Idea: Infer the degree of international capital market integration from savings - investment correlations?

Motivation: In a closed economy those correlations must be 1, but in an open economy they need not. Thus, if we observe low correlations, then we can conclude that there is capital mobility across countries.

Q: Suppose we find a near perfect correlation between S and I. Does this necessarily mean that there is no capital mobility?
Measuring Capital Mobility I: Observed Savings-Investment Correlations

1. Across countries
   
   (a) The Feldstein Horioka Regression: 1960-1974

   (b) Updates of the Feldstein Horioka Regression: 1960 - 2003

2. Overtime within the same country

   (a) The United States, 1928-2015.

   (b)
Saving and Investment Rates for 16 Industrial Countries
(1960-1974 Averages)

\[0.035 + 0.887 \times (S/GDP)\]

Feldstein and Horioka estimated the following equation:

\[
\left( \frac{I}{Q} \right)_i = 0.035 + 0.887 \left( \frac{S}{Q} \right)_i + \nu_i; \quad R^2 = 0.91
\]

where \((I/Q)_i\) and \((S/Q)_i\) are, respectively, the average investment-to-GDP and savings-to-GDP ratios in country \(i\) over the period 1960-74. They have 16 observations. The coefficient on \((S/Q)_i\) is 0.887 with a standard error of 0.07, making it highly unlikely that the true coefficient is zero.
More recent evidence:

Sample of 64 countries with data from 1960 to 2003 find

\[
\left( \frac{I}{Q} \right)_i = \text{constant} + 0.52 \left( \frac{S}{Q} \right)_i + \nu_i
\]

where \((I/Q)_i\) and \((S/Q)_i\) are, respectively, the average investment-to-GDP and savings-to-GDP ratios in country \(i\) over the period 1960-2003.


corr(s/y, i/y) = 0.98 pre 1972 and 0.76 post 1972
But do findings of high savings-investment correlations either across countries or across time, necessarily imply imperfect capital mobility?

No. Even under perfect capital market integration one could observe a high S-I correlation.

Give some examples [to be completed]

Therefore, we conclude that high S-I correlations are not evidence of low capital mobility.
Measuring Capital Mobility II: Interest Rate Differentials

1. Why are interest rate differentials informative about the degree of capital mobility?

2. Empirical Evidence on the size of interest rate differentials
Asset Pricing in a 2-period small open economy model.

Two important interest rate parity conditions are

• CIRP = covered interest rate parity

• UIRP = uncovered interest rate parity

In this lecture we will derive the CIRP condition and ask under what conditions the UIRP condition holds.

Let $i$ denote the domestic, nominally risk free, interest rate on domestic bonds held from period 1 to period 2, and $i^*$ the foreign, nominally risk-free, interest rate on foreign currency bonds held from period 1 to period 2. The domestic currency price of one unit of foreign currency in period $t$ is denoted $S_t$. 
Notation:

\( \pi \) = probability economy is in the good state in period 2.
1 - \( \pi \) = probability economy is in the bad state in period 2.

Nominal Endowments:
Period 1: \( Q_1 \)
Period 2, good state: \( Q^g_2 \)
Period 2, bad state: \( Q^b_2 \)

Consumption:
Period 1: \( C_1 \)
Period 2, good state: \( C^g_2 \)
Period 2, bad state: \( C^b_2 \)
Notation (ctd.):

Exchange rates:
Period 1: $S_1$, spot exchange rate
Period 1: $F_1$, forward exchange rate
Period 2, good state: $S^g_2$, spot exchange rate in good state
Period 2, bad state: $S^b_2$, spot exchange rate in bad state

Domestic Price Level:
Period 1: $P_1$
Period 2, good state, $P^g_2$
Period 2, bad state, $P^b_2$

Expectations operator: $E_1 x_2 = \pi x^g_2 + (1 - \pi)x^b_2$ denotes the expected value of the variable $x_2$ given information in period 1.
Covered Interest Rate Parity (CIRP):

\[ 1 + i = (1 + i^*) \frac{F_1}{S_1} \]

Uncovered Interest Rate Parity (UIRP):

\[ 1 + i = (1 + i^*) E_1 \frac{S_2}{S_1} \]

As we will show below, under free capital mobility, CIRP must always hold. At the same time uncovered interest rate parity typically fails. For it to hold it would have to be the case that the forward rate is equal to the expected future spot rate, that is, it would have to be true that

\[ F_1 = E_1 S_2 \]

But this is not true in the data!
Deriving CIRP...

Household buys 3 types of bonds:

- $B_1$: domestic currency bonds, pay interest $i$
- $B_1^*$: foreign currency bonds, pay interest $i^*$, and buy forward cover
- $\tilde{B}_1^*$: foreign currency bonds, pay interest $i^*$, without forward cover
Households

Expected utility:

\[ U = U(C_1) + \pi U(C^g_2) + (1 - \pi) U(C^b_2) \]  \hspace{1cm} (1)

Budget Constraints:

Period 1:

\[ Q_1 = P_1 C_1 + B_1 + S_1 B^*_1 + S_1 \tilde{B}^*_1 \]  \hspace{1cm} (2)

Period 2, good state:

\[ Q^g_2 + (1 + i) B_1 + (1 + i^*) F_1 B^*_1 + (1 + i^*) S^g_2 \tilde{B}^*_1 = P^g_2 C^g_2 \]  \hspace{1cm} (3)

Period 2, bad state:

\[ Q^b_2 + (1 + i) B_1 + (1 + i^*) F_1 B^*_1 + (1 + i^*) S^b_2 \tilde{B}^*_1 = P^b_2 C^b_2 \]  \hspace{1cm} (4)
How to choose $B_1$, $B_1^*$, and $\tilde{B}_1^*$? To maximize utility.

Household problem: Pick $C_1$, $C^g_2$, $C^b_2$, $B_1$, $B_1^*$, and $\tilde{B}_1^*$ to maximize (1) subject to (2)-(4).

To make the problem easier to characterize solve (2) for $C_1$, (3) for $C^g_2$, and (4) for $C^b_2$ and use the resulting expressions to eliminate $C_1$, $C^g_2$, and $C^b_2$ from (1). Then we have a single objective function in three unknowns, namely, $B_1$, $B_1^*$, and $\tilde{B}_1^*$, which we pick to maximize expected utility.
Solving the period-1 budget constraint for $C_1$ yields:

$$C_1 = \frac{Q_1 - B_1 - S_1 B_1^* - S_1 B_1^*}{P_1}$$

Solving the period-2, good state, budget constraint for $C_2^g$ yields:

$$C_2^g = \frac{Q_2^g + (1 + i) B_1 + (1 + i^*) \left(F_1 B_1^* + S_2^g B_1^*\right)}{P_2^g}$$

Solving the period-2, bad state, budget constraint for $C_2^b$ yields:

$$C_2^b = \frac{Q_2^b + (1 + i) B_1 + (1 + i^*) \left(F_1 B_1^* + S_2^b B_1^*\right)}{P_2^b}$$
Now take the first order condition w.r.t. $B_1$, this yields:

$$U'(C_1) \frac{1}{P_1} = \pi U'(C_2^g) \frac{1 + i}{P_2^g} + (1 - \pi) U'(C_2^b) \frac{1 + i}{P_2^b}$$

Rewrite this expression as:

$$1 = (1 + i) \left[ \frac{\pi U'(C_2^g) P_1}{U'(C_1) P_2^g} + (1 - \pi) \frac{U'(C_2^b) P_1}{U'(C_1) P_2^b} \right]$$

Letting $E_1$ denote the expectations operator, we have:

$$1 = (1 + i) E_1 \left\{ \frac{U'(C_2^g) P_1}{U'(C_1) P_2} \right\}$$

Finally, let $M_2 = \left\{ \frac{U'(C_2^g) P_1}{U'(C_1) P_2} \right\}$ denote the nominal mrs between period 2 and period 1, to arrive at the following asset pricing condition:
\[ 1 = (1 + i)E_1 \{M_2\} \]
And the first-order condition w.r.t. to $B_1^*$ plus forward cover is:

$$U'(C_1) \frac{S_1}{P_1} = \pi (1 + i^*) U'(C_2^g) \frac{F_1}{P_2^g} + (1 - \pi) (1 + i^*) U'(C_2^b) \frac{F_1}{P_2^b}$$

Rewrite this expression as

$$1 = (1 + i^*) \frac{F_1}{S_1} \left[ \pi \frac{U'(C_2^g) P_1}{U'(C_1) P_2^g} + (1 - \pi) \frac{U'(C_2^b) P_1}{U'(C_1) P_2^b} \right]$$

Using the expectations operator notation we have:

$$1 = (1 + i^*) \frac{F_1}{S_1} E_1 \left\{ \frac{U'(C_2) P_1}{U'(C_1) P_2} \right\} = (1 + i^*) \frac{F_1}{S_1} E_1 \{M_2\} \quad (6)$$
Combining (5) and (6) we obtain:

\[(1 + i) = (1 + i^*) \frac{F_1}{S_1}\]  

which is the covered interest rate parity condition, we had set out to derive.
What about Uncovered Interest Rate Parity?

Consider the FOC w.r.t $\tilde{B}_1^*$. 

\[ \frac{U'(C_1)}{P_1} S_1 = \pi (1 + i^*) \frac{U'(C_2)}{P_2} S_2^g + (1 - \pi) (1 + i^*) \frac{U'(C_2)}{P_2} S_2^b \]

Rewrite this expression as

\[ 1 = (1 + i^*) \left[ \pi \frac{S_2^g U'(C_2)}{S_1 U'(C_1)} \frac{P_1}{P_2} + (1 - \pi) \frac{S_2^b U'(C_2)}{S_1 U'(C_1)} \frac{P_1}{P_2} \right] \]

Using the expectations operator notation we have:

\[ 1 = (1 + i^*) E_1 \left\{ \left( \frac{S_2}{S_1} \right)^{-1} \left( \frac{U'(C_2)}{P_1} \right)^{-1} \right\} = (1 + i^*) E_1 \left\{ \left( \frac{S_2}{S_1} \right)^{-1} M_2 \right\} \] (8)
Combining the asset pricing equations (8) and (6) we obtain

\[ F_1 E_1 M_2 = E_1 S_2 M_2 \]

but this expression does in general not imply that the forward rate, \( F_1 \), is equal to the expected future spot rate, \( S_2 \). That is, it does not follow from here that

\[ F_1 = E_1 S_2 \]

Hence, under free capital mobility, uncovered interest rate parity fails in general.

This was the second result we had set out to show.
Now we want to ask under what condition would UIRP hold.

Recall that

\[
\text{cov}(a, b) = E(a - E(a))(b - E(b))
\]

\[
= E(ab) - E(a)E(b)
\]

or

\[
E(ab) = \text{cov}(a, b) + E(a)E(b)
\]

We then can express \( E_1 M_2 (S_2/S_1) \) as

\[
E\left(\frac{S_2}{S_1} M_2 \right) = \text{cov}\left(\frac{S_2}{S_1}, M_2 \right) + E\left(\frac{S_2}{S_1}\right) E(M_2)
\]

and rewrite (8) as

\[
1 = (1 + i^*) \left[ \text{cov}\left(\frac{S_2}{S_1}, M_2 \right) + E\left(\frac{S_2}{S_1}\right) E(M_2) \right]
\]
**Suppose now** that the depreciation rate, $S_2/S_1$, is uncorrelated with the pricing kernel, $M_2$, that is, assume that

$$cov\left(\frac{S_2}{S_1}, M_2\right) = 0$$

**then** equation (8) becomes

$$1 = (1 + i^*) E_1 \left(\frac{S_2}{S_1}\right) E_1(M_2)$$

combine this expression with equation (6) to obtain

$$F_1 = E_1 S_1 \quad (9)$$

If the depreciation rate is uncorrelated with the pricing kernel, $M_2$, then the forward rate equals the expected future spot rate.
And further if we combine the above expression with (5) we have

$$(1 + i) = (1 + i^*)E_1 \left\{ \frac{S_2}{S_1} \right\}$$

or **Uncovered Interest Rate Parity** holds.
Let’s review what we have shown:

1.) Under free capital mobility, CIRP must hold.

2.) When we observe violations of UIRP, we cannot conclude that this is evidence against free capital mobility. For even under free capital mobility UIRP need not hold, that is, the forward rate need not be the expected future spot rate.
Empirical Evidence of Covered Interest Rate Parity

1. CIRD 1982-1988

2. Onshore-Offshore Differentials, 1982 - 1993

3. China

4. Brazil

5. UK - Germany 1870-2000
Covered interest rate differentials for selected countries
September 1982-January 1988 (in percent)

Covered Interest Rate Differential  = \( (1 + i) - (1 + i^*) \frac{F}{S} \).

<table>
<thead>
<tr>
<th>Country</th>
<th>( i - i^* - fs )</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>0.35</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.42</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>-16.7</td>
<td>1.83</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>-1.74</td>
<td>0.32</td>
<td></td>
</tr>
</tbody>
</table>

The covered interest rate differential is measured by the domestic 3-month interest rate minus the 3-month Euro-dollar interest rate minus the forward discount. Source: J. Frankel, “Quantifying International Capital Mobility in the 1980s.”
Observations on the table:

Germany and Switzerland had small CIRD: less than 50 basis points on average. Thus, Germany and Switzerland appeared to be relatively open to international capital flows in the early 1980s.

By contrast, Mexico had an enormous negative CIRD of over 16 percent. The period 1982-1988 corresponds to the post debt crisis period, when the financial sector in Mexico was nationalized and deposits were frozen. During that period, investors wanted to take their capital out of Mexico, but were impeded by financial regulations.

In France barriers to the movement of capital were in place until 1986, which explains the large average deviations from covered interest rate parity vis-a-vis the two other industrialized countries shown in the table.

The fact that the country risk premia of France and Mexico are negative indicates that capital controls were preventing capital from flowing out of these countries.
2.) Onshore Offshore Differentials

International capital mobility in the 1990s
alternative approach to measuring the degree of capital market integration.

interest rate differentials between domestic deposit rates and Eurocurrency deposit rates. For example, compare the interest rate on a French franc deposit in France to the interest rate on a French franc deposit outside France, say in London. Since both deposits are in French francs the exchange rate plays no role in comparing the two interest rates.
Domestic Interbank minus Eurocurrency 3-month interest rates: (in percent)

<table>
<thead>
<tr>
<th>Country</th>
<th>1/1/82-1/31/87</th>
<th>2/1/87-6/30/90</th>
<th>7/1/90-5/31/92</th>
<th>6/1/92-4/30/93</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>-2.27</td>
<td>-0.11</td>
<td>0.08</td>
<td>-0.01</td>
</tr>
<tr>
<td>Italy</td>
<td>-0.50</td>
<td>0.29</td>
<td>0.56</td>
<td>0.36</td>
</tr>
<tr>
<td>Germany</td>
<td>0.17</td>
<td>0.05</td>
<td>-0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>Japan</td>
<td>-0.07</td>
<td>-0.60</td>
<td>0.09</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Observations on the table:

The table provides further evidence suggesting that the presence of capital controls leads to deviations from covered interest rate parity.

It shows differences between domestic interbank and the corresponding Euro currency interest rate for France, Italy, Germany, and Japan from 1982 to 1993. In general, interest rate differentials are lower after 1987.

This is most evident for France, where important capital market deregulation took place in 1986.

In Italy, the high differential observed between 1990 and 1992 reflects market fears that capital controls might be imposed to avoid realignment of the lira, as an attempt to insulate the lira from speculative attacks, like the one that took place in August/September 1992. These violent speculative attacks, which affected a number of European economies, particularly, France, Sweden, Italy, and England, led to exchange rate realignments and a temporary suspension of the European Exchange Rate Mechanism (ERM) in September 1992. Once the ERM was reestablished, the lira interest rate differential falls as fears of capital controls vanish.

Japan had large onshore/offshore differentials between February 1987 and June 1990, which were the result of the Bank of Japan’s heavy use of administrative guidelines to hold interbank rates below offshore rates.
[International Capital Mobility: 1870 to 2000]
Forward exchange contracts of the kind common after 1920 were not prevalent before then. However, there was another widely traded instrument, called the long bill of exchange. Long bills could be used to cover the exchange risk that might otherwise be involved in interest-rate arbitrage. Let $b_t$ denote the long bill rate, which is defined as the date-$t$ dollar price in New York of £1 deliverable in London after ninety days. (Note that $b_t$ is paid 90 days prior to the date of delivery of the £.) Let $i_t^*$ denote the 90-day deposit rate in London, $i_t$ the 90-day deposit rate in New York, and $S_t$ the spot exchange rate, that is, the dollar price of one British pound.

How can you construct a test of free capital mobility between the United States and Great Britain in the period prior to 1920.

There are two ways to get 1 pound in 90-days from now. Way 1: put $1/(1 + i^*)$ on deposit in London. Way 2: take $b_t/S_t$ pounds today, exchange them U.S. dollars. You get $b_t$ dollars. With those
you can buy 1 British pound to be delivered in London 90 days from now. Under free capital mobility it should be true that

$$\frac{1}{1 + i^*} = \frac{b_t}{S_t}$$

So we can construct the following long-bill interest rate differential:

$$LBIRD = \frac{1}{(1 + i^*)} S_t - b_t$$

compute the mean or the mean of the absolute value of those to find the deviations from free capital mobility.
The next figure shows annualized covered interest rate differentials between Germany and the United Kingdom over the period 1870 to 2000. What can you deduce from the figure about the degree of international capital mobility between these two countries over time.


The figure shows that the mean annual interest rate differential was below 1 percent from 1870 to 1914, suggesting that there was relatively high international capital mobility. Then in 1914 the
mean differential suddenly becomes significantly negative. We see UK rates being more than 1 percent below German rates, in some years the differential is as high as 4 percent. Only in 1980 do we see these interest rate differentials disappear, reaching consistently levels below 0.5 percent. In fact, Great Britain abandoned capital controls only in 1980. So a rough description of the history of free capital mobility between the UK and Germany is, free capital mobility between 1870 and 1914, then rather limited international capital mobility between 1914 and 1980, and from 1980 onwards we see very low CIRD indicating free capital mobility.
Brazil 2009-2012

Between October 2009 and March 2012 Brazil imposed a number of capital control taxes to reduce capital inflows into Brazil. After March 2012 those restrictions were removed. The cupom cambial, $i_{cupom}$, is the 360-day interest rate of U.S. dollar deposits inside Brazil. It is defined as

$$1 + i_{cupom} = (1 + i_t) \frac{S_t}{F_t},$$

where $S_t$ is the spot exchange rate (that is, the reais price of one U.S. dollar), $F_t$ is the 360-day forward exchange rate of U.S. dollars, and $i_t$ the 360-day nominal reais interest rate in Brazil. Let $i_t^*$ denote the 360-day U.S. dollar LIBOR rate and define the spread as

$$spread_t = i_{cupom} - i_t^*.$$

a strategy to use observations on the variable $spread_t$ to test the effectiveness of the Brazilian capital controls in reducing capital inflows.
If the inflow controls were successful we should see that (1) the spread is nonzero between 2009 and 2012 and (2) and more importantly, that the spread becomes positive during that time. Meaning dollar interest rates in Brazil can be higher than in London. This interest rate differential cannot be arbitraged away because the capital controls prevent investors from engaging in a trading strategy that consists in borrowing dollars in London at $i^*_t$ and putting it on deposit in Brazil at $i_t^{\text{cupom}}$.

The next figure shows the variable $spread_t$ from June 2009 to December 2012.
The figure plots the variable $spread_t$. Ideally one would like to see a value of zero until October 2009 and again starting in March 2012 and significantly positive in the meantime. The figure shows that $spread_t$ was higher during 2011. This suggests that the capital controls were not that effective until the year 2011. In that year the...
spread was consistently higher than pre Oct 2009 and post March 2012 reaching up to 4 percent. The figure suggests that in the periods without capital controls the spread is below one percent. So I would conclude that yes at least in 2011 the controls lead to non-zero CIRD.
The “Forward Premium Puzzle”

Recall CIRP

\[(1 + i_t) = (1 + i^*_t) \frac{F_t}{S_t}\]

\(i_t\) = domestic interest rate
\(i^*_t\) = foreign interest rate
\(F_t\) = forward exchange rate (domestic price of foreign)
\(S_t\) = spot exchange rate (domestic price of foreign)

Low interest rate currencies are at a premium in the forward market:

\[
\frac{1 + i_t}{1 + i^*_t} < 1 \quad \text{by CIRP} \quad \Rightarrow \quad \frac{F_t}{S_t} < 1
\]

If \(F_t < S_t\), then the domestic currency is said to be at a premium in the forward market.
What is the “Forward Premium Puzzle”?

If $F_t < S_t$, that is, when the domestic currency is at a premium in the forward market

then one might expect that

$$S_{t+1} < S_t$$

(that is that the domestic currency will appreciate and the foreign currency will depreciate)

But in the data the opposite is true:

Currencies that trade at a forward premium ($F_t < S_t$), tend to appreciate by less than the interest rate differential or even to depreciate ($S_{t+1} > S_t$)

Clearly, this empirical finding implies that Uncovered Interest Rate Parity does not hold in the data.
Carry Trade

This observation suggests the following investment strategy:

Borrow in the low interest rate currency, invest in the high interest rate currency, and do not hedge the exchange rate risk.

This investment strategy is known as carry trade and is widely used by practitioners.
Burnside, Eichenbaum, Kleshchelski, and Rebelo* document that the returns to carry trade have been on average positive.

The payoff from a carry trade.

Suppose \( i_t < i_t^* \). Then borrow \( y \) at the rate \( i_t \) and invest in foreign country at rate \( i_t^* \).

\[
\text{Payoff from Carry Trade: } = \left[ (1 + i_t^*) \frac{S_t+1}{S_t} - (1 + i_t) \right] y
\]

*THE RETURNS TO CURRENCY SPECULATION Burnside, Eichenbaum, Kleshchelski, and Rebelo, NBER WP 12489, August 2006.
Burnside et al. use monthly data from 1976:1 to 2005:12. In their study the domestic country is the UK, so $i_t$ is either the 1-month or the 3-month pound sterling interest rate. They collect data on 1-month and 3-month forward exchange rates of the pound, $F_t$, on spot exchange rates, $S_t$, and on foreign 1-month and 3-month interest rates, $i_t^*$. Then they compute the average payoff from carry trade — taking into account that there are some transaction costs. And they find that the average return to carry trade is positive. The following table is taken from their paper.
### TABLE 4

Payoffs to the Carry Trade Strategies 76:01-05:12

<table>
<thead>
<tr>
<th></th>
<th>No Transactions Costs</th>
<th>With Transactions Costs</th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Belgium*</td>
<td>0.0044</td>
<td>0.028</td>
</tr>
<tr>
<td></td>
<td>(0.0019)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Canada</td>
<td>0.0053</td>
<td>0.032</td>
</tr>
<tr>
<td></td>
<td>(0.0018)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>France*</td>
<td>0.0054</td>
<td>0.027</td>
</tr>
<tr>
<td></td>
<td>(0.0016)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Germany*</td>
<td>0.0011</td>
<td>0.028</td>
</tr>
<tr>
<td></td>
<td>(0.0018)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Italy*</td>
<td>0.0029</td>
<td>0.028</td>
</tr>
<tr>
<td></td>
<td>(0.0017)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Japan†</td>
<td>0.0022</td>
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</tr>
<tr>
<td></td>
<td>(0.0022)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Netherlands*</td>
<td>0.0024</td>
<td>0.028</td>
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<tr>
<td></td>
<td>(0.0018)</td>
<td>(0.002)</td>
</tr>
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<td>Switzerland</td>
<td>0.0019</td>
<td>0.030</td>
</tr>
<tr>
<td></td>
<td>(0.0017)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>USA</td>
<td>0.0039</td>
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<tr>
<td></td>
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<td>(0.002)</td>
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<tr>
<td>Euro‡</td>
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<td>0.021</td>
</tr>
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<td></td>
<td>(0.0017)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Average</td>
<td>0.0031</td>
<td>0.029</td>
</tr>
<tr>
<td>Equally-weighted portfolio</td>
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<td>0.017</td>
</tr>
<tr>
<td></td>
<td>(0.0009)</td>
<td>(0.001)</td>
</tr>
</tbody>
</table>

* Euro legacy currencies available 76:1-98:12
Observations on Table 4 of Burnside et al. (2006)

1. Consider the case with corrections for transactions cost, columns 5, 6, and 7 of the table. The average return to carry trade for an equally-weighted portfolio of the 10 currencies considered is 0.0029 per unit of currency invested for one month.

2. To generate substantial profits, speculators must wager very large sums of money. For example, suppose $y = 1,000,000,000$, that is, you invest one billion pounds in carry trade, then after one month the carry trade had, over the sample period, an average payout of 2.9 million pounds per month.

3. The fact that the average payoff from carry trade is non-zero implies that UIRP fails empirically.
4. Columns 4 and 7 of the table report the Sharpe Ratio, which is defined as

\[\text{Sharpe ratio} = \frac{\text{mean(payoff)}}{\text{std of payoff}}\]

The Sharpe ratio is a measure of risk. The higher the Sharpe ratio, the higher the risk adjusted return. For comparision, note that the Sharpe ratio of investing in the S&P 500 index over the sample period was 0.14, which is comparable to the Sharpe ratio of the carry trade.

5. Q: Suppose a speculator wants to generate a payoff of 1 million pounds on average per year. How large a carry trade must he engage in? A: He needs GBP 28.7 million each month.

6. Burnside et al. also compute covered interest rate differentials (not shown) and find that CIRP parity holds in their sample.
Carry Trade returns are thought to have crash risk. The Economist article refers to carry trade returns as “picking up nickels in front of steamrollers.”

Example: large surprise appreciation of the Japanese Yen against the U.S. dollar on October 6-8, 1998. The Yen appreciated by 14 percent (or equivalently the U.S. dollar depreciated by 14 percent).

Suppose that you were a carry trader with 1 billion dollars short in Yen and long in U.S. dollars. The payoff of that carry trade in the span of 2 days was -140 million dollars — that is, the steamroller caught up with the carry trader.
Real interest rate differentials as indicators of the degree of international capital market integration

One might think that observed real interest rate differentials are a good measure of capital market integration.

For example, in the model of chapter 3, we found that the domestic real interest rate, $r$, was equal to the world real interest rate, $r^*$, under free capital mobility. However, that model abstracts from (a) uncertainty and (b) does not allow for nontraded good. As we will see either uncertainty or the presence of nontraded goods can give rise to non-zero real interest rate differentials even when international capital markets are fully integrated.
Decomposing real interest rate differentials

Our starting point is the Fisher relation, according to which the real interest rate equals the nominal interest rate minus expected inflation.

\[ r_t \] — real interest rate between period \( t \) and \( t + 1 \)
\[ i_t \] — nominal interest rate between period \( t \) and \( t + 1 \)
\[ P_t \] —