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A number of studies have used survey data on traders' exchange rate forecasts to examine the role of risk and non-REH forecasting in accounting for excess returns in currency markets. This work re-examines those results using an alternative estimation technique, the Cointegrated VAR, which allows for better examination of non-stationarity in a multivariate framework. The results demonstrate the importance of focusing on the persistence of deviations from any found relationships. Consistent with some later studies, clear evidence of a time-varying risk premium is found, and REH is rejected for all three exchange rate samples examined (BP/USD, DM/USD, and JY/USD). The results strongly draw into question though the interpretation that this represents obvious irrationality. The relationship between the forecast error and interest rate differential is found to be non-stationary at very high significance levels, implying that the correlations are spurious and unstable over time, and individuals are not, in fact, mis-forecasting in a fixed manner relative to interest rates.

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Keywords: Excess returns puzzle, survey data, risk premium, non-stationarity, irrationality
Rethinking What Survey Data has to Say about the Role of Risk and Irrationality in Currency Markets

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September 2013

Abstract: A number of studies have used survey data on traders’ exchange rate forecasts to examine the role of risk and non-REH forecasting in accounting for excess returns in currency markets. This work re-examines those results using an alternative estimation technique, the Cointegrated VAR, which allows for better examination of non-stationarity in a multivariate framework. The results demonstrate the importance of focusing on the persistence of deviations from any found relationships. Consistent with some later studies, clear evidence of a time-varying risk premium is found, and REH is rejected for all three exchange rate samples examined (BP/USD, DM/USD, and JY/USD). The results strongly draw into question though the interpretation that this represents obvious irrationality. The relationship between the forecast error and interest rate differential is found to be non-stationary at very high significance levels, implying that the correlations are unstable over time, and individuals are not, in fact, mis-forecasting in a fixed manner relative to interest rates.

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1 Searching for the Source of Excess Returns: Risk or "Irrationality"?

The widespread rejection of REH-based risk premium models has led many in the field to search for explanations of currency returns, the forward discount anomaly in particular, based on the notion that returns are driven solely by irrationality.\(^1\) In these models, market participants are often presumed to hold very specific distortions of belief. That is they are specified to mis-forecast in an exact way eternally.\(^2\) It is worth emphasizing that such explanations, which attempt to account for the forward rate bias (even in part) with the fixed forecasting biases of traders, imply that one could make predictable profits, even risk-adjusted profits, simply by betting against the forward rate. This would constitute a truly gross form of market inefficiency.

This line of research was further motivated by the work of Froot and Frankel (1989), which uses survey data to decompose the forward rate bias into a component attributable to the risk premium and another attributable to the forecast error. They conclude that essentially none of the bias can be attributed to the risk premium, though they find a large average value of the premium which they interpret as constant. Froot and Frankel are careful to note however that their results do not immediately imply irrationality, as the results could be driven by a peso problem or a shift in the process governing the spot rate. Nonetheless, their work has often been cited in support of the irrationality view.

Later studies using survey data tend to overturn one half of the Froot and Frankel results. Cavaglia, Verschoor, and Wolff (1994) find that Froot and Frankel’s practice of pooling data across exchange rates tends to obscure the influence of the risk premium. Chinn and Frankel (1994, 2000) are able to detect a time-varying risk premium in alternative bilateral samples at longer

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\(^1\)The forward discount anomaly is the finding that the exchange rate tends to move in the opposite direction of that implied by the forward rate (see Fama 1984 and Froot and Thaler 1990). For literature reviews of the REH-based risk premium models difficulty in reconciling this observation see Lewis (1995) and Engel (1996).

\(^2\)See for example Burnside et al. (2011) who specify market participants as underestimating the variance of their forecast errors and Gourinchas and Tornell (2004) who specify market participants as underestimating interest rate persistence. The latter does note that their finding could instead be related to robust control behavior however as opposed to irrationality.
horizons, which they attribute to a greater diversity of less developed countries where the assumption of perfect substitutability is less likely to hold.\(^3\) Both similarly find a role for "irrationality" however, or more accurately stated a violation of rational expectations. Both papers again frequently make use of this less strong interpretation, but the interest in accounting for returns via irrationality has continued.

This work provides an alternative test for the presence of a time-varying risk premium in survey data, using the Cointegrated VAR framework to better address issues of non-stationarity in a multivariate framework. The presence of a time-varying risk premium is found to be statistically relevant, as in later studies using survey data and alternative econometric methodologies.

This work departs from the previously mentioned survey data studies however in its examination of the rationality of forecasting. The CVAR allows for explicit examination of the stationarity of the relationship between forecasting errors and available information. In all cases, the relationship is found to be non-stationary, suggesting these correlations are in fact unstable.\(^4\) This undermines explanations based on "irrationality" in the form of a consistent, perpetual bias in forecasting relative to the forward rate. This does support though Froot and Frankel’s conjectured possibility that this correlation could instead be related to structural change, and Frydman and Goldberg’s imperfect knowledge economics (2007) and contingent markets hypothesis (2011), both of which predict structural change in the process driving asset prices.

### 2 Testing for a Time-Varying Risk Premium

The approach in this section follows that of the previous literature closely, though with an alternative technique to estimation. Beginning with Froot and Frankel (1989) studies using survey data have evaluated the importance

\(^3\)Nieuwland, Verschoor, and Wolff (1998) also find evidence of a time-varying risk premium which they relate to an ARCH specification, though they do not examine the "rationality" of the observed forecasts. Dominguez (1987) and MacDonald and Torrance (1988) both reject rationality of forecasting but do not examine the risk premium.

\(^4\)Frydman and Goldberg (2007) find evidence of temporal instability in the forward discount using ex post excess returns and a CUSUM test. Here instead the focus is on ex ante measures and testing for temporal instability by focusing on the stationarity of the relation.
of a time-varying risk premium by testing whether Uncovered Interest Parity holds ex ante, that is expected returns equalize and the domestic return equals the expected foreign return. This is conducted by estimation of the following equation:

$$s_{t+1|t} - s_t = \alpha + \beta(i_t - i_t^*) + \varepsilon_t$$

where survey data is used to capture $s_{t+1|t}$ and the null hypothesis of UIP implies that $\alpha = 0$ and $\beta = 1$.

Froot and Frankel rejected that $\alpha = 0$, but found estimates for $\beta$ indistinguishable from one, suggesting a notable average premium, but one which was approximately constant, or at least uncorrelated with the interest differential (or forward rate). They thus concluded that it could not account for the forward rate bias. Cavaglia, Verschoor, and Wolff (1994) found that the practice of pooling data across exchange rates tended to obscure the importance of the risk premium. Using bilateral data they, along with Chinn and Frankel (1994), began also rejecting the hypothesis that $\beta = 1$.

The work here uses data from Money Market Service International (a common source of forecast data in the literature) for data on the Deutsche mark, British pound, and Japanese yen from 1982:11-2000:09 (the mark sample ends in 1998:12 however), and data from the IMF’s IFS database on short-term (3-month interest rates) and spot rate data designed to correspond as closely as possible to the survey dates.

This work uses differing econometric methodology from previous studies though, applying the Cointegrated VAR. In the CVAR, we begin by examining the statistical properties of the model and determining the rank (found to be one in all cases). We then explicitly test the restrictions im-

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5Although this is the standard presentation of UIP, the survey data studies discuss it most often in reference to the forward discount or premium rather than the interest rate differential, but the two are equivalent given Covered Interest Parity which ensures no risk-free arbitrage opportunities.


7See appendix. Of particular note is that in order to obtain a statistically well-specified model, a break in level is required for the DM sample approximate to German reunification, though it is restricted to zero in the tests to accord with the hypotheses of interest. Juselius and MacDonald (2004) find an identical needed break in the DM sample. Failing to include
posed on the data, including the creation of the interest rate differential.\textsuperscript{8} We then use these restrictions as well as the restrictions from the null hypothesis ($\alpha = 0$ and $\beta = 1$) to achieve over-identification and to estimate the model. The focus is then on the behavior of the error term. If the deviations from the imposed relationship are non-stationary, it indicates that UIP does not constitute an equilibrium relationship, and even expected returns do not equalize, implying a role for risk. We can then relax this further by eliminating the restriction $\alpha = 0$ and test whether the risk premium can be represented as approximately constant, or whether it is in fact time-varying.

**DM/USD Expected Excess Returns**

\begin{center}
\includegraphics[width=\textwidth]{DM_USD.png}
\end{center}

**JY/USD Expected Excess Returns**

\begin{center}
\includegraphics[width=\textwidth]{JY_USD.png}
\end{center}

The break in the baseline model tends to obscure the influence of the risk premium and the instability of the forecast error’s correlations. It also demonstrates the importance of structural change.

\textsuperscript{8}The restriction for the expected change in the exchange rate is not explicitly tested here since it is included as one variable. Doing so however would tend to lower the p-value, which is not problematic given we do still reject the null of stationarity.
There is a large amount of variability in the measures of the expected excess return, but perhaps more importantly there is also a seemingly notable degree of persistence, prolonged periods where the expected excess return is primarily positive or negative. This tentative observation will be formally tested now.

The results reported below show the tests of UIP. The p-value reported is the test of a stationary error term.

\[
(s_{t+1} - s_t) + i^*_t - i_t = \varepsilon_t
\]

<table>
<thead>
<tr>
<th></th>
<th>p-value of the stationary of (\varepsilon_t)</th>
</tr>
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<tbody>
<tr>
<td>BP</td>
<td>0.038</td>
</tr>
<tr>
<td>JY</td>
<td>0.000</td>
</tr>
<tr>
<td>DM</td>
<td>0.017</td>
</tr>
</tbody>
</table>

As can be seen, the null hypothesis of a stationary error term (and hence the restrictions implied by the null hypothesis of UIP) is clearly rejected for all three samples. Further, this is true even here examining a short-time horizon and developed countries only, which contradicts some of the previous conclusions in the literature.

Next we can examine whether the risk premium can be represented as approximately constant. The t-value is reported in parentheses below the coefficient estimate.

\[
(s_{t+1|t} - s_t) + i^*_t - i_t - \alpha = \varepsilon_t
\]
In all cases we can again see that the null is rejected. Even when allowing for a non-zero constant, the deviations from the relationship are so persistent as to reject stationarity. This provides strong evidence that the risk premium appears to be fluctuating over time. The economic interpretation is that market participants are viewing the bonds of these nations as not only imperfect substitutes, but actually that the perceived relative risk between them is changing notably over time.\(^9\) This suggests that any narrative attempting to account for currency returns absent a notion of time-varying risk is, at the very least, incomplete. Expected returns clearly cannot be reconciled solely through irrationality or transaction costs.\(^{10}\)

### 3 Testing the Stability of Systematic Mis-forcasting

The studies using survey data then go on to examine the other possible source of the forward discount anomaly, violations of REH. A common test is to examine the relationship between the forecast error, and the forward discount from the preceding period. Analogously here we estimate:

\[
s_t - s_{it-1}^e = \alpha + \beta (i_{t-1} - i_{t-1}^*) + \varepsilon_t
\]

\(^9\)Frydman and Goldberg (2007) and Stillwagon (2013) provide evidence that the survey data risk premium is related to the deviation or "gap" between the expected exchange rate and its benchmark value of purchasing power parity. This solidifies the interpretation that this persistent error is in fact related to risk, as opposed to a persistent measurement error. It appears that even survey measures of ex-ante returns are correlated with time-\(t\) information.

\(^{10}\)See for example Burnside, Eichenbaum and Rebelo (2007) and Lyons (2001) who explain currency returns via market microstructure. This does not mean these cannot be partial explanations, but the survey evidence suggests the importance of a time-varying risk premium as well.
Again in the Cointegrated VAR we test the restrictions implied by the relationship, including both the restriction used to produce the measure of the forecast error and the interest rate differential. In this case, $\alpha$ and $\beta$ are given free parameters. If $\alpha = \beta = 0$ and $\varepsilon$ is a white-noise process, this is a necessary condition for REH to hold. If $\beta$ is significant, then it suggests individuals are mis-forecasting "systematically" and could improve their performance simply by altering the weight they attach to the interest rate differential. This would be consistent with the common interpretation that one could make excess profits simply by betting against the forward rate.

If however the relationship is non-stationary, then it suggests not only a rejection of REH, but that the observed correlations between the forecast error and interest rate differential are unstable, and we should not expect any in-sample observation of a systematic misforecast to hold out of sample.

This would tend to overturn the interpretation that is typically attached to the finding of a correlation between the forecast error and forward premium.

DM/USD forecast error (in black) and the lagged interest rate differential (in blue)
There appear to be some sub-periods where the forecast error and previous period’s interest rate differential co-move, particularly for the BP sample, but there certainly does not appear to be a tight and consistent co-movement between the two. This tentative observation will be rigorously tested in what follows.

Reported below are the results with the p-value representing the test of a stationary error term. The t-values are reported in parentheses below the coefficient estimates.

\[ s_t - s^e_{t|t-1} - \beta(i_{t-1} - i^*_{t-1}) - \alpha = \varepsilon_t \]
In the first two cases we very clearly reject the null of REH, given the significance of the two estimated parameters, as is common in the survey data literature, though we do not reject this necessary condition for REH for the DM sample. As can be seen however, in all cases we reject that the relationship between the forecast error and the interest rate differential is stationary. This non-stationarity implies that the relationship is not stable over-time, and draws major question to the notion that market participants are mis-forecasting in a very specific way perpetually.

4 Conclusion

This work uses an alternative econometric approach, the Cointegrated VAR, to re-examine the conclusions of the survey data literature on the role of risk and irrationality. The results corroborate previous studies which find violations of REH, and later studies which find clear evidence of a time-varying risk premium. The results differ however in clearly refuting the interpretation that the rejection of REH implies a systematic bias in forecasting. The relationship between the forecast error and the interest rate differential is found to be non-stationary, implying that the correlations are unstable over time and individuals are not mis-forecasting in a fixed manner relative to the forward rate.

5 References


Chinn, Menzie and Jeffrey Frankel (1994), "Patterns in Exchange Rate Forecasts for Twenty-five Currencies", Journal of Money, Credit and Banking, 26, 757-770.


6 Appendix

The cointegrated VAR methodology begins by attempting to achieve a well-specified statistical model. The focus is primarily on addressing issues of skewness and auto-correlation, particularly first-order auto-correlation, as
the cointegration results are quite robust to excess kurtosis and ARCH effects (Parulo 1998).

In order to improve the statistical specification, a dummy variable is incorporated for the JY sample to address a large outlier in the expected depreciation series, and in the BP sample to address a large outlier in the UK interest rate series, proximate to the UK’s abandonment of the EMS. The results are robust to the dummy variables’ exclusion however. A break-in-level (mean shift) is included in the German mark sample, proximate to reunification. MacDonald and Juselius (2004) also find a similarly needed break in their work. The results are sensitive to its exclusion however, as following to address this significant structural change obscures the persistence of the risk premium. A lag-length of two is used in all cases, following the rule of thumb suggested by Juselius (2006) for CVAR estimation.

After the residual diagnosis, the next step is rank determination. There is little ambiguity in this regard and a rank of one in all systems appears most appropriate. Thereafter, restrictions are imposed on the beta vector in order to achieve identification and to conduct hypothesis testing (presented in the body of the paper).