What the Fama?

This short study aims at presenting Fama's 1984 article "Forward and Spot Exchange Rates" in a simple and straightforward way. The conclusions provide color on what is the risk premium component within forward exchange rates and interpretations over the lack of information that such forward rates bear on actual future exchange rates

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Eugene Fama is well-known from his contributions on portfolio theory, asset pricing and efficient-market hypothesis. In fact, most of us in the financial market recognize him because of the Fama-French three-factor model.

It came as a pleasant surprise to come across his work related to foreign exchange rates. I realized that his studies in this field were as extraordinary as the others.

Perhaps because of the technicality behind of these studies or because some of the conclusions mess with the common knowledge on the functionality of exchange rates market, they were left out of the usual finance courses and certifications. In light of that, this article aims to summarize Fama's ideas on forward exchange rates in a way that appears relatable to us, common readers of the financial market.

Eugene Fama

Eugene Francis Fama was born in 1939 in Boston, Massachusetts. He holds a bachelor's degree in Romance Languages from Tufts University and he has an M.B.A. and a Ph.D. from University of Chicago Booth School of Business in Economics and Finance. In 2013, he won the Nobel Memorial Prize in Economic Sciences together with two other economists. The Prize motivation was "for their empirical analysis of asset prices". Currently, he is a Robert R. McCormick Distinguished Service Professor of Finance at the University of Chicago Booth School of Business.

In the financial market, Fama is commonly cited for his work in asset pricing, notably his work on efficient capital markets and work on developing and testing asset pricing models. He is often referred to as "the father of modern finance". In most finance courses and certifications, Fama comes along as the creator of the

Fama-French three factor model. Such model extended the Capital Asset Pricing Model to include two other factors beyond stocks' beta: (i) market capitalization; and (ii) value, to explain the stock returns.

Forward and Spot Exchange Rates (1984)

In 1984, Fama wrote an article to the Journal of Monetary Economics entitled "Forward and Spot Exchange Rates". There, he conducted econometric studies to analyze forward foreign exchange rates as predictors of future spot rates. First, he comments on what is already a general consensus: that forward exchange rates have little, if any, forecast power regarding future spot exchange rates. Then, he goes on to say that forward exchange rates bear mainly information about risk premiums and almost no information about future exchange rates and, lastly, he shows that the premium and expected future spot rate components of forward rates are negatively correlated. My reaction when reading the article for the first time was "What the Fama?!".

I must admit. I read his article at least five times to understand all of it. But when I did (or think I did), I could see why his studies in the field are so important and why this topic is so puzzling until today. As mentioned, I will attempt to explain his study in a simple way so others, like me, may understand his ideas in a one-time simple reading. Sort of "Fama's on forward rates for Dummies".

Definitions

First, let us define what a Forward Exchange Rate is. In simple terms, it equals the expected future spot rate plus a premium:

$$Foward\ Rate_t = Expected\ Future\ Spot\ Rate_{t+1} + Premium_t\ or$$

$$F_t = E(S_{t+1}) + P_t$$

Fama works with the hypothesis that the forward market is efficient or rational. Therefore, the Expected Future Spot rate is a result of an efficient forecast based on all available information.

He extends this equation to account for the difference between the Forward Exchange Rate and the Current Spot Exchange Rate and between the Future Spot Exchange Rate and the Current Spot Exchange Rate:

$$F_t - S_t = E(S_{t+1} - S_t) + P_t$$

He runs a regression on the equation above. He uses the Forward Rate minus the Future Spot rate ($F_t - S_{t+1}$) as dependent variable and the Forward Rate minus the Current Spot Rate ($F_t - S_t$) as independent variable. The result is:

$$F_t - S_{t+1} = \alpha_1 + \beta_1(F_t - S_t) + \varepsilon_{1,t+1}$$

We can also rewrite it as:

$$F_t - S_{t+1} = \alpha_1 + \beta_1(E(S_{t+1}) - S_t + P_t) + \varepsilon_{1,t+1}$$

Having all that, his idea will go as follows: if β_1 is reliably non-zero, then the premium P_t has a variation that is reliably present in $F_t - S_{t+1}$.

He runs a second regression. This time he uses the Future Spot Rate minus the Current Spot rate ($S_{t+1} - S_t$) as dependent variable and the Forward Rate minus the Current Spot Rate ($F_t - S_t$) as independent variable. The result is:

$$S_{t+1_t} - S_t = \alpha_2 + \beta_2(F_t - S_t) + \varepsilon_{2,t+1}$$

His second idea is, therefore, that if β_2 is reliably non-zero it means that the Forward Rate contains information about the Future Spot Exchange Rate. If β_2 differs from 1, it means that there is a time varying premium in the forward rate. This is very important, so I will repeat: a β_2 different than 1 is, and I quote Fama, "a direct measure of the variation of the premium in the Forward Rate".

About the Premium

Since the Premium has showed to be so important, an economic discussion of the premium is valid.

By using the interest rate parity (IRP) no arbitrage condition, Fama shows that any Premium in the Forward Rate must be explainable in terms of interest rate differential.

What is the interest rate parity (IRP) no arbitrage condition? It is a theory according to which the interest rate differential between two countries is equal to the differential between the forward exchange rate and the spot exchange rate:

$$F_t^{i,j} = S_t^{i,j} * \frac{(1 + R_{i,t})}{(1 + R_{j,t})} \quad or \quad \frac{F_t^{i,j}}{S_t^{i,j}} = \frac{(1 + R_{i,t})}{(1 + R_{j,t})}$$

Where:

$F_t^{i,j}$
$= The\ Forward\ Echange\ Rate, units\ of\ currency\ i\ per\ unity\ of\ currency\ j$

$S_t^{i,j}$
$= The\ Spot\ Echange\ Rate, units\ of\ currency\ i\ per\ unity\ of\ currency\ j$

$R_i = Nominal\ interest\ rates\ in\ country\ i$

$R_j = Nominal\ interest\ rates\ in\ country\ j$

Fama goes on to use the Purchasing Power Parity (PPP) and the Fisher equation to isolate the Premium component.

PPP is an economic theory that compares two different countries' currencies through a "basket of goods" and the currencies are said to be in equilibrium when such basket of goods is priced the same in both countries, taking into account the exchange rates. In a nutshell:

$$S_t^{i,j} = \frac{V_{i,t}}{V_{j,t}}$$

Where:

$V_i = $ Price levels in country i

$V_j = $ Price levels in country j

Additionally, the Fisher Equation defines that:

$$real\ interest\ rate$$
$$\approx nominal\ interest\ rate$$
$$- inflation\ rate$$

And inflation may be defined as:

$$\Delta_{i,t+1} = ln\left(\frac{V_{i,t+1}}{V_{i,t}}\right) \approx E(lnV_{i,t+1}) - lnV_{i,t}$$

So:

$$\frac{F_t^{i,j}}{S_t^{i,j}} = \frac{(1 + [r_{i,t+1} + \Delta_{i,t+1}])}{(1 + [r_{j,t+1} + \Delta_{j,t+1}])} \approx F_t^{i,j} - S_t^{i,j}$$

$$= [E(r_{i,t+1}) + E(\Delta_{i,t+1})] - [E(r_{j,t+1}) + E(\Delta_{j,t+1})]$$

Where:

r_i = Real interest rates in country i

r_j = Real interest rates in country j

Δ_i = Inflation rate in country i

Δ_j = Inflation rate in country i

Mixing PPP and Fisher, we can reach:

$$F_t^{i,j} - S_t^{i,j} = [E(r_{i,t+1}) - E(r_{j,t+1})] + [E(\Delta_{i,t+1}) - E(\Delta_{j,t+1})] \ or$$

$$F_t^{i,j} - S_t^{i,j} = [E(r_{i,t+1}) - E(r_{j,t+1})] + [E(lnV_{i,t+1}) - E(lnV_{j,t+1})] - [lnV_{i,t} - lnV_{j,t}]$$

And:

$$F_t^{i,j} - S_t^{i,j} = [E(r_{i,t+1}) - E(r_{j,t+1})] + E(S_{t+1}^{i,j}) - S_t^{i,j}$$

Finally:

$$F_t^{i,j} = [E(r_{i,t+1}) - E(r_{j,t+1})] + E(S_{t+1}^{i,j})$$

Comparing this to our very first equation:

$$F_t = E(S_{t+1}) + P_t$$

E may reach the conclusion that:

$$P_t^{i,j} = [E(r_{i,t+1}) - E(r_{j,t+1})]$$

Therefore, the Premium is just the difference between the Expected Real Returns between countries. How this premium varies is of extreme importance, as it can obscure the perdition power of the Forward Rates regarding the Future Forward rates.

Econometric Study

Fama uses spot exchange rates and thirty-day forward rates for nine major currencies. The sample contains Friday closes at four-week intervals. He gathers 122 observations between August 31, 1973 and December 10, 1982. All exchange rates are in US dollars per unit of foreign exchange.

I will not go into details of all the econometric tests he ran with this sample. I will just summarize the conclusions he obtained by implying the definitions we described earlier with the results from the sample.

First: there is a variation in both the Premium P_t and in $E(S_{t+1} - S_t)$, the components of $F_t - S_t$:

$$F_t - S_t = E(S_{t+1} - S_t) + P_t$$

Second: the variance of the Premium P_t component is large relative to the variance of changes in the spot rate $E(S_{t+1} - S_t)$.

Third: there is a negative covariation and a negative correlation between the Premium P_t and $E(S_{t+1} - S_t)$.

Fourth: the negative covariation dominates the variance of $E(S_{t+1} - S_t)$ and produces a β_1 and a β_2 that are reliably different than zero.

Remember what we said earlier: if β_1 is reliably non-zero, then the premium P_t has a variation that is

reliably present in $F_t - S_{t+1}$. And, if β_2 is reliably non-zero it means that the Forward Rate contains information about the Future Spot Exchange Rate. If β_2 differs from 1, it means that there is a time varying premium in the forward rate.

Therefore, the Forward Exchange Rate contains information about the Future Spot Exchange Rate, but such information is mainly within the variability of the Premium component and has little to do with the $E(S_{t+1})$.

Interpretation

Which explanations can be user to corroborate with these results? Fama proposes 4 explanations of why these results may be appearing, saying that none are complete, and neither are mutually exclusive:

1. The market is, in fact, inefficient: the market does not perform an efficient assessment of $F_t - S_t \; and \; E(S_{t+1} - S_t)$. The negative coefficients reflect a poor assessment of the true expected value of change in the spot rate.

2. Government intervenes in the spot exchange market. The intervention is a kind of market inefficiency. Governments may have an interest in keeping the national currency strong relative to other countries, to cheapen imports for example, or keeping it weak, to boost exports – for example. The market might be expecting a future spot rate different that the one desired by the Government. The government may intervene through open market operations, or by curbing foreign trade, or by influencing the flow of capital.

3. The doomsday theory: there are brief episodes during which market participants assess a small probability in country A changing its monetary police. This leads to a dramatic rise in country's A inflation which causes the distribution of the anticipated changes in exchange rates to be asymmetrical.

4. The PPP condition does not hold due to stochastic (random) deviations. Such as brief times when differences in prices for same goods between two countries cannot be correctly explained by the exchange rate.

Conclusion

In his Nobel Prize Lecture, Fama puts the Following:

"In Fama (1984a), I apply the complementary regression approach to study forward foreign exchange rates as predictors of future spot rates. Again, the information in forward exchange rates seems to be about risk premiums, and there is little or no information about future spot exchange rates. The exchange rate literature has puzzled over this result for 30 years."

I think this passage really summarizes what he did in his study about Forward Exchange rates. He added to the general consensus that forward exchange rates have little, if any, forecast power regarding future spot exchange rates. But he went beyond to find that forward exchange rates bear mainly information about risk premiums and almost no information about future change rates. And he found strong evidence that the

premium and expected future spot rate components of forward rates are negatively correlated.

Having him derived the premium as the difference between the expected real returns between two countries, one may infer that such difference is what explains, mostly, the forward rates and is what has a negative relation with expected future spot rates.

Fama himself said that such conclusions could change in the future. I hope to come across other articles in the field and, who knows, maybe find someone who can show that the puzzling is over.

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