API-119: Advanced Macroeconomics for the Open Economy II

• **Staff -- Professors:** Jeffrey Frankel (1st 5 lectures), Filipe Campante (from Feb. 9 on).

• **Teaching Fellow:** Tilahun Emiru


• **Times -- Lectures:** Tues. & Thurs., 10:15-11:30 p.m., L230

Review sessions: Fri., 10:15-11:30 & 11:45-1:00, Land Hall

Frankel Office hours: Mon.-Tues., 3:00-4:00, Littauer 217
Lectures 1-5:
Risk, Diversification & Emerging Market Crises

• L1: The carry trade
  • Forward market bias
  • Risk premium & introduction to portfolio balance model

• L2: Optimal portfolio diversification
  • Foreign exchange risk
  • Equity market risk
  • Home bias

• L3: Country risk
  • Sovereign spreads
  • Debt dynamics
Lecture 1: The Carry Trade

Motivations for testing unbiasedness:

• Efficient Markets Hypothesis (EMH)
  • Does rational expectations hold?
  • Does the forward rate reveal all public information?

• Does Uncovered Interest Parity hold? Or is there a risk premium?
  • The carry trade: Does “borrow at low \( i \) & lend at high \( i^* \)” make money?

Outline of lecture

1. Specification of the test of unbiasedness.
2. Answer: The forward market is biased; the carry trade works.
3. How should we interpret the bias?
  • Risk premium: Introduction to the portfolio balance model.
Sample page of spot and forward exchange rates, local per 
$ (but $/€ and $/€).

<table>
<thead>
<tr>
<th>Country</th>
<th>Spot rate</th>
<th>Closing mid-point</th>
<th>Forward rates</th>
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<td>UAE</td>
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*Financial Times* Jan. 30, 2009
Tests of unbiasedness in the forward exchange market

Overview of concepts

$H_0$, null hypothesis to be tested: $E_t (\Delta s_{t+1}) = (fd)_t$

defined logarithmically.†

Specification of unbiasedness equation

$$H_0: \quad \Delta s_{t+1} = (fd)_t + \varepsilon_{t+1}.$$  

where $E_t (\varepsilon_{t+1}) = 0$.
$\varepsilon_{t+1} \equiv$ prediction error.

Would unbiasedness $H_0$ => accurate forecasts?

No. $\leq \ (\varepsilon_{t+1}) \neq 0$.

† Why logs instead of levels? See appendix 3, end.
$H_0: \ E_t(\Delta s_{t+1}) = (fd)_t.$

Most popular test: Regress $\Delta s_{t+1} = \alpha + \beta(fd)_t + \varepsilon_{t+1}.$

Unbiasedness of the fx market: $H_0: \ \beta = 1.$

No time-varying risk premium: $\Delta s^e_t - (fd)_t = \alpha.$

Rational expectations: $\Delta s^e_t = E_t(\Delta s_{t+1}) \equiv \Delta s_{t+1} - \varepsilon_{t+1}.$

where $E_t \varepsilon_{t+1} = 0$ conditional on info at time $t.$

$\Rightarrow \ H_0: \ \Delta s_{t+1} = \alpha + (fd)_t + \varepsilon_{t+1}.$

But usual finding is $\beta << 1,$ e.g., $\approx 0.$
• Does EMH => \( E_t \Delta s_{t+1} = fd_t \)?

    Not necessarily. <= Could be rp \( \neq 0 \).

• UIP version of unbiasedness

    \[ \Delta s_{t+1} = \alpha + (i - i^*)_t + \varepsilon_{t+1}. \]

Finding: rejection of \( H_0 \).

One can make money, on average, betting against the forward discount or, equivalently, doing the carry trade.

How to interpret?

(i) exchange risk premium, or

(ii) expectations biased in-sample.
Tests of forward market bias extended to emerging markets:

A majority of currencies show a rejection of unbiasedness and an inability to reject a coefficient of zero (same as advanced countries).

<table>
<thead>
<tr>
<th>Currency</th>
<th>N</th>
<th>β</th>
<th>Test of β=0</th>
<th>Statistical significance levels</th>
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<tbody>
<tr>
<td>Hungarian forint</td>
<td>167</td>
<td>-0.4888</td>
<td>0.5874</td>
<td>0.0996</td>
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<td>Indian rupee</td>
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<td>Indonesian rupiah</td>
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</tr>
</tbody>
</table>

† probability that rejection of β=0 (random walk) is just chance.
‡ probability that rejection of β=1 (unbiasedness) is just chance.

Table 7: Full Period Developing Currencies Regression Results

Shows the results of a regression over the period 31st December 1996 to 30th September 2011 of the form \( s_{t+1} - s_t = \alpha + \beta(f_{t+1} - s_t) + u_t \).

Unanswered question:

Is the systematic component of $\varepsilon$ -- the fd bias -- due to:

« a risk premium $rp$? or
« a failure of Rational Expectations?

Two possible approaches:

1) Find a measure of $\Delta s^e$: survey data.

2) Model $rp$ theoretically. See if prediction errors $\varepsilon$ depend systematically on variables $rp$ should depend on.

—> Subject of Lecture 2: Optimal portfolio diversification.
Introduction to the portfolio-balance model:

Each investor at time $t$ allocates shares of his or her portfolio to a menu of assets, as a function of expected return, risk, & perhaps other factors (tax treatment, liquidity...):

$$x_{i,t} = \beta_i (E_t r_{t+1}, \text{risk}).$$

Sum across investors $i$ to get the aggregate demand for assets, which must equal supply in the market.

We will invert the function to determine what $E_t r_{t+1}$ must be, for asset supplies $x_t$ to be willingly held.
Now invert:

\[ \begin{bmatrix} r_p_t \end{bmatrix} = B^{-1} \begin{bmatrix} x_t \end{bmatrix} - B^{-1} A. \]

We see that asset supplies are a determinant of the risk premium.

Special case: \( |B^{-1}| = 0 \),

- perfect substitutability (\( |B| = \infty \)),
- no risk premium (\( r_p_t = 0 \)), and so
- no effect from sterilized forex intervention.
How the supply of debt $x$ determines the risk premium $rp$ in the portfolio balance model.

A large $x$ forces up the expected return that portfolio holders must be paid.
Appendix 1: Test of forward market unbiasedness
Overview of concepts, continued

Definition: Random Walk $\equiv (\Delta s_{t+1} = \varepsilon_{t+1})$.

Does unbiasedness $\Rightarrow$ RW?

No. $\iff (fd_t \neq 0)$, so $E_t \Delta s_{t+1} \neq 0$.

Def.: Rational Expectations $\equiv S^e_t = E_t (S_{t+1})$

Def.: Efficient Markets Hypothesis $\equiv F$ reveals all info

Does RE $\Rightarrow$ EMH?

Not necessarily.

$\iff$ There could be transactions costs, capital controls, missing markets...
Appendix 2: Applications of the forward discount bias (or interest differential bias) strategy

• The **Convergence Play** in the European Monetary System (1990-92): Go short in DM; long in £, Swedish kronor, Italian lira, Finnish markka & Portuguese escudo.

• The **Carry Trade**
  - (1991-94) Go short in $, long in Mexican pesos, etc.
  - (1995-98) Go short in ¥; long in $ assets, in Asia or US
  - (2002-07) Go short $, ¥, SFr; long in Australia, Brazil, Iceland, India, Indonesia, Mexico, New Zealand, Russia, S. Africa, & Turkey.

• New convergence play (2007):
  - Go short in €; long in Hungary, Baltics, other EMU candidates.

  2016: Go short in €.
**Carry trade:** A strategy of going short in the (low-interest-rate) ¥ and long in the (high interest rate) A$ made a little money every month 2001-08: the 5% interest differential was not offset by any depreciation of the A$ during these years.

**IT’S ALL IN THE INTEREST**

The profit differential between two currencies comes down to their relative interest rates, all else equal.

Suddenly in 2008, the strategy of going short in ¥ and long in A$ lost a *lot* of money, as risk concerns rose sharply, the carry trade “unwound,” and the A$ plunged against the ¥.
Appendix 3: Technical econometrics regarding error term:

- Overlapping observations
  => Moving Average error process

- “Peso problem:”
  small probability of big devaluation
  => error term not $\sim$ iid normal.

- The Siegal paradox:
  What is the $H_0$: $F_t = E_t(S_{t+1})$? or $1/F_t = E_t(1/S_{t+1})$?
Appendix 3, continued: The Siegal Paradox -- an annoying technicality in tests of unbiasedness

One would think that if the forward rate is unbiased when one currency is defined to be the domestic currency, it would also be unbiased when the other is. Unfortunately this is not so, an instance of "Jensen’s inequality."

We do it in logs: $H_0: E_t s_{t+1} = f_t$.
If $\log F = E \log S_{+1}$, then
\[
\log \frac{1}{F} = -\log F = -E \log S_{+1} = E \log \left( \frac{1}{S_{+1}} \right)
\]
Running the equation with spot & forward rates defined in logs avoids the Siegal paradox.

(Is that specification legitimate? It is, if \( S_{t+1} \) is distributed log-normally.)

Thus our null hypothesis, \( H_0 \), is: \( E_t(s_{t+1}) = f_t \).

Equivalently: \( E_t(s_{t+1}) - s_t = f_t - s_t \).

Or (the expression used in lecture): \( E_t(\Delta s_{t+1}) = (fd)_t \).