Chapter 8
IFE, EH & RW

International Fisher Effect (IFE)

• IFE builds on the law of one price, but for financial transactions.

• <u>Idea</u>: The return to international investors who invest in money markets in their home country should be equal to the return they would get if they invest in foreign money markets once adjusted for currency fluctuations.

• Exchange rates are set in such a way that international investors cannot profit from interest rate differentials –i.e., no profits from *carry trades*.

Carry trade: A strategy that borrows the low interest currency to invest in the high interest currency.

That is, IFE determines $e_{f,t,T} = \frac{S_{t+T} - S_t}{S_t}$ that makes looking for the "extra yield" in international money markets not profitable.

The "*effective*" T-day return on a foreign bank deposit is:

$$r_f \text{ (in DC)} = \left(1 + i_f * \frac{T}{360}\right)(1 + e_{f,t,T}) - 1.$$

• While, the effective T-day return on a home bank deposit is:

$$r_d \text{ (in DC)} = i_d * T/360.$$

• Setting r_f (in DC) $= r_d$ and solving for $e_{f,t,T} (= e^{IFE}_{f,t,T})$ we get:

$$e^{IFE}_{f,t,T} = \frac{\left(1 + i_d * \frac{T}{360}\right)}{\left(1 + i_f * \frac{T}{360}\right)} - 1 \qquad \text{(This is the IFE)}$$

• Using a linear approximation: $e^{IFE}_{f,t,T} \approx (i_d - i_f) * T/360.$

• $e^{IFE}_{f,t,T}$ represents an *expectation*: The expected change in S_t from t to t+T that makes looking for the "extra yield" in international money markets not profitable.

• Since IFE gives us an expectation for a future exchange rate, $S^{IFE}_{t,T}$, if we believe in IFE we can use this expectation as a forecast.

Example: Forecasting S_t using IFE.

It's 2022:I. You have the following information:

$S_{2022:I}$ = **1 .0659 USD/EUR**.

$i_{USD,2022:I} = 0.5\%$

$i_{EUR,2022:I} = 1.0\%$.

T = 1 semester = 180 days.

$$e^{IFE}_{f,t,T} = \frac{\left(1 + i_{d=USD,2022:I} * \frac{T}{360}\right)}{\left(1 + i_{f=EUR,2022:I} * \frac{T}{360}\right)} - 1 = \frac{\left(1 + .005 * \frac{180}{360}\right)}{\left(1 + .01 * \frac{180}{360}\right)} - 1 = \mathbf{-0.0024875}$$

$$S^{IFE}_{t,2022:II} = S_{2022:I} * (1 + e^{IFE}_{f,t,2022:II}) = \mathbf{1.0659\ USD/EUR} * (1 - \mathbf{0.0024875})$$

$$= \mathbf{1.06325\ USD/EUR}$$

⇒ IFE expects S_t to change to $S^{IFE}_{t,2022:II}$ = **1.06325 USD/EUR** to compensate for the lower US interest rates. ¶

Example (continuation):

$S^{IFE}_{t,2022:II} = S_{2022:I} * (1 + e^{IFE}_{f,t,2022:II})$

$= 1.0659$ **USD/EUR** $* (1 – 0.0024875)$

$= 1.06325$ **USD/EUR**

Suppose $S_{2022:II} = 1.08$ **USD/EUR** $> S^{IFE}_{t,2022:II} = 1.06325$ **USD/EUR**

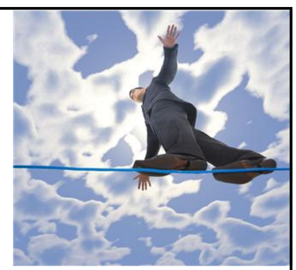
⇒ According to IFE, EUR is ***overvalued***.

⇒ Trading signal: Sell EUR/Buy USD.

Note: Same result by looking at the observed change:

$e_{f,t,2022:II} = 1.08/\ 1.0659 – 1 = 0.01323 > e^{IFE}_{f,t,2022:II} = -0.0024875.$

⇒ According to IFE, EUR appreciated more than expected. That is, EUR is ***overvalued***. ¶



• Note: Like PPP, IFE also gives an *equilibrium* exchange rate. Equilibrium will be reached when there is no capital flows from one country to another to take advantage of interest rate differentials.

IFE: Implications

If IFE holds, the expected cost of borrowing funds is identical across currencies. Also, the expected return of lending is identical across currencies.

Carry trades –i.e., borrowing a low interest currency to invest in a high interest currency– should not be profitable.

If departures from IFE are consistent, investors can profit from them.

Example: Mexican peso depreciated 5% a year during the early 90s.

Annual interest rate differentials ($i_{MXN} - i_{USD}$) were between 7% and 16%.

Then, $E_t[e_{f,t,T}]$ = -5% > $e_{f,t,T}^{IFE}$ = -7% ⇒ Pseudo-arbitrage is possible (The MXN at t+T is ***overvalued***!)

Suppose we expect $E_t[e_{f,t,T}] > e_{f,t,T}^{IFE}$ in next T days.

Carry Trade Strategy (USD = DC; we invest in the *overvalued* currency):

1) Borrow USD funds (at i_{USD}) for T days.

2) Convert to MXN at S_t

3) Invest in Mexican funds (at i_{MXN}) for T days.

4) *Wait until T*. Convert to USD at S_{t+T} –expect: $E[S_{t+T}]=S_t*(1+ E_t[e_{f,t,T}])$

Expected FX loss = 5% ($E_t[e_{f,t,T}]$ = -5%)

Assume ($i_{USD} - i_{MXN}$) = -7%. (Say, i_{USD} = 6%; i_{MXN} = 13%.)

$E_t[e_{f,t,T}]$ = -5% > $e_{f,t,T}^{IFE}$ = -7% ⇒ "On average," strategy (1)-(4) works.

Example (continuation):

Expected USD return from MXN investment:

r_f (in DC) = $(1 + i_{MXN} * T/360) * (1 + E_t[e_{f,t,T}]) - 1$

= (1 + .13) * (1 – **.05**) – 1 = 0.074

Payment for USD borrowing: $r_d = i_{d=USD} * T/360 = .06$

Expected Profit = E[Π] = 0.074 – .06 = .014 per year.

Overall expected profits ranged from: 1.4% to 11%. ¶

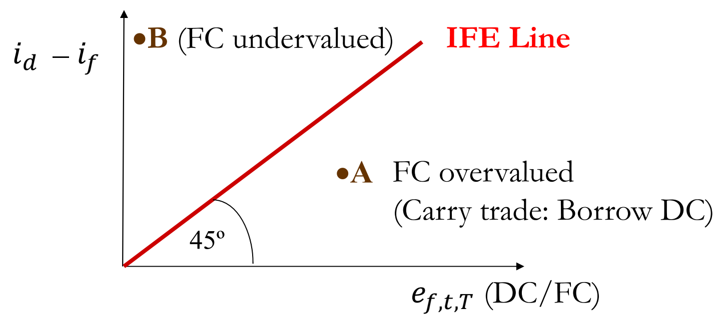
Note: A carry trade strategy is based on an expectation: $E_t[e_{f,t,T}]$ = -5%. It may or may not occur every time. This is risky!

Example: Risk at work. Fidelity used this uncovered strategy during the early 90s. In Dec. 94, after the Tequila devaluation of the MXN against the USD (40% in a month), it lost everything it gained before. ¶

• An IFE driven carry trade differs from covered arbitrage in the final step. Step 4) involves no coverage. It's an *uncovered* strategy. IFE is also called *Uncovered Interest Rate Parity* (UIRP).

• UIRP is difficult to test since it involves an expectation (an *unobservable*). In general, we test UIRP assuming that on average what we expect occurs.

• Test: UIRP true (no carry trade profits) if $e_{f,t,T} \approx (i_d - i_f) * T/360$.

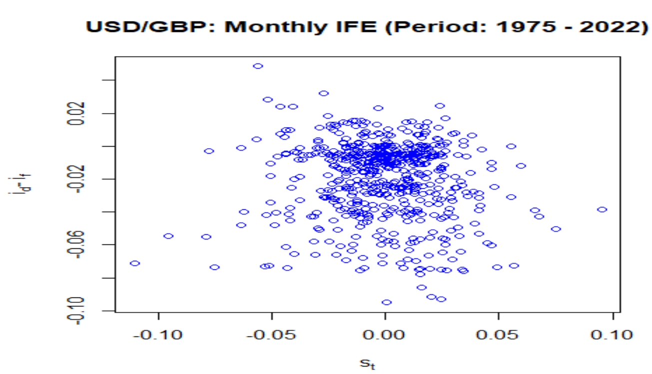


1. Visual evidence.

Based on linearized IFE: $e_{f,t,T} = \dfrac{S_{t+T} - S_t}{S_t} \approx (i_d - i_f) * T/360$

Expect a 45 degree line in a plot of $e_{f,t,T}$ against $(i_d - i_f)$

Example: Plot for the monthly USD/GBP exchange rate (**1975 - 2022**)



No 45° line ⇒ Visual evidence rejects IFE. ¶

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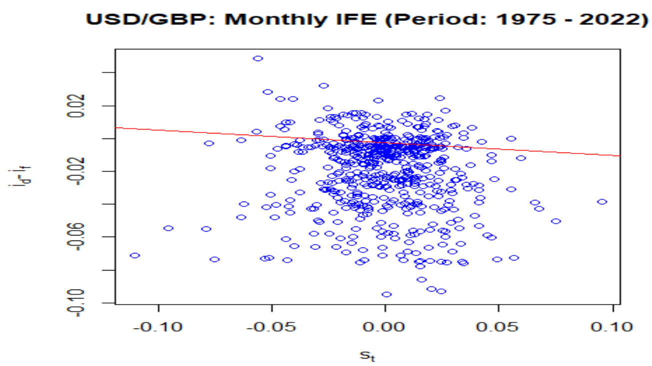

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2. Regression evidence

$$e_{f,t,T} = \alpha + \beta\,(i_d - i_f)_t + \varepsilon_t, \qquad (\varepsilon_t\text{: error term, } E[\varepsilon_t] = 0).$$

• The null hypothesis is: H_0 (IFE true): $\alpha=0$ and $\beta=1$

H_1 (IFE not true): $\alpha \neq 0$ and/or $\beta \neq 1$

Example: Testing IFE for the USD/GBP with monthly data (**1975 - 2022**).

$R^2 = 0.00577$

Standard Error = 0.002377

F-statistic (slopes=0) = 3.33 (*p-value* = 0.0686)

F-test (α=0 and β=1) = **182.4331** (*p-value* = lower than 0.0001)

⇒ rejects H_0 at the 5% level ($F_{2,193,.05}$ = **3.05**)

Observations = 576

	Coefficients	Standard Error	t Stat	P-value
Intercept (α)	**-0.002676**	**0.001305**	-2.051	0.0408
$(i_d - i_f)_t$ (β)	**-0.077150**	**0.042590**	-1.825	0.0686

Let's test H_0, using t-tets ($t_{104,.05}$ = **1.96**) :

$t_{\alpha=0}$ (t-test for α = 0): (**0.002676** – 0)/**0.00194** = **-2.051**

⇒ reject H_0 at the 5% level.

$t_{\beta=1}$ (t-test for β = 1): (**-0.077715** – 1)/**0.04259** = **-25.304**

⇒ reject H_0 at the 5% level.

Formally, IFE is rejected in the short-run (both the joint test and the t-tests reject H_0). Also, note that β is negative, not positive as IFE expects. ¶

• IFE is rejected. Then,

Q: Is a "carry trade" strategy profitable?

During the 1975-2022 period, the average monthly (i_{USD} – i_{GBP}) was:

-1.9947%/12= **-0.166%** ⇒ s_t^{IFE} = **-0.166%** per month (≠0, statistically)

Average monthly s_t(USD/GBP) was **-0.113%** (≈**0**, statistically speaking)

⇒ $E_t[s_t]$ = -**0.113%** > s_t^{IFE} = **-0.166%** (GBP overvalued!)

<u>Note</u>: Consistent deviations from IFE make carry trades profitable. During the 1975-2022 period, USD-GBP carry trades should have been profitable.

Carry trade strategy:

1) Borrow USD at i_{USD} for 30 days. (average i_{USD} = 4.28%)

2) Convert to GBP

3) Deposit BPG at i_{GBP} for 30 days. (average i_{GBP} = 6.27%)

4) Wait 30 days and convert back to USD (on average, 0% monthly change)

From 1) + 3), we make **0.166%** per month.

From 2) + 4), we lose **0.112%** per month.

Total carry trade gain over a year: **0.65%**.

⇒ Total gain over the whole period: **36.5%**. ¶

• IFE: Evidence

No short-run evidence ⇒ Carry trades work (on average).

Burnside (2008): The average excess return of an equally weighted carry trade strategy, executed monthly, over the period 1976–2007, was about **5% per year.** (Sharpe ratio twice as big as the S&P500, since annualized volatility of carry trade returns is much less than that for stocks).

Some long-run support:

"Currencies with high interest rate differentials tend to depreciate."

(For example, the Mexican peso finally depreciated in Dec. 1994.)

Expectations Hypothesis (EH)

• According to the Expectations hypothesis (EH) of exchange rates:

$$E_t[S_{t+T}] = F_{t,T}.$$

⇒ On *average*, the future spot rate is equal to the forward rate.

Since expectations are involved, many times the equality will not hold. It will only hold on average.

Q: Why should this equality hold on average?

Suppose it does not hold. That means, what people expect to happen at time T is *consistently* different from the rate you can set for time T. A potential profit strategy can be developed that works, on average.

Example: Suppose that over time, investors violate EH.

Data: $F_{t,180}$ = **5.17 ZAR/USD.**

An investor expects: $E_t[S_{t+180}]$ = **5.34 ZAR/USD**. (A potential profit!)

Strategy for this investor:

1. Buy USD forward at **ZAR 5.17**
2. In 180 days, sell the USD for **ZAR 5.34.**

Now, suppose everybody expects $E_t[S_{t+180}]$ = **5.34 ZAR/USD**

⇒ *Disequilibrium*: Today, everybody buys USD forward. ($F_{t,180}$ ↑)

In 180 days, everybody will be selling USD. ($E_t[S_{t+180}]$↓)

⇒ Prices should adjust until EH holds.

Expectations are involved: Sometimes you will have a loss, but, on average, you profit from $E_t[S_{t+T}] \neq F_{t,T}$. ¶

Expectations Hypothesis: Implications

EH: $E_t[S_{t+T}] = F_{t,T}$ → On average, $F_{t,T}$ is an *unbiased* predictor of S_{t+T}.

Example: Today, it is 2014:II. A firm wants to forecast the quarterly S_t USD/GBP. You are given the **90-day** interest rate differential (in %) and S_t. Using IRP you calculate $F_{t,T=90}$:

$$F_{t,T=90} = S_t * [1 + (i_{USD} - i_{GBP})_t * T/360]. \qquad (\Rightarrow S^{EH}_{t+90})$$

Data available:

$S_{t=2014:II}$ = **1.6883 USD/GBP**

$(i_{USD} - i_{GBP})_{t=2014:II}$ = -0.304%.

Then,

$F_{t,90}$ = **1.6883 USD/GBP** * [1 – 0.00304 * 90/360] = **1.68702 USD/GBP**

⇒ $S^{EH}_{t=2014:III}$ = **1.68702 USD/GBP**

According to EH, if a firm forecasts S_{t+T} using the forward rate, over time, will be right on average.

⇒ average forecast error $E_t[S_{t+T} - F_{t,T}] = 0$.

Expectations Hypothesis: Implications

Doing this forecasting exercise each period generates the following quarterly forecasts and forecasting errors, ε_t:

Quarter	$(i_{US} - i_{UK})$	S_t	$S^F_{t+90} = F_{t,90}$	$\varepsilon_T = S_{t+T} - S^F_{t+T}$
2014:II	-0.304	1.6883		
2014:III	-0.395	1.6889	**1.68702**	**0.0019**
2014:IV	-0.350	1.5999	**1.68723**	-0.0873
2015:I	-0.312	1.5026	**1.59850**	-0.0959
2015:II	-0.415	1.5328	**1.50143**	0.0314
2015:III	-0.495	1.5634	**1.53121**	0.0322
2015:IV		1.5445	**1.56146**	-0.0170

Calculation of the forecasting error for 2014:III:

$$\varepsilon_{t=2014:III} = 1.6889 - 1.68702 = 0.0019.$$ ¶

Note: Since $(S_{t+T} - F_{t,T})$ is unpredictable, expected cash flows associated with hedging or not hedging currency risk are the same.

Expectations Hypothesis: Evidence

Under EH, $E_t[S_{t+T}] = F_{t,T} \rightarrow E_t[S_{t+T} - F_{t,T}] = 0$

Empirical tests of the EH are based on a regression:

$$(S_{t+T} - F_{t,T})/S_t = \alpha + \beta Z_t + \varepsilon_t, \qquad \text{(where } E[\varepsilon_t]=0\text{)}$$

where Z_t represents any economic variable that might have power to explain S_t, for example, $(i_d - i_f)$.

H_0 (EH true): $\alpha = 0$ and $\beta = 0$. ($(S_{t+T} - F_{t,T})$ should be unpredictable!)

H_1 (EH not true): $\alpha \neq 0$ and/or $\beta \neq 0$.

Usual result: $\beta < 0$ (and significant) when $Z_t = (i_d - i_f)$.

But, the R^2 is very low.

Expectations Hypothesis: IFE (UIRP) Revisited

EH: $E_t[S_{t+T}] = F_{t,T}$.

Replace $F_{t,T}$ by IRP, say, linearized version:

$E_t[S_{t+T}] \approx S_t * [1 + (i_d - i_f) * T/360]$.

A little bit of algebra gives:

$(E[S_{t+T}] - S_t)/S_t \approx (i_d - i_f) * T/360$ <= IFE linearized!

- EH can also be tested based on the Uncovered IRP (IFE) formulation:

$$(S_{t+T} - S_t)/S_t = e_{f,t,T} = \alpha + \beta\,(i_{US} - i_{UK})_t + \varepsilon_{t+T}.$$

The null hypothesis is H_0: α=0 and β=1.

Usual Result: $\beta < 0$ ⇒ when $(i_d - i_f)$ = 2%, the exchange rate appreciates by (β * .02), instead of depreciating by 2% as predicted by UIRPT!

- Risk Premium

The risk premium of a given security is defined as the return on this security, over and above the risk-free return.

- Q: Is a risk premium justified in the FX market?

  A: Only if exchange rate risk is not diversifiable.

After some simple algebra, we find that the expected excess return on the FX market is given by:

$$(E_t[S_{t+T}] - F_{t,T})/S_t = P_{t+T}.$$

A risk premium, P, in FX markets implies

$$E_t[S_{t+T}] = F_{t,T} + S_t\, P_{t+T}.$$

If P_{t+T} is consistently different from zero, markets will display a forward bias.

Example: Understanding the meaning of the FX Risk Premium.

Data: S_t = **1.58 USD/GBP**

$E_t[S_{t+6-mo}]$ = **1.60 USD/GBP**

$F_{t,6\text{-}mo}$ = **1.62 USD/GBP**.

- Expected change in S_t:

  $\Rightarrow E[e_{f,t,6-mo}] = (E_t[S_{t+6-mo}] - S_t)/S_t = (1.60 - 1.58)/1.58 = \mathbf{0.0127}$.
- 6-mo FX premium

  $\Rightarrow p_{6-mo} = (F_{t,6\text{-}mo} - S_t)/S_t = (1.62 - 1.58)/1.58 = \mathbf{0.0253}$.

- In the next 6-month period:

  The GBP is expected to appreciate against the USD by **1.27%**

  The forward premium suggests a GBP appreciation of **2.53%**.

  $\Rightarrow E[e_{f,t,6-mo}] < p_{6-mo} \qquad (\approx (i_{d=USD} - i_{f=GBP})/2)$

$\Rightarrow$ Higher USD return from a USD deposit, than from a GBP deposit.

$\Rightarrow$ Higher USD return from a USD deposit, than from a GBP deposit.

E[Return from a GBP deposit] = GBP 1 * (1 + $i_{f=GBP}$/2)*1.60 USD/GBP

Return from a USD deposit = **1.58 USD/GBP** * (1 + $i_{d=USD}$ /2)

- In the next 6-month period: $E[e_{f,t,6-mo}] \neq p_{6-mo}$

Discrepancy: The presence of a FX risk premium, $P_{t,t+6\text{-}mo}$, makes the forward rate a biased predictor of S_{t+6-mo}.

- The expected (USD) return from holding a GBP deposit will be less (different) than the USD return from holding a USD deposit.

<u>Rational Investor</u>: The lower return from holding a GBP deposit is necessary to induce investors to hold the riskier USD denominated investments. ¶

• IFE: Evidence

No short-run evidence ⇒ Carry trades work (on average).

Q: Does carry trade work?

A: Burnside (2008): The average excess return of an equally weighted carry trade strategy, executed monthly, over the period 1976–2007, was about **5% per year.** (Sharpe ratio twice as big as the S&P500!, since annualized volatility of carry trade returns is much less than that for stocks).

Some long-run support:

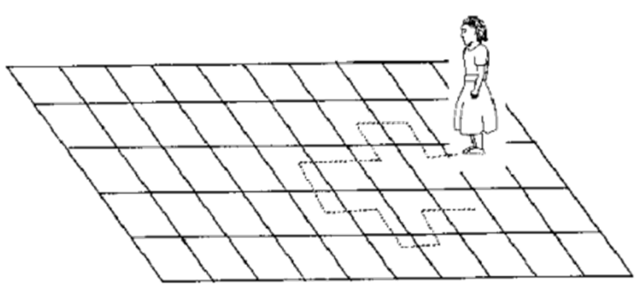
⇒ Currencies with high interest rate differential tend to depreciate.

(For example, the Mexican peso finally depreciated in Dec. 1994.)

Martingale-RW Model

The Martingale-Random Walk Model

A random walk is a time series independent of its own history. Your *last step* has no influence in your *next step*. The past does not help to explain the future.



Motivation: Drunk walking in a park. (Problem posted in *Nature*. Solved by Karl Pearson. July 1905 issue.)

Very difficult to predict where the drunk will end up after T steps.

Intuitive notion: The FX market is a "*fair game*." (Unpredictable!)

• Martingale-Random Walk Model: Implications

The Random Walk Model (RWM) implies:

$E_t[S_{t+T}] = S_t$.

Powerful theory: At time t, all the info about S_{t+T} is summarized by S_t.

Theoretical Justification: Efficient Markets (all available info is incorporated into today's S_t.)

Example: Forecasting with RWM

S_t = 1.60 USD/GBP

$E_t[S_{t+7-day}]$ = **1.60 USD/GBP**

$E_t[S_{t+180-day}]$ = **1.60 USD/GBP**

$E_t[S_{t+10-year}]$ = **1.60 USD/GBP**. ¶

Note: If S_t follows a RW, a firm should spend no resources to forecast S_{t+T}.

• Martingale-Random Walk Model: Evidence

Meese and Rogoff (1983, *Journal of International Economics*) tested the short-run forecasting performance of different models for the four most traded FX rates. They considered economic models (PPP, IFE, Monetary Approach, etc.) and the RWM.

The metric used in the comparison: MSE (mean squared error)

$$\Rightarrow \text{MSE} = \frac{\sum_{t=1}^{Q} \varepsilon_{t+T}^2}{Q} = \frac{\sum_{t=1}^{Q} \left(S_{t+T} - S_{t+T}^F\right)^2}{Q}$$

where $\varepsilon_{t+T} = S_{t+T} - S_{t+T}^F$ = forecasting error at horizon T.

⇒ The **RWM** performed *as well as* any other model. Big surprise!

Cheung, Chinn & Pascual (2005) checked M&R's results with 20 more years of data. ⇒ **RWM** still the **best model** in the **short-run**.

M&R started a big literature. In general, M&R's results hold in the short-run (say, up to 6-months), but for longer horizons (say, 1-4 years), models can do better (PPP, IFE and Taylor rule models, individually or combined).

Example: MSE - Forecasting S_t (USD/GBP) with forwards and the RWM

Data: interest rate differential (in %) and S_t from 2014:II on.

Using IRP, you calculate the forward rate, $F_{t,T=90}$, and, then, to forecast $E_t[S_{t+90}] = S_{t+90}^F$.

Using the RWM you forecast $E_t[S_{t+90}] = S_t$. Then, to check the accuracy of the forecasts, you calculate the MSE.

Quarter	$(i_{US}-i_{UK})$	S_t	Forward Rate		Random Walk	
			$S^F_{t+90} = F_{t,90}$	$\varepsilon_{t\text{-}FR} = S_t - S^F_t$	$S^F_{t+90}=S_t$	$\varepsilon_{t\text{-}RW} = S_t - S^F_t$
2014:II	-0.304	**1.6883**				
2014:III	-0.395	**1.6889**	**1.6870**	0.0019	**1.6883**	0.0006
2014:IV	-0.350	**1.5999**	**1.6872**	-0.0873	**1.6889**	-0.0890
2015:I	-0.312	**1.5026**	**1.5985**	-0.0959	**1.5999**	-0.0973
2015:II	-0.415	**1.5328**	**1.5014**	0.0314	**1.5026**	0.0302
2015:III	-0.495	**1.5634**	**1.5312**	0.0322	**1.5328**	0.0306
2015:IV		**1.5445**	**1.5615**	-0.0170	**1.5634**	-0.0189
MSE				**0.04427**		**0.04443**

Both MSEs are similar, though the $F_{t,T}$'s MSE is a bit smaller (.4% lower). ¶

• Martingale-Random Walk Model: Empirical Models Trying to Compete

Models of FX rates determination based on economic fundamentals have problems explaining the short-run behavior of S_t. This is not good news if the aim of the model is to forecast S_t.

As a result of this failure, a lot of empirical models, modifying the traditional fundamental-driven models, have been developed to better explain *equilibrium exchange rates* (EERs).

Some models are built to explain the medium- or long-run behavior of S_t, others are built to beat (or get closer to) the forecasting performance of the RWM.

A short list of the new models includes CHEERs, ITMEERs, BEERs, PEERs, FEERs, APEERs, PEERs, and NATREX. Below, I include a Table, taken from Driver and Westaway (2003, Bank of England), describing the main models used to explain EERs.

	UIP	PPP	Balassa-Samuelson	Monetary Models	CHEERs	ITMEERs	BEERs
Name	Uncovered Interest Parity	Purchasing Power Parity	Balassa-Samuelson	Monetary and Portfolio balance models	Capital Enhanced Equilibrium Exchange Rates	Intermediate Term Model Based Equilibrium Exchange Rates	Behavioural Equilibrium Exchange Rates
Theoretical Assumptions	The expected change in the exchange rate determined by interest differentials	Constant Equilibrium Exchange Rate	PPP for tradable goods. Productivity differentials between traded and nontraded goods	PPP in long run (or short run) plus demand for money.	PPP plus nominal UIP without risk premia	Nominal UIP including a risk premia plus expected future movements in real exchange rates determined by fundamentals	Real UIP with a risk premia and/or expected future movements in real exchange rates determined by fundamentals
Relevant Time Horizon	Short run	Long run	Long run	Short run	Short run (forecast)	Short run (forecast)	Short run (also forecast)
Statistical Assumptions	Stationarity (of change)	Stationary	Non-stationary	Non-stationary	Stationary, with emphasis on speed of convergence	None	Non-stationary
Dependent Variable	Expected change in the real or nominal	Real or nominal	Real	Nominal	Nominal	Future change in the Nominal	Real
Estimation Method	Direct	Test for stationarity	Direct	Direct	Direct	Direct	Direct

FEERs	DEERs	APEERs	PEERs	NATREX	SVARs	DSGE
Fundamental Equilibrium Exchange Rates	Desired Equilibrium Exchange Rates	Atheoretical Permanent Equilibrium Exchange Rates	Permanent Equilibrium Exchange Rates	Natural Real Exchange Rates	Structural Vector Auto Regression	Dynamic Stochastic General Equilibrium models
Real exchange rate compatible with both internal and external balance. Flow not full stock equilibrium	As with FEERs, but the definition of external balance based on *optimal* policy	None	As BEERs	As with FEERs, but with the assumption of portfolio balance (so domestic real interest rate is equal to the world rate).	Real exchange rate affected by supply and demand (but not nominal) shocks in the long run	Models designed to explore movements in real and/or nominal exchange rates in response to shocks.
Medium run	Medium Run	Medium / Long run	Medium / Long run	Long run	Short (and long) run	Short and long run
Non-stationary	Non-stationary	Non-stationary (extract permanent component)	Non-stationary (extract permanent component)	Non-stationary	As with theoretical	As with theoretical
Real Effective	Real Effective	Real	Real	Real	Change in the Real	Change relative to long run steady state
Underlying Balance	Underlying Balance	Direct	Direct	Direct	Direct	Simulation