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Interest Rate Parity

Interest Rate Parity Conditions

Interest parity conditions are no-arbitrage profit conditions for financial capital. When such conditions hold, it is infeasible for investors to obtain higher returns by borrowing or lending. Hence, in principle, interest parity conditions define theoretical linkages between interest rates and exchange rates between countries.

The easiest way to understand parity conditions is to consider how a typical investor can save in different locations. Suppose the home currency is a dollar, and the foreign currency is a euro. Further assume a forward market exists. A forward contract allows an investor to enter into an agreement this period to exchange currencies k periods hence at a forward rate *F* known today. Then the investor can either save at home, receiving interest rate *i*, or save abroad, converting by the exchange rate *S*, receiving the foreign interest rate *i**, and then converting back to home currency by the forward rate *F* obtaining at time *t* for a trade at time *t+1*.

$$(1+i) \qquad \text{versus} \qquad (1+i_t^*)\times\frac{F_{t,t+1}}{S_t}$$

If the gross return on the left is greater than that on the right, then investors will place their capital in the home country; if it is less, then investors will place their capital abroad. With infinite amounts of capital moving in search of the highest return (and in this example, there is no risk in nominal terms), these returns will be equalized.

$$(1+i)=(1+i_t^*)\times\frac{F_{t,t+1}}{S_t} \qquad (1)$$

After manipulation,

$$\frac{(i-i^*)}{(1+i_t^*)}=\frac{F_{t,t+1}-S_t}{S_t} \qquad (2)$$

This condition is called “covered interest rate parity,” reflecting the fact that investors are “covered” against nominal uncertainty by way of the forward market.

If the forward rate is equal to the future spot rate, such that $F_{t,t+1}=S_{t,t+1}^e$ then (2) becomes:

$$\frac{(i-i^*)}{(1+i_t^*)}=\frac{S_{t,t+1}^e-S_t}{S_t} \qquad (3)$$

where the e superscript denotes “expected”. Equation (3) is termed “uncovered interest rate parity”. This expression holds when investors do not require compensation for the uncertainty associated with trading currencies in the future. It states that *expected* nominal returns are equalized across borders in common currency terms.

When interest rates are low, the following log approximations are often used for equations (2) and (3).

$$(i_t - i_t^*) = f_{t,t+1} - s_t \qquad (2')$$
$$(i_t - i_t^*) = s_{t,t+1}^e - s_t \qquad (3')$$

Jeffrey Frankel (1991) has labeled condition (2) holding as characterizing perfect capital mobility, while condition (3) is associated with perfect capital substitutability. These terms arise from the view that if (2) does not hold, there must be some sort of impediment – capital controls or the threat thereof – to the free flow of financial capital. But even if capital is free to move, investors may still respond to risk; that response to risk might drive a wedge between the expected spot and forward rate. When investors are risk-neutral in nominal terms, then investors will treat capital (say debt instruments issued in different currencies) as perfectly substitutable.

The above conditions pertain to financial capital. In order to consider the mobility of physical capital, one has to bring into play the prices of commodities. Integration of goods markets are often defined as relative purchasing power parity holding (see Purchasing power parity). Ex ante relative PPP can be written as:

$$s_{t,t+1}^e - s_t = (p_{t,t+1}^e - p_t) - (p_{t,t+1}^{*e} - p_t^*) \qquad (4)$$

where p is the log price level. Equation 4 states that expected depreciation equals the expected inflation differential. Combining (4) with the uncovered interest rate parity condition (3') leads to real interest parity.

$$i_t - (p_{t,t+1}^e - p_t) = i_t^* - (p_{t,t+1}^{*e} - p_t^*) \qquad (5)$$

This says the expected rate of return on capital, expressed in physical units, is equalized across borders. To the extent that in neoclassical models the marginal product of capital equals the real interest rate, this condition is equivalent to the equalization of marginal product of capital equalized across borders.

Covered Interest Parity Assessed

For developed economies since the dismantling of capital controls, covered interest parity holds fairly well. It should be noted that most tests are conducted using offshore rates, in which case (2) is sometimes termed "closed interest parity", although covered interest parity is often used as a term encompassing this concept.

Early tests were conducted by Jacob Frenkel and Richard Levich (1975). They found that, after accounting for transactions costs, covered interest parity held for 3 month horizons. Offshore rates sometimes diverge from onshore rates, so that the findings of covered interest parity are somewhat weaker.

The question of whether covered interest parity holds for longer horizons is an open one. Helen Popper (1993) concludes that covered interest differentials at long maturities are not appreciably greater than those for short (up to one year) maturities. This is a surprising result given that there are likely a number of regulatory impediments that would tend to introduce frictions into the arbitrage process.

Prior to the dismantling of capital controls, and in many emerging markets today, covered interest parity is unlikely to hold. In other words, covered interest differentials could be interpreted as political risk, associated with the possibility of governmental authorities placing restrictions on deposits located in different jurisdictions (clearly this is something that is not relevant when all the deposits are offshore). Robert Aliber (1973) is credited with this interpretation, while Michael Dooley and Peter Isard (1980) provided empirical estimates for the DM/dollar rate.

The Empirical Evidence for Uncovered Interest Parity

Uncovered interest parity is a more difficult condition to test, essentially because expected exchange rate changes are unobservable. In the literature, most tests of UIP are actually joint tests of UIP and the rational expectations hypothesis, i.e., that ex post realizations of the exchange rate are a unbiased measure of the ex ante exchange rate, viz., $s^e_{t,t+1} = E(s_{t+1} \mid I_t)$. This assumption combined with equation (2’) yields this standard regression equation, sometimes called the “Fama equation” (Fama, 1984):

$$s_{t+1} - s_t = \beta_0 + \beta_1 (f_{t,t+1} - s_t) + \upsilon_{t+1} \qquad (6)$$

Or by virtue of covered interest parity holding,

$$s_{t+1} - s_t = \beta_0 + \beta_1 (i_t - i^*_t) + \upsilon_{t+1} \qquad (7)$$

where under the joint null hypothesis υ_{t+1} is a mean zero error unpredictable using past information, and $\beta_1 = 1$.

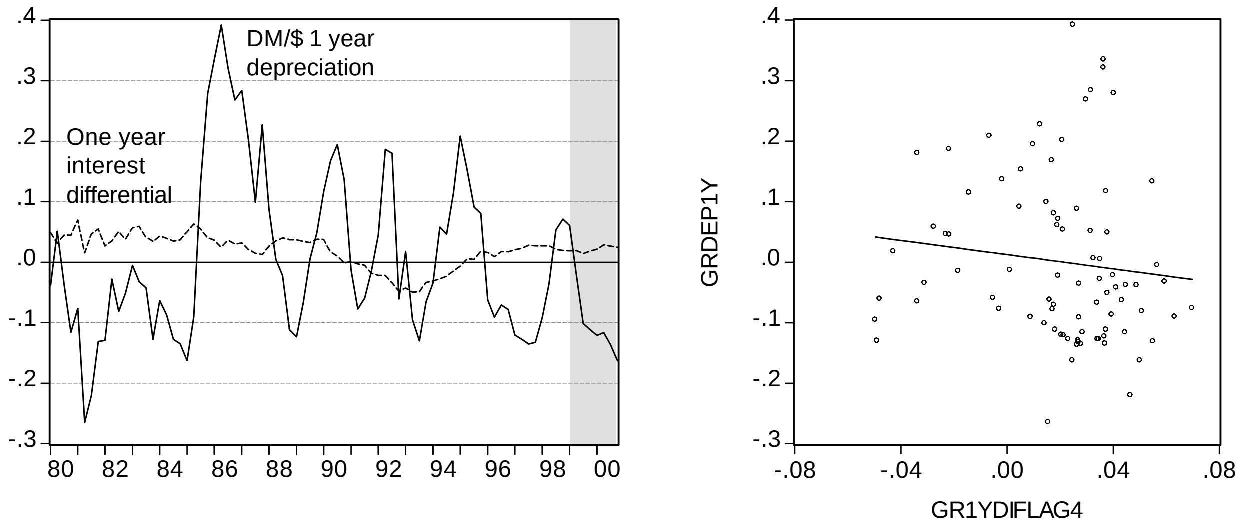

Figure 1: One year DM/US$ depreciation and one year offshore interest differential

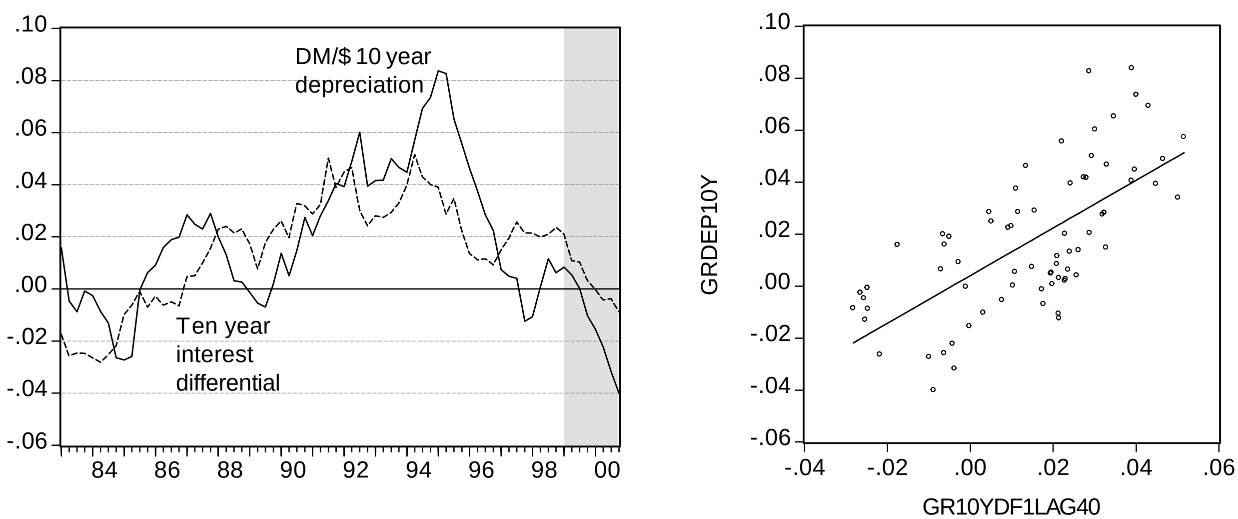

Figure 2: Ten year DM/US$ depreciation and ten year onshore interest differential
The relationship described by equation (7) – for different horizons – is depicted in the Figure below.

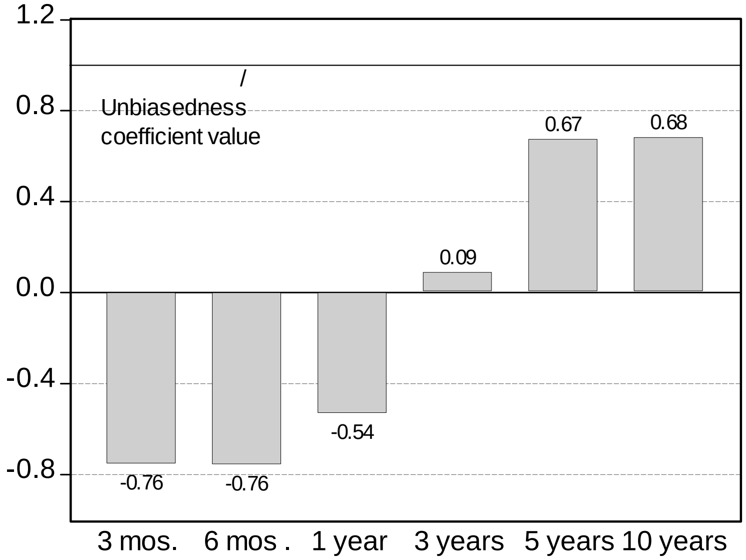

Figure 3: Panel beta coefficients at different horizons.
Notes: Up to 12 months, panel estimates for 6 currencies against US$, eurodeposit rates, 1980q1-00q4; 3 year results are zero coupon yields, 76q1-99q2; 5 and 10 years, constant yields to maturity, 80q1-00q4 and 83q1-00q4. Sources: 3, 6, 12 months, 5 and 10 years from Chinn and Meredith (2004); 3 years, author's calculations using data supplied by Geert Bekaert.

The evidence in favor of this joint hypothesis of UIP and rational expectations is quite weak. The regression of the ex post change of the spot exchange rate on either the forward discount (in equation 6), or the interest differential (in equation 7) typically yields a slope coefficient estimate that is not only different from unity, but in fact negative and different from zero at conventional levels of statistical significance. This is true for reserve currencies (the U.S. dollar, the yen, the Swiss franc, the deutschemark, the franc, or their successor currency, the euro) at horizons up to a year. It is also true for some emerging market currencies (see Frankel and Poonawala, 2006). One interesting characteristic of these regressions is that, although the coefficients are typically different from zero in a statistical sense, the proportion of total variation explained is typically very small.

At longer horizons, (3, 5, 10 years) the evidence is more supportive of the combined UIP-rational expectations hypothesis. Menzie Chinn and Guy Meredith (2004) document that estimates of the β_1 coefficient are usually not significantly different from the posited value of unity at 5 and 10 year horizons. The finding that the joint hypothesis of uncovered interest parity and rational expectations holds better at long horizons than at short appears to be robust. Nonetheless, some caution is necessary here. Consider regressions involving ten year interest differentials; by 2003, there would only be three non-overlapping observations available per currency. Interestingly, Chaboud et al. (2005) find that UIP also holds at extremely short horizons of a few minutes.

Other interesting results pertain to periods of extreme market turmoil. Robert Flood and Andrew Rose (2002), following their 1996 work, find that uncovered interest parity holds better in recent times when the sample encompasses successful attacks on currency pegs. Nonetheless, the still find lots of heterogeneity in experiences with UIP.

A different perspective on uncovered interest parity is provided by dropping the rational expectations hypothesis.

A new area of research involves investigation of whether uncovered interest parity holds for emerging markets. Ravi Bansal and Magnus Dahlquist (2000) found that there was a basic asymmetry in whether UIP holds. In particular, they find that when the U.S. interest rate is lower than foreign country rates, UIP holds, while UIP fails to hold when the U.S. rate is higher. They also find that idiosyncratic factors, such as the GDP per capita of the foreign country, are important in determining the degree of failure of UIP to hold.

Using the forward discount in stead of interest differentials, Jeffrey Frankel and Jumana Poonawala (2006) find that there is substantial heterogeneity in the results. What matters importantly is the exchange rate regime; highly managed exchange rate regimes are associated with currencies that exhibit greater deviations from UIP.

There has been a lot of recent discussion of the “carry trade”. Essentially, the carry trade exploits the failure of ex post UIP to hold. Market participants borrow where interest rates are low, and lend where high. As long as exchange rate changes are not sufficiently large as wipe out the gains from the differential rates, a hefty profit can be made. However, this is a risky business, as even relatively small unanticipated changes in the exchange rate can wipe out accumulated profits. (For more, see Cavallo, 2006.)

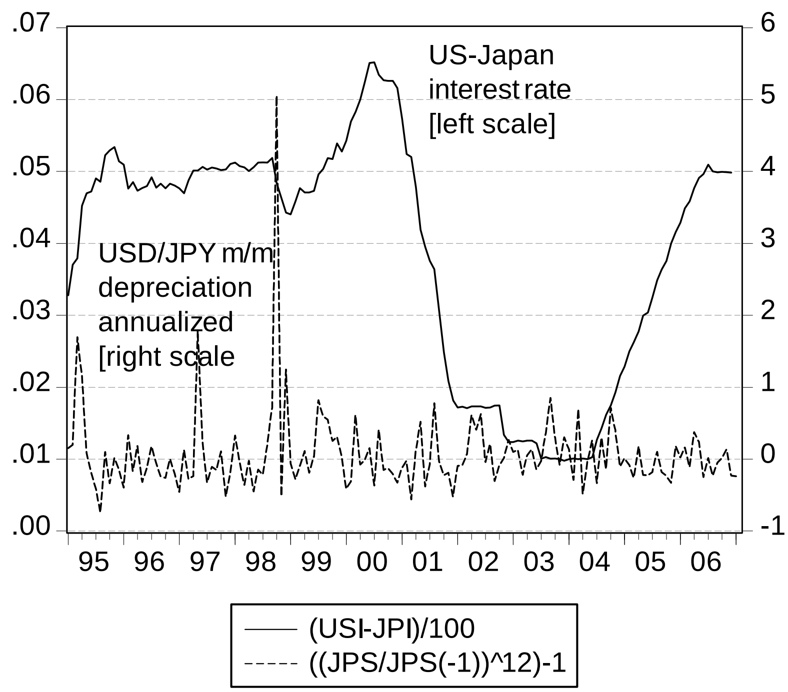

Figure 4: US-Japan overnight interest differential, and monthly depreciation of USD against JPY, annualized. Source: IMF, *International Financial Statistics*.

Real Interest Parity Measured

If uncovered interest parity does not seem to hold at short horizons, it seems unlikely that real interest parity, described as exact equalization of real interest rates, would hold. However, one could still test the weaker condition that movements in real rates in one country would be met by one for one real movements in other countries.

The key difficulty with testing this condition, like that of uncovered interest parity, is that market expectations are not directly observable. Hence, one can conduct only joint tests for real interest parity. In Eiji Fujii and Menzie Chinn (2001), real interest rates are calculated using a variety of proxy measures of expected inflation: ex post inflation, and inflation predicted using lagged values of inflation models. Both approaches are consistent with rational expectations. They find that there real interest parity holds with different strength at different horizons. As in numerous previous studies (Cumby and Obstfeld, 1984; Mark, 1985), the real interest parity (RIP) hypothesis is decisively rejected with short horizon data. At five to ten-year horizons, however, the empirical evidence becomes far more supportive and in some cases the RIP hypothesis is not rejected. In general, RIP, *up to a constant*, holds better at long horizons than at short horizons. These results are robust to alternative ways of modeling expected inflation rates.

In recent years, several countries, including the U.K., the U.S., France and Canada, have begun issuing inflation-indexed debt securities. These are marketable securities whose principal is adjusted by changes in the price level (usually the CPI). The principal increases with the inflation rate so that the real return can be directly observed. A cursory investigation reveals that there is no evidence of equalization. Moreover, while there is some covariation, it is not anywhere near one for one. However, the thinness of the markets and the differences in the maturities of the relevant debt instruments makes strong conclusions in either direction difficult.

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