991. These survey data are collected by *FX Forecasts*, the successor organization to *Currency Forecaster's Digest*, and the data used are at the 3 and 12 month horizons.

Table 2 presents the results of estimating equation (8). The most obvious and striking difference is that there is only one negative estimated coefficient for all the currencies (Japan at the 3 month horizon). In all other instances, the estimated

[12] Tthe point estimates are quantitatively close to the posited value of unity in two cases – Sweden and Spain. Italy's coefficients at the short horizon is very high, nearly 2. In the latter two countries' currencies, the rate of the inflation over the sample period (which ends in 1998M12) is the highest.

coefficients are positive, are closer to the posited value of unity, and in most cases reject the null of a zero coefficient. In other words, whereas the regressions involving *ex post* depreciation cluster on the wrong side of zero, here we have much more evidence in accord with UIP. Figure 1 shows how the ex post and ex ante depreciation of the US dollar against the pound compare.

In economic terms, this means that the forward discount actually does tell us a lot about the direction in which market participants *think* the exchange rate will move in the future, despite the usual conclusion that they tell us nothing about what it will *actually* do. Hence, forward market bias cannot be interpreted as primarily the result of a risk premium, as is commonly assumed .

Why do the results differ so widely between the two approaches to measuring expectations? One can examine this from a mechanical perspective. If exchange rate expectations, as measured by the survey data, point in a substantially different direction from the actual *ex post* exchange rate changes, then one would expect differing results. One can quantify the differences by examining whether expected changes exhibit bias.

$$\Delta s_{t,t+k} = \theta_0 + \theta_1 (\Delta \hat{s}^e_{t,t+k}) + u_{t+k} . \qquad (9)$$

These results are reported in Tables 3.1 and 3.2, for the 3 month and 12 month horizons, respectively. Almost all the survey-based forecasts show biased expectations and exhibit very small correlation with the actual exchange rate changes. However, it is also notable that most of the cases where the θ coefficients switch from negative to positive are the instances where the survey-based expected changes are negatively correlated with the actual changes.[13]

Another point of commonality with the rational expectations-UIP hypothesis is that the proportion of variation explained is very low, with the exception of the 12 month horizon. Moreover, a high degree of serial correlation is evident in both the unbiasedness and UIP regressions.

4. Does the Risk Premium Behave as If Related to Risk?

The risk premium is typically defined as the gap between the forward rate and the expected future spot rate, as shown in equation 1. As is well known, numerous researchers have failed to relate the risk premium identified using rational expectations to macroeconomic fundamentals.[14] In simple finance models of the fundamentals, the exchange risk premium arises from the correlation of currency returns with the marginal utility of consumption. Older models link the risk premium to stocks of government debt that have to be held along with the variance-covariance matrix of exchange rate changes.15

Here, we examine how the behavior of the risk premium defined under rational expectations differs from that defined using survey data. The three month risk premium for the US dollar against the pound is compared against excess returns in Figure 2. The red line presents the risk premia obtained using survey data, while the blue line depicts the conventional risk premia implied by the rational expectations hypothesis. Clearly, the

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[13] In Bussiere et al. (2018), the difference in the coefficients is attributed to violations of rational expectations, covered interest parity, and risk neutrality, using survey data over the 2002-2016 period.

[14] See Froot and Thaler (1991), Engel (1996, 2014) for extensive reviews of the literature, including the survey-based studies.

15 E.g., Frankel (1982).

risk premia obtained using the survey data are much more persistent than the one implied by the rational expectations methodology; they also exhibit much less high frequency volatility.

To quantify the degree of persistence formally, we sampled the three month risk premia every three months (end of each quarter), so as to eliminate the overlapping data issue. We then regressed the current premium on its own lagged value, assuming an AR(1) specification can capture the dynamics fairly well. The results are presented in Table 5.

The pattern is striking. In almost every case, the risk premium obtained using survey data is highly persistent. This is what one would expect if the fundamental determinants of risk were persistent. In contrast, the "risk premium" estimated using the traditional rational expectations methodology is not persistent. In fact it would be hard to distinguish the latter from white noise in most cases. The exceptions are the Swedish krone, Australian, Canadian and New Zealand dollar. In those cases save the NZ dollar,[16] one can reject the null of a zero AR(1) coefficient. However, in each of those cases, the survey-based measure is more persistent. The half-life of a typical survey-based risk premium is about 2 quarters. The maximal half-life for a risk premium assuming rational expectations is about 2 months.

It is conceivable that the earlier stylized fact that the exchange risk premium is unrelated to macroeconomic variables is in fact an artifact of the questionable methodology of rational expectations. In order to investigate this issue, we examine the

[16] The sample sizes differ between the two sets of regressions, so the coefficients are not directly comparable.

correlation between the risk premium defined both ways and the VIX, a widely used measure of overall market risk. The regressions take the form:

$$\eta_{t+k} = \lambda_0 + \lambda_1 VIX_t + u_t \qquad (10)$$

Importantly, there appears to be a relationship between the VIX and the survey-measured *ex ante* risk premium. However, there is no systematic relationship between the VIX and the *ex post* risk premium. These results are reported in Table 5.

An increase in the VIX tends to decrease the exchange risk premium for the dollar against most currencies that span the entire sample. A similar finding applies to the euro legacy currencies (with the exception of the Irish punt). Exceptions inclue the euro (from 1999 on), British pound, Australian and New Zealand dollar, which exhibited a positive coefficient. In contrast, the Japanese yen, does not exhibit a statistically significant relationship.

Whenever the VIX rises, the risk premium on US dollar assets falls, or equivalently, the risk premium on the non dollar asset rises (with some exceptions). This finding is in line with the common "safe haven" characterization that associates an increase in risk perception with a strengthening of demand for the US dollar.

5. Conclusions

In this study, we have re-examined the hypothesis of forward market unbiasedness, both using the rational expectations methodology and using the survey data methodology to identify expected exchange rate changes. We arrive at the following conclusions:

- Forward rate unbiasedness is generally rejected on a currency by currency basis.
- The forward discount deviates from survey-measured expected depreciation in about a third of the currencies when using survey data based expectations. The interest differential does on average correctly reflect the direction of exchange rate changes expected by market participants. Nonetheless, one can still reject the null of forward market unbiasedness in many cases, particularly at the three month horizon.
- Oftentimes, the difference in the results between the two measures of expectations is linked to the finding of bias in exchange rate expectations. This pattern suggests that biased expectations are an important reason why the forward discount point in the wrong direction for subsequent *ex post* exchange rate changes.
- The risk premium identified using survey data differs substantially in terms of persistence and high frequency volatility from the standard risk premium. The survey-data based risk premium is much more persistent. This is consistent the with idea that the fundamental determinants of risk are persistent.
- The risk premium identified using survey data depends on the VIX— a standard measure of risk perceptions -- in a direct fashion. No such relationship is found using *ex post* realizations of exchange rate changes to proxy for expected depreciation. This reinforces the conclusion that there is an exchange risk premium but that it does not explain forward market bias.

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Table 1.1. Unbiasedness Regressions, Three Month Horizon

$$\Delta s_{t,t+k} = \beta_0 + \beta_1 \left(f_{t,t+k} - s_t\right) + \varepsilon_{t+k} .$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
VARIABLES	BEL	FRA	DEU	IRL	ITA	NLD	ESP	EUR	DNK	NOR	SWE	CHE	GBR	JPN	AUS	CAN	NZL
fs3	**-0.600**	**-0.096**	0.065	0.312	1.824**	**-0.179**	0.704	-0.670	**-0.303**	**-0.021**	1.360***	**-1.293****	0.560	**-2.080*****	**-0.888**	**-0.271**	0.086
	(0.642)	(0.642)	(0.670)	(0.552)	(0.727)	(0.717)	(0.559)	(2.037)	(0.501)	(0.583)	(0.343)	(0.626)	(0.380)	(0.666)	(0.581)	(0.556)	(1.157)
Constant	0.005	0.003	0.005	-0.005	0.016*	0.005	0.008	0.008	0.016	0.007	0.004	0.012***	0.005	0.022***	-0.001	0.003	0.004
	(0.005)	(0.005)	(0.005)	(0.005)	(0.009)	(0.005)	(0.008)	(0.005)	(0.028)	(0.006)	(0.004)	(0.004)	(0.004)	(0.006)	(0.005)	(0.003)	(0.009)
N	134	131	134	134	134	134	134	233	267	198	267	267	267	264	264	264	165
R-squared	0.007	0.000	0.000	0.002	0.046	0.000	0.012	0.002	0.001	0.000	0.056	0.016	0.008	0.036	0.009	0.001	0.000

Notes: OLS regression estimates; Newey-West standard errors. Columns 1-7: 1986M08-1998M09, column 8: 1999M01-2018M05, columns 9-16: 1986M08-2018M05, column 17: 1989M01-2018M05. Entries in **bold face** denote significance at the 10% level, for null hypothesis of β=1.

Table 1.2. Unbiasedness Regressions, Twelve Month Horizon

$$\Delta s_{t,t+k} = \beta_0 + \beta_1 \left(f_{t,t+k} - s_t\right) + \varepsilon_{t+k}.$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
VARIABLES	BEL	FRA	DEU	IRL	ITA	NLD	ESP	EUR	DNK	NOR	SWE	CHE	GBR	JPN	AUS	CAN	NZL
fs12	**-1.011****	**-0.225**	**-0.344**	**0.179**	**1.742*****	**-0.607**	0.763*	-0.906	**-0.635****	**-0.109**	**0.342**	**-1.398*****	**0.191**	**-2.417*****	**-0.950*****	**-0.099**	**-0.235**
	(0.428)	(0.413)	(0.360)	(0.358)	(0.410)	(0.381)	(0.389)	(1.399)	(0.307)	(0.276)	(0.298)	(0.319)	(0.378)	(0.300)	(0.320)	(0.340)	(0.687)
Constant	0.003	0.004	0.010	-0.005	0.045**	0.010	0.021	0.005	0.008	0.013	0.002	0.044***	0.006	0.099***	-0.007	0.013**	0.009
	(0.010)	(0.010)	(0.009)	(0.012)	(0.018)	(0.009)	(0.020)	(0.017)	(0.007)	(0.009)	(0.008)	(0.009)	(0.009)	(0.011)	(0.011)	(0.005)	(0.021)
N	123	122	125	125	123	125	123	224	267	225	267	267	267	264	264	264	184
R-squared	0.044	0.002	0.007	0.002	0.130	0.020	0.031	0.010	0.016	0.001	0.005	0.067	0.001	0.199	0.032	0.000	0.001

Notes: OLS regression estimates; Newey-West standard errors. Columns 1-7: 1986M08-1998M09, column 8: 1999M01-2007M08, columns 9-16: 1986M08-2017M08, column 17: 1989M01-2017M8. Entries in **bold face** denote significance at the 10% level, for null hypothesis of β=1.

Table 2.1. Uncovered Interest Parity Regressions, Three Month Horizon

$$\Delta\hat{s}^{e}_{t,t+k} = \beta_0^{'} + \beta_1^{'}\left(f_{t,t+k} - s_t\right) + \tilde{\varepsilon}_{t+k}\,.$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
VARIABLES	BEL	FRA	DEU	IRL	ITA	NLD	ESP	EUR	DNK	NOR	SWE	CHE	GBR	JPN	AUS	CAN	NZL
fs3	0.891***	0.774***	0.774***	1.093***	1.309***	**1.581*****	0.252	0.528	0.915***	**0.739*****	0.898***	1.221***	**0.155**	**-0.602****	**1.776*****	**0.708*****	0.991***
	(0.281)	(0.294)	(0.167)	(0.275)	(0.280)	(0.312)	(0.265)	(0.491)	(0.192)	(0.124)	(0.122)	(0.254)	(0.141)	(0.243)	(0.149)	(0.141)	(0.315)
Constant	-0.007***	-0.008***	-0.007***	0.0057*	0.002	-0.008***	-0.007*	0.007	0.001	0.006***	0.003*	-0.006***	-0.004***	0.0001	0.014***	0.004***	0.019***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.004)	(0.007)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)
N	139	137	139	139	139	139	139	234	270	234	270	270	270	267	267	267	161
R-squared	0.068	0.049	0.136	0.104	0.138	0.158	0.007	0.012	0.078	0.132	0.168	0.079	0.004	0.023	0.349	0.086	0.059

Notes: OLS regression estimates; Newey-West standard errors. Columns 1-7: 1986M08-1998M09, column 8: 1999M01-2018M08, columns 9-16: 1986M08-2018M08, column 17: 1989M01-2018M08. Entries in **bold face** denote significance at the 10% level, for null hypothesis of β'=1.

Table 2.2. Uncovered Interest Parity Regressions, Twelve Month Horizon

$$\Delta\hat{s}^{e}_{t,t+k} \;=\; \beta_0^{'} + \beta_1^{'}\left(f_{\,t,t+k} - s_t\right) + \tilde{\varepsilon}_{\,t+k}\,.$$

VARIABLES	(1) BEL	(2) FRA	(3) DEU	(4) IRL	(5) ITA	(6) NLD	(7) ESP	(8) EUR	(9) DNK	(10) NOR	(11) SWE	(12) CHE	(13) GBR	(14) JPN	(15) AUS	(16) CAN	(17) NZL
fs12	0.856***	**0.690*** **	**1.296*** **	**0.627*** **	0.936***	1.168***	**0.394*** **	1.057**	**1.485*** **	0.822***	**1.614*** **	**1.367*** **	**1.585*** **	**0.323** **	**1.679*** **	**0.788*** **	1.190***
	(0.166)	(0.172)	(0.136)	(0.162)	(0.181)	(0.152)	(0.145)	(0.483)	(0.155)	(0.134)	(0.117)	(0.183)	(0.169)	(0.161)	(0.099)	(0.097)	(0.215)
Constant	-0.045***	-0.042***	-0.046***	0.038***	-0.019**	-0.044***	-0.033***	-0.001	0.005	0.018***	0.017***	-0.027***	0.010**	-0.026***	0.058***	0.013***	0.064***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.008)	(0.004)	(0.007)	(0.007)	(0.003)	(0.005)	(0.003)	(0.005)	(0.004)	(0.006)	(0.003)	(0.001)	(0.006)
N	128	128	130	130	128	130	128	234	270	232	270	270	270	267	267	267	161
R-squared	0.175	0.113	0.416	0.105	0.175	0.314	0.055	0.073	0.256	0.140	0.416	0.173	0.248	0.015	0.520	0.200	0.162

Notes: OLS regression estimates; Newey-West standard errors. Columns 1-7: 1986M08-1998M12, column 8: 1999M01-2018M08, columns 9-16: 1986M08-2018M08, column 17: 1989M01-2018M08. Entries in **bold face** denote significance at the 10% level, for null hypothesis of β'=1.

Table 3.1 Bias, Three Month Horizon

$$\Delta s_{t,t+k} = \gamma + \theta(\Delta \hat{s}^{e}_{t,t+k}) + u_{t+k}.$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
VARIABLES	BEL	FRA	DEU	IRL	ITA	NLD	ESP	EUR	DNK	NOR	SWE	CHE	GBR	JPN	AUS	CAN	NZL
dse3	**0.321***	**0.210**	**0.174**	**0.332****	**0.292**	**0.196**	**0.202**	**0.085**	**0.050**	**-0.141**	**0.236**	**0.012**	**-0.087**	**0.038**	**-0.348***	**-0.167**	**-0.684****
	(0.181)	(0.176)	(0.176)	(0.160)	(0.195)	(0.173)	(0.177)	(0.235)	(0.151)	(0.242)	(0.157)	(0.144)	(0.166)	(0.164)	(0.193)	(0.230)	(0.340)
Constant	0.008	0.006	0.006	-0.007	0.002	0.006	0.002	0.017	0.005	0.008*	0.001	0.006*	0.002	0.006*	0.006	0.003	0.020**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.023)	(0.003)	(0.005)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.002)	(0.008)
N	136	134	136	136	136	136	136	231	267	196	267	267	267	267	267	267	131
R-squared	0.023	0.011	0.007	0.031	0.017	0.009	0.010	0.001	0.000	0.002	0.008	0.000	0.001	0.000	0.012	0.002	0.030

Notes: OLS regression estimates; Newey-West standard errors. Columns 1-7: 1986M08-1998M09, column 8: 1999M01-2018M05, columns 9-16: 1986M08-2018M05, column 17: 1989M01-2018M05. Entries in **bold face** denote significance at the 10% level, for null hypothesis of θ=1.

Table 3.2 Bias, Twelve Month Horizon

$\Delta s_{t,t+k} = \gamma + \theta(\Delta \hat{s}^{e}_{t,t+k}) + u_{t+k}$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
VARIABLES	BEL	FRA	DEU	IRL	ITA	NLD	ESP	EUR	DNK	NOR	SWE	CHE	GBR	JPN	AUS	CAN	NZL
dse12	**-0.084**	**-0.148**	**0.075**	**0.062**	**0.269**	**0.093**	**0.328**	**0.447**	**0.046**	**0.210***	**0.230***	**0.081**	**0.280****	**-0.012**	**-0.109**	**0.405****	**0.034**
	(0.217)	(0.204)	(0.180)	(0.187)	(0.199)	(0.185)	(0.236)	(0.303)	(0.105)	(0.123)	(0.117)	(0.0999)	(0.117)	(0.125)	(0.139)	(0.189)	(0.270)
Constant	0.002	-0.002	0.010	-0.005	-0.008	0.011	0.004	0.001	0.012*	0.015**	-0.002	0.019***	0.008	0.023***	0.018**	0.010*	0.027*
	(0.014)	(0.014)	(0.012)	(0.013)	(0.015)	(0.012)	(0.016)	(0.014)	(0.007)	(0.007)	(0.008)	(0.006)	(0.006)	(0.007)	(0.008)	(0.005)	(0.015)
N	125	125	127	127	125	127	125	222	267	223	267	267	267	267	267	267	157
R-squared	0.001	0.004	0.001	0.001	0.015	0.002	0.015	0.044	0.001	0.013	0.014	0.002	0.021	0.000	0.002	0.017	0.000

Notes: OLS regression estimates; Newey-West standard errors. Columns 1-7: 1986M08-1998M09, column 8: 1999M01-2007M08, columns 9-16: 1986M08-2017M08, column 17: 1989M01-2017M8. Entries in **bold face** denote significance at the 10% level, for null hypothesis of θ=1.

Table 4.1 Persistence in the Excess Returns, Three Month Horizon

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
VARIABLES	BEL	FRA	DEU	IRL	ITA	NLD	ESP	EUR	DNK	NOR	SWE	CHE	GBR	JPN	AUS	CAN	NZL
L.rpre3	0.131	0.183	0.0412	0.204	0.0562	0.0552	0.180	0.0771	0.109	-0.0161	0.189*	-0.0329	0.148	-0.0685	0.189*	0.220**	0.299**
	(0.159)	(0.161)	(0.162)	(0.161)	(0.155)	(0.161)	(0.150)	(0.151)	(0.110)	(0.130)	(0.108)	(0.110)	(0.111)	(0.110)	(0.111)	(0.110)	(0.133)
Constant	-0.006	-0.005	-0.004	0.006	-0.010	-0.004	-0.014*	-0.005	-0.006	-0.013*	-0.005	-0.003	-0.006	0.002	-0.010	-0.005	-0.006
	(0.009)	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.006)	(0.008)	(0.006)	(0.006)	(0.005)	(0.007)	(0.007)	(0.004)	(0.008)
N	38	38	38	38	38	38	38	43	82	62	82	82	82	80	80	80	53
R-squared	0.018	0.035	0.002	0.043	0.004	0.003	0.039	0.006	0.012	0.000	0.037	0.001	0.022	0.005	0.036	0.049	0.091

Table 4.2 Persistence in the Risk Premium, Three Month Horizon

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
VARIABLES	BEL	FRA	DEU	IRL	ITA	NLD	ESP	EUR	DNK	NOR	SWE	CHE	GBR	JPN	AUS	CAN	NZL
L.rp3	0.637***	0.580***	0.576***	0.666***	0.636***	0.682***	0.685***	0.116	0.532***	0.450***	0.593***	0.510***	0.597***	0.662***	0.382***	0.292**	0.095
	(0.119)	(0.128)	(0.151)	(0.123)	(0.119)	(0.115)	(0.116)	(0.146)	(0.094)	(0.115)	(0.086)	(0.093)	(0.087)	(0.085)	(0.101)	(0.112)	(0.148)
Constant	0.002	0.002	-0.000	-0.001	-0.000	0.002	-0.001	-0.005**	-0.001	-0.008***	-0.002	0.002	-0.001	0.004*	-0.006***	-0.003***	-0.017***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.004)
N	40	40	40	40	40	40	40	41	82	62	82	82	82	80	80	80	42
R-squared	0.431	0.352	0.277	0.434	0.428	0.479	0.480	0.016	0.285	0.202	0.375	0.275	0.370	0.436	0.156	0.080	0.010

Notes: OLS regression estimates; Newey-West standard errors. Columns 1-7: 1986Q3-1998Q3, column 8: 1999Q1-2018Q1, columns 9-16: 1986Q3-2018Q1, column 17: 1989Q1-2018Q1. Entries in **bold face** denote significance at the 5% level, for null hypothesis of ρ=0.

Table 5: Three month ex ante Risk Premium and VIX

$$\eta_{t+k} = \lambda_0 + \lambda_1 VIX_t + u_t$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
VARIABLES	BEL	FRA	DEU	IRL	ITA	NLD	ESP	EUR	DNK	NOR	SWE	CHE	GBR	JPN	AUS	CAN	NZL
VIX	-0.663**	-0.715***	-0.733***	0.823***	-0.648***	-0.786***	-0.745**	0.124**	-0.279***	-0.295***	-0.281***	-0.239***	0.163**	0.074	0.198***	-0.142***	0.253***
	(0.267)	(0.270)	(0.266)	(0.282)	(0.237)	(0.255)	(0.318)	(0.056)	(0.076)	(0.075)	(0.077)	(0.082)	(0.078)	(0.095)	(0.058)	(0.034)	(0.060)
Constant	0.173	0.183	0.185	-0.209	-0.000	0.199	0.158	-0.032**	0.071	0.039***	0.052	0.078	-0.052***	0.041**	-0.010	0.014**	-0.010
	(0.039)	(0.039)	(0.039)	(0.043)	(0.146)	(0.037)	(0.318)	(0.013)	(0.015)	(0.015)	(0.015)	(0.017)	(0.017)	(0.018)	(0.013)	(0.007)	(0.013)
N	102	100	102	102	102	102	102	243	337	301	337	337	337	334	334	334	267
R-squared	0.202	0.238	0.220	0.206	0.243	0.271	0.191	0.031	0.092	0.122	0.096	0.060	0.025	0.007	0.068	0.073	0.094

Notes: OLS regression estimates; Newey-West standard errors. Columns 1-7: 1986M08-1998M09, column 8: 1999M01-2018M05, columns 9-16: 1986M08-2018M05, column 17: 1989M01-2018M05.

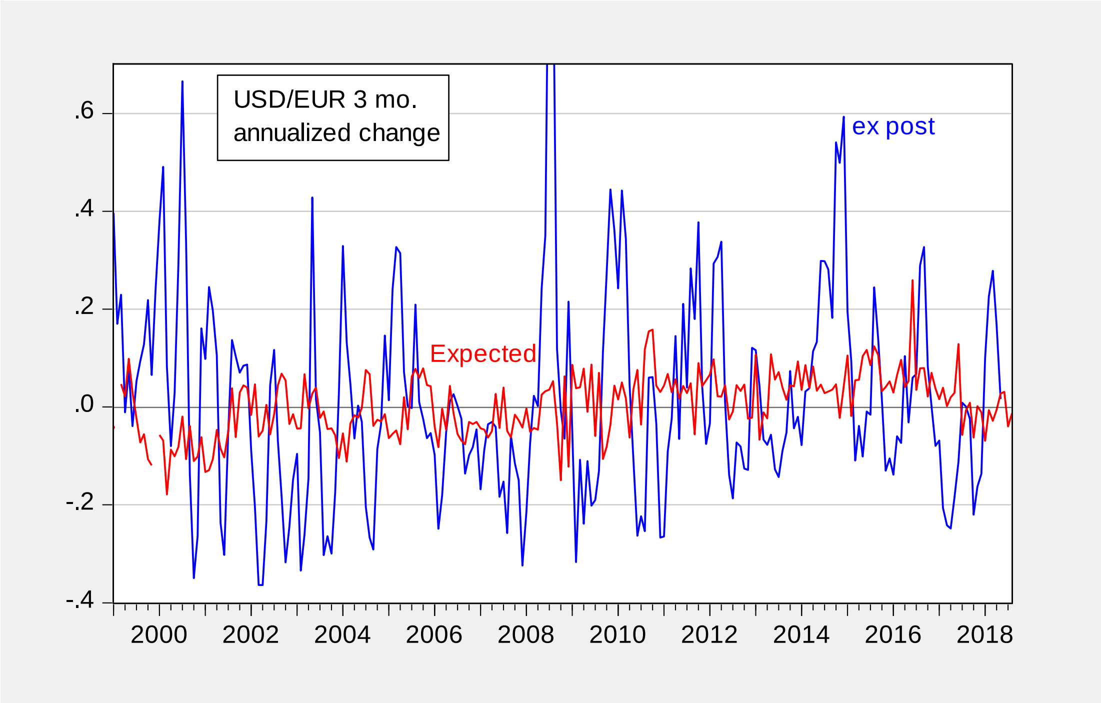

Figure 1

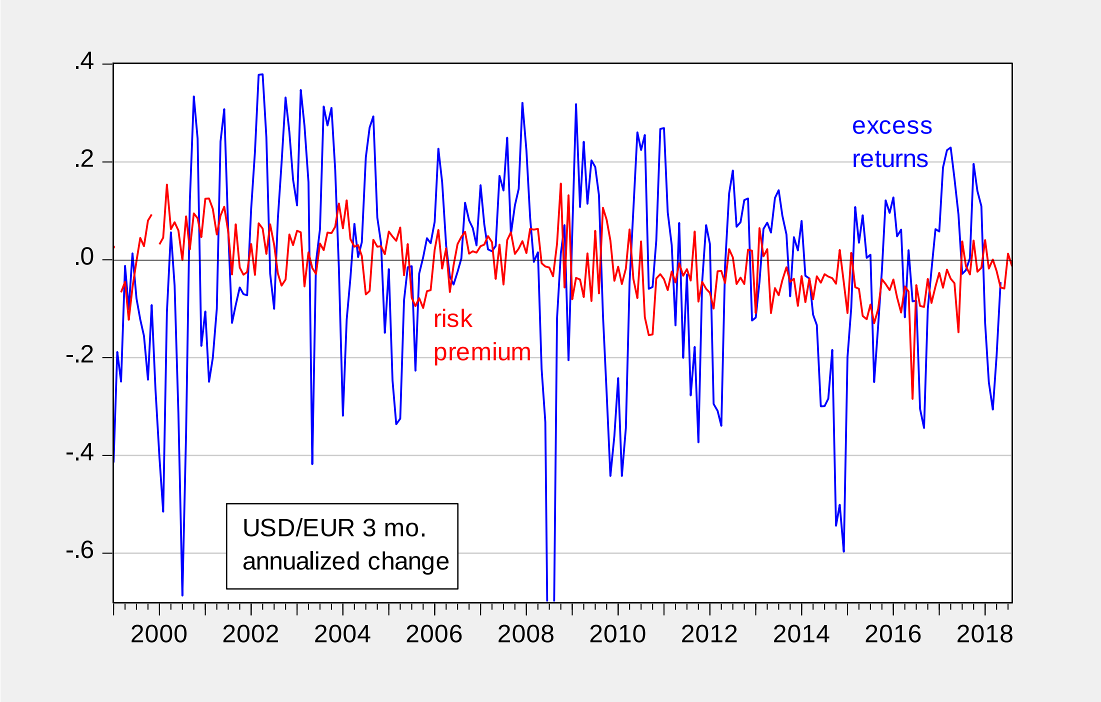

Figure 2