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CURRENCY VOLATILITY ANALYSIS USING FAMA REGRESSION

UTILIZAREA REGRESIEI FAMA ÎN ANALIZA VOLATILITĂȚII VALUTARE

CASIAN Cătălin, student, specialitatea: Econometrics & Operations Research
Maastricht University, Olanda,
Maastricht, Department of Quantitative Economics
e-mail autor: c.casian@student.maastrichtuniversity.nl

Abstract: *Destul de mulți actori ai pieții valutare îți explică raționamentul investiției pe piața valutară și așteptările față de câștigurile viitoare prin diferența dintre sistematică a ratelor de schimb forward față de ratele spot viitoare. Însă, în urma analize acestui raționament, bazat pe urmărirea volatilității pieței valutare, se poate constata o anomalie care poate fi observată în mod repetat pentru zeci de valute, perioade de timp și modele de estimare diferite. Anomalia poartă denumirea de „enigma primei forward", care constă în faptul că, conform multor studii, deprecierea este asociată pozitiv cu prima forward, nu cu o reducere. În acest articol ne propunem să analizăm această anomalie pe un șir de patru valute (AUD, HKD, EUR, JPY) în raport cu USD ca referință. Vom calcula randamentul spot lunar și seria de prime forward pentru respectivele valute, ceea ce ne permite să analizăm mișcările valutare istorice și așteptate. Acest lucru ne permite să creăm o analiză detaliată a regresiei Fama, care subliniază prezența constatării empirice - cunoscută sub numele de anomalie a primei forward.*
Cuvinte cheie: *Piață valutară Anomalie forward, Regresia Fama*

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INTRODUCTION

The purpose of this report is to provide a comprehensive analysis of currency exchange rates beginning with an initial comparison of the four currencies (AUD, HKD, EUR, JPY) relative to the USD as the benchmark. Moving on with our analysis, we calculate the monthly spot return and the forward premium series of the respective currencies which enables us to analyse the historical and expected currency movements. This allows us to create a detailed analysis of the Fama regression which emphasises the presence of the empirical finding - known as the forward premium anomaly. The report concludes with the comparison of our previously denoted results (USD) against our new findings that derive from having GBP as the benchmark currency.

CORE CONTENT

The forward premium puzzle is a traditional problem in international economics and nance; as such, it has attracted the attention of dozens of researchers during the last four decades. Yet still no clear-cut consensus emerges on whether the puzzle really exists or whether it represents a statistical artifact, how large the departure from the null hypothesis is, and how material the implications are in practice. Important prospective solutions to the forward premium puzzle put forward in the last decade include infrequent portfolio decisions (Bacchetta & van Wincoop, 2010), investor overcondence (Burnside et al., 2011), omitted variables (Pippenger, 2011), sentiment (Yu, 2013), sovereign default risk (Coudert & Mignon, 2013), order ow (Breedon et al., 2016), and in ation targeting (Coulibaly & Kempf, 2019), a string of e orts that highlights persistent research activity in the eld. What the literature lacks is a quantitative synthesis, or meta-analysis, that would take stock of the enormous body of work and shed light on potential biases and patterns that are impossible to detect in individual studies considered separately.

In order to run the Fama regression for all four currencies against the USD we have to analyse the previous data in order to find the values that are to be regressed. It is important to men-

tion here that the model is an autoregressive one, to be more precise, the output variable is linearly dependent on its own previous values. That is, Δs〖_t〗=s_t-s_(t-1), where s_t is the monthly spot rate at time t and s_t is the monthly spot rate at time t-1. In simpler terms, the regression describes the fluctuations and the overall changes in the future values by referring to the past values of the same variable.

It is obvious to assume that future values will be affected by past values, however in this analysis we are going to prove that that is not true and that a new term called the "forward premium anomaly" or "The Fama puzzle" is observed. As described by (Zigraiova et al., 2020) the forward premium anomaly is the tendency of the forward rate to overestimate changes in the spot rates.

To begin with, the formula that represents the regression that was done on all four currencies (AUD,HKD,EUR,JPY) is the following:

$$\Delta s\_t=\alpha+\beta(f\_(t-1)-s\_(t-1))+\varepsilon\_t \quad (1)$$

Here α is the y-intercept, β is the slope of the independent variable, and ε_t is the error term of the regression that accounts for small deviations during the computation. The independent variable consists of the difference between the forward rate at time t-1 and the spot rate at time t-1, these values were calculated in points A and B.

Comparing Regression Analysis Results with Zigraiova et al. (2020) on Currency Exchange Rates and Interest Rate Parity, we can conclude that our results following the analysis of the regressions is that, on the contrary of what Zigraiova et al. (2020) mentioned in their research "Yet the exact results in the literature vary, and null hypothesis not rejected universally", our results for the p-values suggest a rejection of the null hypothesis only for the Hong Kong Dollar (HKD) and not for the Australian Dollar, Euro and Japanese Yen. Of course the quote mentions that the results may vary so we have, in the latter currencies, an acceptance of the null hypothesis.

For the coefficient β our results are in line with the paper because following different analyses of the variables, researchers often "find a statistically significant negative coefficient" (Zigraiova et al., 2020). The results of the previously presented regressions are in line with the uncovered interest parity, as the highest nominal interest rate (5,75%) is seen in Hong Kong (HKD) and Zigraiova et al. (2020) mention that "If the covered interest parity holds, this result is equivalent to the finding that currencies with higher interest rates tend to appreciate" as we observed that the regression that was done on the HKD was the most significant one, showing a more clear negative relationship between the variables.

The mean of the variables calculated are both negative and positive but all of them are very close to zero which made some questions arise about the standard deviation and the accuracy of the values in the descriptive statistics table as well as in the regression. However, we can see from Zigraiova et al. (2020) that the values of the mean are universally known to be similar to what we got in our analysis: "The most precise estimates are around zero or mildly positive, but many imprecise positive estimates seem to be missing from the literature".

Hence, our conclusions on several variables that play a pivotal role in the analysis are in line with the paper and thus in line with the times as the authors mentioned that the estimates for the coefficient β vary over time "the β estimates from the differences regression exhibit a tendency to increase over time, starting with values around −1 in the 1980's and approaching values close to 0 at the end of the 2010's".

Table 1. Interpreting Z-Statistics and Their Implications on the Bias

	AUD	HKD	EUR	JPY
Z	-2,05934	-9,61416	-1,96306	-0,42396

$$z = \frac{\hat{\beta} - 1}{s.d.(\hat{\beta})}$$

Source: developed by the author

Where βˆ is the slope coefficient that was computed in every regression for each currency and the standard deviation of βˆ was taken out of the ANOVA (Figure 1) in every regression. This value is found under the "standard error" column in the said table.

One can observe that the z values that have been computed represent a certain percentage in Table 1. For instance, the z-value for the AUD, which is -2,05 represents 0,0202 or 2,02%. To elaborate on that, it means that the data our data set is 2,05 standard deviations below the mean and if you were to select a value from a standard normal distribution, there is about a 0,64% chance that the value you select is lower than or equal to -2,05. This shows a so-called "extreme tail event" as the distribution will be heavy-tailed because the value is far away from the mean.

Figure 1. The estimates for AUD, HKD, EUR, JPY uzing the ANOVA
Source: developed by the author

The same will be true for the other values of the z statistic for HKG (-9,61), EUR (-1,96 or 2,50%). However, for the z-value of JPY we observe something different, the value is the smallest one out of all of them (-0,42) which means, by consulting the z table above, that it represents the value 0,3372 or 33,72% expressed as a percentage which is more comfortable when analysing the variables with respect to the normal distribution. To put that into context, a z-value of -0.42 suggests that the data point in question is not very different from the mean, it's only 0.42 standard deviations below the mean. This indicates that the data point is closer to the centre of the distribution and doesn't deviate significantly from the average value. In practical terms, a z-value of -0.42 means that, within the

context of a standard normal distribution, the data point is somewhat close to the average, so in contrast to the other three values it doesn't represent an extreme or outlier value.

All of these findings represent a good background for the conclusions made by Zigraiova et al. (2020) in their paper as they have mentioned that "Our results still show negative publication bias and positive mean beyond the bias,but with much less precision".

To add to that, the values of the mean of the coefficients β are normally negative just like in our regression but the bias corrects the mean into a positive one: "All 4 recently proposed nonlinear techniques suggest that the mean β corrected for publication bias is positive". The only-negative values computed for the z-statistic show a clear presence of bias in the analysis, this is a universally accepted result in literature. Our conclusions on the different research variables, especially on the negative values of β may suggest a type of "confirmation bias" but we analyse the further depths of this in the next section (Zigraiova et al., 2020).

Our main goal is to see whether deviations from uncovered interest parity and changes in relationship between the regression variables are due to the change in benchmark currency.

The values represented in each analysis for the R^2 are very low, varying between 0,025% and 0,85%. The majority of the p-values are high, besides the ones for the Japanese Yen (JPY) which means that the null hypothesis is still majorly not rejected. However, a good thing to observe here is that we had better values for the Hong-Kong (HKD) in our previous analysis but in this one, the values for the HKD have worsened and the values for JPY are better and more significant. This is a first sign that the choice of the benchmark currency matters when running the regression. The scatter plots for every currency are still represented by nearly flat trendlines.

It is important to mention here that the different values that have been computed in this section are mainly due to the change in benchmark currency. This conclusion can also be observed in Zigraiova et al. (2020) "the puzzling finding of a negative β is systematically related to the use of data from advanced economies". A big part in creating the bias in our calculation is played by the choice of data that was examined, as Zigraiova et al. (2020) analysis"finds support for the unbiasedness hypothesis when one-year forward exchange rates are used instead of one-month contracts".

Now, if we analyse the results under a different spectrum, more precisely if we look at the interest rates between the currencies, as mentioned in the previous section, these values will vary over a certain interval. An important thing to note is that, considering that our regression analysis gave two different results for this section and for the previous one, one can conclude that there is a defining underlying factor that makes these fluctuations happen. If we relate to Zigraiova et al. (2020) it is easy to conclude that this factor is the deviation from UIP, as the difference between the forward and spot returns should be correlated to changes in exchange rates over the same period. Also, this change and deviation from the UIP depends on the regime and economic situation of the foreign exchange rate and thus in certain regimes there are "persistent deviations from the uncovered interest rate parity, while in the other regime reversions to the parity occur" (Zigraiova et al., 2020). A nice result following these conclusions is that the "forward premium anomaly" occurs when volatility in the foreign exchange market is high, this is proved in the paper by using the example of the US (Zigraiova et al., 2020).

The questionable changes based on the difference of benchmark should be accounted for by the UIP but ultimately "The choice of the currency has strong implications for the estimated β coefficient". So, in conclusion it is true that the fluctuations of the β coefficient is solely related to bias and the changes in benchmark currency and hence all of these reasons lead to deviation from UIP. Also, the regime is playing a big part in the values for β , that's why we got more stable values for the Australian Dollar (AUD) and the Euro (EUR) than for the Hong-Kong Dollar (HKD) or the Japanese Yen (JPY) as "β estimates are regime-dependent as they differ across different time periods and they tend to increase over time" (Zigraiova et al., 2020).

CONCLUSION

In conclusion, we presented a quantitative analysis of the 'forward premium puzzle,' and our findings are in line with universally accepted results. We utilised the values received from the forward premium series to compare them against the monthly spot return and observed the fluctuations in both variables.

Based on these findings we ran a regression called the 'Fama' regression to find the correlation between the spot return and the difference between forward rate at time t-1 and the spot rate at time t-1.

Our results showed that there was little to no correlation between the regressor and the response variable which proves the existence of the forward premium puzzle.

Finally, a key takeaway to be observed is that depending on the benchmark currency there are deviations in the coefficient β and deviations from uncovered interest parity.

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Coordonator științific: COCIUG Victoria, dr., conf.univ.,
Academia de Studii Economice din Moldova
Republica Moldova, Chișinău, str. Bănulescu-Bodoni 61, www.ase.md
Telefon: +373 402705
e-mail: v.cociug@ase.md