Survey of Literature on Covered and Uncovered Interest Parities

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Abstract

This paper explains the concepts of covered and uncovered interest parities and surveys related literature.

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I. Basic Concepts

In a fully integrated world with perfectly competitive profit maximizing agents and no transactions costs, the following Covered Interest Parity (CIP) condition would hold in equilibrium:

$$(1+i_t) = (1+i_t^*)\frac{F_t}{S_t} \qquad (1)$$

Where i_t and i_t* are respectively returns on comparable domestic and foreign assets between time t and *t+1,* S_t is the domestic currency price of foreign currency, F_t is the forward rate or the next period domestic currency price of foreign exchange delivered next period. Since all the variables in the above equation are known a priori, any deviation from this parity in our model world represents pure profits and therefore cannot exist in equilibrium. In addition, assuming risk neutral rational agents implies that forward rate would equal the expected future rate therefore, the Uncovered Interest Parity (UIP) condition must also hold in equilibrium:

$$(1+i_t) = (1+i_t^*)\frac{S_{t+1}^e}{S_t} \qquad (2)$$

However, in a world with oligopolistic players in financial markets, underdeveloped money markets, exchange or capital controls or risk of such controls, differential taxation, limited supply of capital, sovereign immunities, transaction costs and other inconveniences, forward rate may differ from current spot rate by more than the interest differential and moreover, it may differ from expected future spot rate [Keynes, 1923; Dooley and Isard, 1980; Frankel 1992; Frenkel and Levich (1975)]. The former difference has been estimated by several studies (reviewed below) for industrial countries to lie within the bounds implied by the existing transactions costs, thus validating the covered interest parity relationship. How much the latter differential can be in an efficient market has been the subject of several asset pricing models (e.g. Lucas, 1982; Frenkel and Razin, 1980; Svensson, 1985 and Stulz, 1984), portfolio balance models (Branson and Henderson, 1985; Frankel, 1983, 1984) and currency crises models (Arias, 2001).

The presence of an expected variable, unobserved to the econometrician, makes it hard to test for UIP directly. It has therefore been tested empirically by assuming rational expectations and/or CIP. Taking logs of (2) and imposing rational expectations, we get:

$$E_t(s_{t+1} - s_t) \approx i_t - i_t^*$$

where the small case letters denote logs. The above relation can be expressed as the null $H_0 : \alpha = 0, \quad \beta = 1$ in the equation:

$$s_{t+1} - s_t = \alpha + \beta(i_t - i_t^*) + \varepsilon_t \qquad (3)$$

If one additionally assumes that CIP holds, then a test of $H_1 : \delta = 0, \quad \rho = 1$ in the following equation is equivalent to the test in (3)[3]:

$$s_{t+1} - s_t = \delta + \rho(f_t - s_t) + \xi_t \qquad (4)$$

Both the above specifications have been used to test the validity of UIP assumption, although it must be remembered that neither is a direct test, and (4) involves, in addition to the RE assumption, the assumption of no risk premium in forward rate. $H_1 : \delta = 0, \quad \rho = 1$ is therefore referred to as the Risk Neutral Efficient Market Hypothesis [RNEMH]. A weaker version is the unbiasedness hypothesis, which allows a risk premium in (4) but constrains it to be uncorrelated with information set at time t.,

[3] Taking logs of (1) yields $f_t - s_t \approx i_t - i_t^*$

thus putting it in the error term. Basically, RNEMH requires that no other variable have any explanatory power in (4).

Note that (4) can be transformed into:

$$\frac{f_t - s_{t+1}}{s_t} = a_1 + b_1(\frac{f_t - s_t}{s_t}) + \eta_t \qquad (5)$$

This is equivalent to (4) under the assumptions $a_1=b_1=0$, i.e. under H_1. This specification tests for existence of predictable excess returns in the forward market.

Note also that the interest differential may be expressed as:

$$i_t - i_t^* \equiv [i_t - i_t^* - (f_t - s_t)] + (f_t - s_{t+1}^e) + (s_{t+1}^e - s_t) \qquad (6)$$

where the first term on the right is the covered interest differential, the second term is the excess of forward rate over expected future rate and the last term is the expected depreciation. Covered interest differential may exist because of transactions costs, existence of capital controls and risks of future capital controls, thinness of markets and other reasons discussed above. The second term may be non-zero if the agents are risk-averse. Taking the last term to the left hand side gives us the uncovered interest differential, which by definition then, is the sum of the covered interest differential and what is known as the currency or exchange risk premium, i.e.

$$i_t - i_t^* - (s_{t+1}^e - s_t) \equiv [i_t - i_t^* - (f_t - s_t)] + (f_t - s_{t+1}^e) \qquad (7)$$

When the covered interest parity doesn't hold, then the uncovered parity will not hold, unless the exchange risk premium for some reason is negative and exactly equal to the covered differential, a highly unlikely scenario. This observation is particularly relevant when testing for the parities in emerging markets.

Specifications (3)-(5) are valid regression equations only if the variables on both sides of the equations are stationary. Tests of unbiasedness or of CIP above therefore are based on the assumption that the exchange rate and the forward rate are co-integrated with co-integration vector (1, -1). Actual tests of stationarity of exchange rates and forward rates have often found them to be I(1) processes, which makes the LHS of (3) stationary. Unbiasedness therefore requires that the forward premium be stationary as well. Although there are good economic reasons to believe that that should be so – when the CIP holds, the forward premium is simply the interest differentials - results of studies of forward premium stationarity are mixed [Hutchison and Singh, 1997; Horvath and Watson, 1994; Evans and Lewis, 1994; Engel, 1996 for a survey]. While unbiasedness can hold only if the exchange rate and forward rate are co-integrated, the reverse is not true. Finding co-integration between s_{t+1} and f_t does not imply that unbiasedness holds. The additional requirement that unbiasedness imposes is that this co-integrating vector as well as the co-integrating vector between s_t and f_t be (1,-1).

Another thing to take into account while estimating an equation such as (4) is the conditional heteroskedasticity of errors, which will be present in one-period horizon data if forex markets are characterized by tranquil and turbulent periods. Errors will also be conditionally heteroskedastic if the data is sampled at a higher frequency than the forward rate horizon (e.g. using daily data on one-month forward interest rates). This is typically taken care of by using the GMM estimator proposed by Hansen (1982).

Bulk of the empirical research on interest parities has focused on industrialized countries. I review some of this literature below.

II. Literature Review

II.1 Covered Interest Parity

> *"…Forward quotations for the purchase of the currency of the dearer money market tend to be cheaper than spot quotations by a percent per month equal to the excess of the interest which can be earned in a month in the dearer market over what can be earned in the cheaper." [Keynes, 1923, p103]*

Empirical literature on CIP has generally tended to validate the hypothesis for the industrial countries, within the limits of the transaction costs and limits to speed of adjustment due to imperfectly elastic supply of funds. Obstfeld and Taylor (2004) compute covered interest differentials with monthly data vis-à-vis the Pound Sterling for US and German markets for the period 1921-2003. They estimated:

$$(1+i_t)\frac{F_t}{S_t}-(1+i_t^*) \qquad (6)$$

and found that the differentials were large between 1920 and 1980, but shrank considerably after 1980 [See Figure 2]. For the period 1870-1914, they use data on interest rates on long bills of exchange and find shrinking differences between 1870-1914 as well (another reason to expect shrinking differences now, in Emerging Economies). Significantly, these differences became lower post 1980 than they were at the peak of the Gold Standard. And have been falling since…Frankel (1991) estimated a time trend in absolute value of covered interest differentials for 25 developed countries during the 1980's and found a statistically significant negative trend for 10 of those 25 countries.

Other studies that have estimated the differential in (6) and tested for presence of profitable opportunities outside of the "transfer points" include Frenkel and Levich

(1975), Clinton (1988), Taylor (1989), Peel and Taylor (2002) and Obstfeld and Taylor (2004). Transfer points measure the minimum interest differentials that would induce arbitrage (because of the existence of transaction costs, controls etc). These transfer points have been estimated through data on triangular arbitrage, bid-ask spreads and brokerage fees and endogenously through a Threshold Autoregressive (TAR) model in Peel and Taylor (2002) and Obstfeld and Taylor (2004).

Clinton (1988) estimated, for 5 major currencies against the US$, a transfer band of ±6 basis points in the mid-1980's. He rejected the null of zero deviations from parity, but found that any such deviations were small and short lived. Frenkel and Levich (1975) estimate transaction costs in foreign exchange markets through triangular arbitrage differentials and in securities markets through bid-ask spreads and find that these explain 85 per cent of the deviations from CIP. The rest could be explained to a large extent by less than perfectly elastic demand and supply curves and by lags between observing a profitable opportunity and arbitraging. Obstfeld and Taylor (2004) and Peel and Taylor (2002) use a TAR methodology to estimate transfer bands of ± 19 basis points for New York London and ± 35 basis points for London-Berlin transactions for the period 1880-1914, and bands of about ± 50 basis points for the 1920's. Deviations outside the bands do occur in their samples, but these tend to be mean reverting. These suggest a much higher degree of integration in the post-Bretton Woods era than what was attained in the pre-1914 period of financial globalization. Moreover, Dooley and Isard (1980) showed that much of the differentials could be accounted for by political risks, including capital controls and risks of their imposition.

CIP has also been tested as $H'_0 : a = 0, \quad b = 1$ in:

$$f_t - s_t = a + b(i_t - i_t^*) + u_t \qquad (2)$$

Examples of such studies include Grubel (1966), Branson (1969), Cosandier and Lang (1981), Fratianni and Wakeman (1982). Furthur confirmation of CIP has been obtained from survey data. Herring and Marston, 1976 and Levich, 1985 present evidence from interviews of large bankers that reveal that they use spreads between forward and spot rates to determine the spreads between domestic and foreign currency deposit rates they offer. Also that CIP condition was used to determine forward exchange rates that traders offered to clients. Popper (1993) and Vierira (2003) provide evidence that CIP more or less holds even at longer maturities (more than one year). Deviations were found to be linked to out-of-line fiscal policies. Taylor and Branson (2004) is a study of covered interest parity between US and Russia, which finds large bands around the equality using the TAR technique, but these bands are not symmetric. The lower bound is close to zero and the upper bound, which involves borrowing in US dollars and lending in Rubles to be large, about 1 per cent.

II.2 Uncovered Interest Parity (UIP)

Uncovered Interest Parity has become notorious as a favorite theoretical abstraction which is resoundingly rejected by data. Part of the reason is that it cannot be tested directly, and therefore has to be tested in conjunction with rational expectations, as the unbiasedness hypothesis. Froot and Thaler (1990) in a famous survey, reported an average estimated value of β for industrialized countries in equation (4)[4] to be -0.88 for data of maturity more than one day and less than one year. Surveys by Macdonald and Taylor (1992) and Isard (1996) came to similar conclusions. Tests of the alternative specification in (5) yield similar results. Backus, Gregory and Telman (1993) estimated equation (5) and find estimated b_1 close to 2, consistent with an estimated β close to -1 in (4). A b_1 different from zero implies excess returns that are predictable, and therefore exploitable. Similar results can be found in Fama (1984) and Bilson (1981). Chinn and Meredith (2004) use data from 1980-2000 at 3, 6 and 12 month horizons for 6 major currencies and find an average coefficient also of -0.8, with four of the estimated coefficients having the wrong sign and being significantly different from unity. Another important finding is that estimates from the arbitrage equations tend to be highly imprecise, so even where one cannot reject the null of unity coefficient one can often also not reject the null of zero coefficient.

Several explanations have been forwarded for this failure of unbiasedness to hold at horizons less than a year and more than a few hours. These basically fall into three categories: Risk Premium, Forecast Errors, and Non-Linearities.

Risk Premium models include static Capital Asset Pricing Models (and the portfolio balance models) [Branson and Henderson, 1985; Frankel 1983, 1984] and dynamic general equilibrium models [Lewis, 1995; Lucas, 1982]. Fama (1984) showed that any explanation relying on risk-premium to explain the negative estimated betas (or any beta less than half) must satisfy two criteria: One, there must be a negative correlation between the risk premium and expected depreciation. Two, risk premium

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[4] No distinction is made here between estimates of (3) and (4). For industrialized countries, the series for interest differentials and forward premia are so highly correlated that estimates from the two specifications are similar.

must be more volatile than expected depreciation. Both types of risk premium models fail on the second count. In a static CAPM, Lewis (1995) showed that the risk premium's variability must come from one or more of the following three: (a) shares of home and foreign wealth held in different assets (b) shares of world wealth held by home and foreign countries or (c) conditional variance of exchange rate and co-variances between exchange rate and domestic and foreign inflations. None of the three are sufficiently variable in the data to account for the high variability in risk premium. Other portfolio balance models, for example those discussed in Giovannini and Jorion (1989), Flood and Rose (1996) and McCallum (1994) postulate the risk premium as a function of volatility of exchange rate; and of considerations of liquidity, size and depth of financial markets[5] [Davanne, 1990]. Lucas (1982) model can in theory explain the higher variability of risk premium than of exchange rate change, but the degree of risk aversion required to obtain this result is very large [Bekaert and Hodrick, 1992]. Other versions of CAPM do not fare much better. Allowing for habit persistence as in Backus, Gregory and Telmar (1993) or allowing for first order risk aversion as in Bekaert, Hodrick and Marshall (1997) increases variability of risk premium, but not by enough. Moreover, Froot and Frankel (1989) used survey data to decompose excess return and found that the component due to risk premium was not large. A bigger challenge that risk premium explanations face is to explain the dependence of betas on sample period used, for example, the pattern shown in Figure 4 below.

Two sources of forecast errors have been identified in the literature: irrational expectations and rational systematic errors. Irrational expectations may arise because of presence of heterogeneous traders in the market [Carlson and Osler, 1999; Mark and Wu,

[5] This explanation is used to justify the negative risk premia on US$.

1998; Froot and Frankel, 1989; Delong, Shleifer, Summers and Waldmann, 1990]. In these models, the risk premium and departures from UIP depend on the relative size of rational speculators vs. other agents in the market. This is the only explanation forwarded that allows for market inefficiency. The others try to explain how negative coefficients may arise despite the markets being efficient. The second set of explanations relying on forecast errors highlight the difficulties in measuring accurately rational expectations with sample data. Rational systematic forecast errors in sample data may arise because of: (a) Presence of regime shifts and Bayesian updation of probabilities that regime shift has actually occurred. (b) Peso problems, i.e. the misalignment of sample moment from population moments because not all events to which agents accord positive probabilities have actually occurred in the sample. Lewis (1989) showed that not all the excess returns could be explained by learning models and Lewis (1995) that the same applies to peso problems.

A third and in my view the most satisfactory way of explaining the unwholesome estimates of beta in the unbiasedness equations are non-linearities. These may arise because of transaction costs [Baldwin, 1990; Dumas, 1992], Central Bank intervention [MacCallum 1993; Mark and Moh, 2002 and Moh 2002] or because of limits to speculation [Keynes, 1923; Lyons, 2001 pp 206-220]. Empirical work on non-linearities includes Leon, Sarno and Valente, 2004; Baillie and Kilic, 2004; Flood and Rose, 1996; Flood and Taylor, 1996 and Bansal and Dahlquist, 2000. We know that the real world is not frictionless and that there exist transactions costs, which have reduced dramatically in the last 10 or 15 years, but still exist. We therefore need to take these into account as constraints over market induced arbitrage. Baldwin (1990) shows that even small transactions costs can induce relatively large hysteresis bands, i.e. a range of deviations within which speculative activities will not occur, so that the usual linear equation tests are misleading. Tests of CIP seem to have incorporated these transactions costs more readily than tests of unbiasedness. Baldwin (1990) also shows that with transaction costs, hysteresis bands would be wider for daily trading horizons than with annual trading, so that long-horizon parity would hold better in linear tests than short-horizon, a result seen in the literature, as discussed below. Nonlinearity based literature also explains better the changes in betas over time and across countries [Baillie and Bollerslev, 2000 and Figure 4 below]

Unbiasedness at very short and at long horizons

Lyons and Rose (1995) and Chaboud and Wright (2005) find support for Unbiasedness with very high frequency data. Both the studies exploit the fact that interest is only paid on positions open overnight. Chaboud and Wright (2005) regress exchange rate change between end of day *t* and beginning of day *t+1* [1630 NYT and 2100 NYT] on overnight interest differential and find that for all but yen-dollar trade, estimated coefficients are positive and insignificantly different from 1. Lyons and Rose (1995) use data on intra-day positions for currencies under attack (so that a depreciation is expected and interest differentials are large) and argue that such positions don't earn interest and so need to be rewarded by appreciation, conditional on the expectations of depreciation not having been realized. Moreover, they show that the larger the expected depreciation, and therefore the interest differential, the more the currency appreciates within any day during which it does not depreciate.

Meredith and Chinn (1998) and Chinn (2006) obtained panel estimates for UIP at 5 and 10 year horizons for 4 countries and obtained betas close to 1, although these were imprecisely estimated. Lothian and Simaan (1998) used time averaged long-horizon data to obtain evidence in favor of UIP for 1974-1994. Cheung et. al (2005) also note more evidence of UIP at long, rather than at short horizons. Figure 3 below summarizes panel data evidence on unbiasedness for horizons varying from 3 months to 10 years.

Several explanations have been forwarded for long-short result discrepancy. These include:

- Weak exogeneity of long run rates in a model where monetary authorities use short term rates as instruments.[MacCallum 1993, Anker 1999, Chinn and Meredith 2004, Moore 1994]
- Segmented Short and Long Term bond markets, because of 'preferred habitat' [Lim and Ogaki 2003; Alexius and Sellin, 2001] or 'limited participation' [Mizrach and Occhino, 2004; Lahiri et.al., 2003; Alvarez et. al., 2001]
- Different expectations at different horizons [Frenkel and Froot 1987, Froot and Ito 1989]
- For very high frequency data, the risk involved in taking an open position goes to zero. If one believes that the estimates of unbiasedness at other horizons are corrupted by the existence of a time-varying risk premium, then the very high frequency data, by eliminating that risk premium, should yield a coefficient of 1 if UIP in fact holds.

- Transactions costs induced hysteresis bands which are larger for shorter horizon data [Baldwin, 1990]

Tests of UIP with survey data

Direct tests of UIP have been attempted from survey data on expectations, and the results favor UIP, thus implying that rejection of unbiasedness in the data comes from imposition of rational and linear expectations. [Froot and Frankel 1989, Chinn and Frankel 1994, 2002; Chinn 2006]. The problems with survey data are that these might not reflect true expectations, might have different working horizons than those of the forecasters and more importantly might be based on the current forward premium themselves. Another issue with survey data is its availability and completeness.

Unbiasedness over time

Flood and Rose (2002) and Baillie and Bollerslev (2000) provide evidence that deviations from UIP were lower in the 1990's than earlier. Flood and Rose (2002) use daily data from both industrial and some emerging market economies and find that not only are estimated coefficients positive in the 1990's (compared to negative coefficients found in studies with data for previous decades) but also that UIP holds better at times of crises. Baillie and Bollerslev (2000) estimate betas from 5 year rolling regressions, beginning March 1973 with monthly horizon data and find that in the 1990's even conventional estimates of betas turned positive [See Figure 4]. Chinn and Meredith

(2005) however find that the same cannot be said when data of 3 month horizon is used. Even if one accepts that higher estimated betas imply that UIP held better in the 1990's one if still left with explaining why the same should be the case for the 1970's. Given the evidence reviewed above, the case for estimates from linear equations being biased because of non-linearities introduced by frictions is strong, and an adequate answer to the question of whether or not deviations from UIP have reduced over time needs to take these into account while testing for UIP in samples with different time periods. I am not aware of any such study, even for the industrialized countries.

Unbiasedness in Emerging markets

Chinn and Frankel (1994) was an early study on UIP in emerging markets and used survey data to test the condition for East Asian economies.

Flood and Rose (2002) use daily data on interest differentials for 10 emerging markets for the 1990's and find that for four out of the ten, the coefficients are non-negative. Their study however, focuses exclusively on the 1990's and on a few emerging markets that suffered a crises in that period, and the question they are trying to answer is whether during crises the UIP holds better than otherwise. Both Flood and Rose (2002) and Bansal and Dahlquist (2000) find that unbiasedness holds better in times of high inflation and inflation volatility, perhaps because the exchange rate depreciations are more easily forecast in such periods. The latter also find that it holds better for lower income countries[6], a finding not corroborated in Flood and Rose (2002). Frankel and Poonawala

[6] Why this should be so, is a question left largely unanswered.

(2004) examine the unbiasedness hypothesis using data on forward rates for the period 1996-2004, for 14 emerging markets and find eight positive coefficients, although these are imprecisely estimated. However, the specification in equation (4) is a test of unbiasedness only on the assumption that covered interest parity holds. This assumption is very likely to be violated for emerging markets, for reasons discussed in Section II.

Francis, Hasan and Hunter (2002) investigate the impact that emerging market liberalization has on the time-varying risk premium demanded by US investors. They try to link each liberalization episode with subsequent movements in excess returns in currency deposits and find that much of the excess returns are due to and compensation for bearing systematic (non-diversifiable) risk, a claim disputed in Bansal and Dahlquist (2000). . Their data is averaged monthly deposit rates from the IFS. Since much of the arbitrage in emerging markets is undertaken by financial institutions, not individual investors, one needs to look not at deposit rates (which, as given in IFS are the *average monthly* rates on deposits offered to *resident* customers) but at rates at which financial institutions (including non-resident financial institutions) can lend and borrow between dates A and B and the depreciation between those two dates.

When discussing unbiasedness in emerging markets, consideration has to be taken of the fact that most of these have had fixed exchange rates over at least part of the last 20 year period. If the fixed rate is perfectly credible, the expected exchange rate would equal the actual rate and the home and foreign rates would be equal. Arias(2001) summarizes how the UIP relationship is modified in models where the fixed rate is less than credible, hence susceptible to an attack (most of these modifications are in the spirit of the portfolio balance models discussed above). The interest rate in this case would exceed the foreign rate by a devaluation risk premium, but different currency crises models differ on how this premium is modeled. This literature also generates interesting insights on what the UIP differential should depend on. In the case where there is a positive probability, say ρ of the devaluation and where the rate of devaluation, if it occurs is known at δ. Then, the UIP relation will be:

$$i = i^* + \rho\delta * s_t$$

The first generation crises models of Krugman (1979) and Flood and Garber (1984) the fundamentals, i.e. the ability of the central bank to defend the exchange rate are continuously deteriorating because of a fiscal policy inconsistent with a monetary one. The interest rate in these models is fixed until the date of depreciation when it jumps. If you add uncertainty in the level of reserves that the central bank will commit to the exchange rate defense and limit the mobility of capital, then one gets more interesting parity conditions like the one suggested by Artus (1994):

$$i = i^* + s^e{}_{t+1} - \lambda * d_t$$

where

$$\Delta d_{t+1} = i^* - \alpha(s_t - p_t) + z_t$$

Where d_t is the external debt of the domestic country, λ is a constant inversely proportional to the degree of capital mobility, p_t is the price level, z is the external balance. Other modifications of the UIP[7] include adding a self-fulfilling mechanism by specifying the UIP as follows [Flood and Marion, 1998]:

$$i = i^* + \Delta s^e{}_{t+1} + x\,\mathrm{var}(s_{t+1})(b_t - b_t^* - s_t)$$

[7] Discussed in Arias (2001)

Where x is proportional to the degree of risk aversion, θ, $b_{t,}$ and b^*_t are the shares of world wealth in domestic assets and foreign assets respectively and $var(s_{t+1})$ is the conditional variance of the future exchange rate. Or as in a bond-market led speculative attack model as:

$$i = i^* + \Delta s^e{}_{t+1} + \theta(b_t - b_t^* - s_t)$$

Another interesting modification specific to emerging markets is suggested by Arida, Bacha and Lara-Resende (2004) wherein the risk premium depends on the interaction between judicial uncertainty (the uncertainty that contracts will be enforced by courts) and capital controls.

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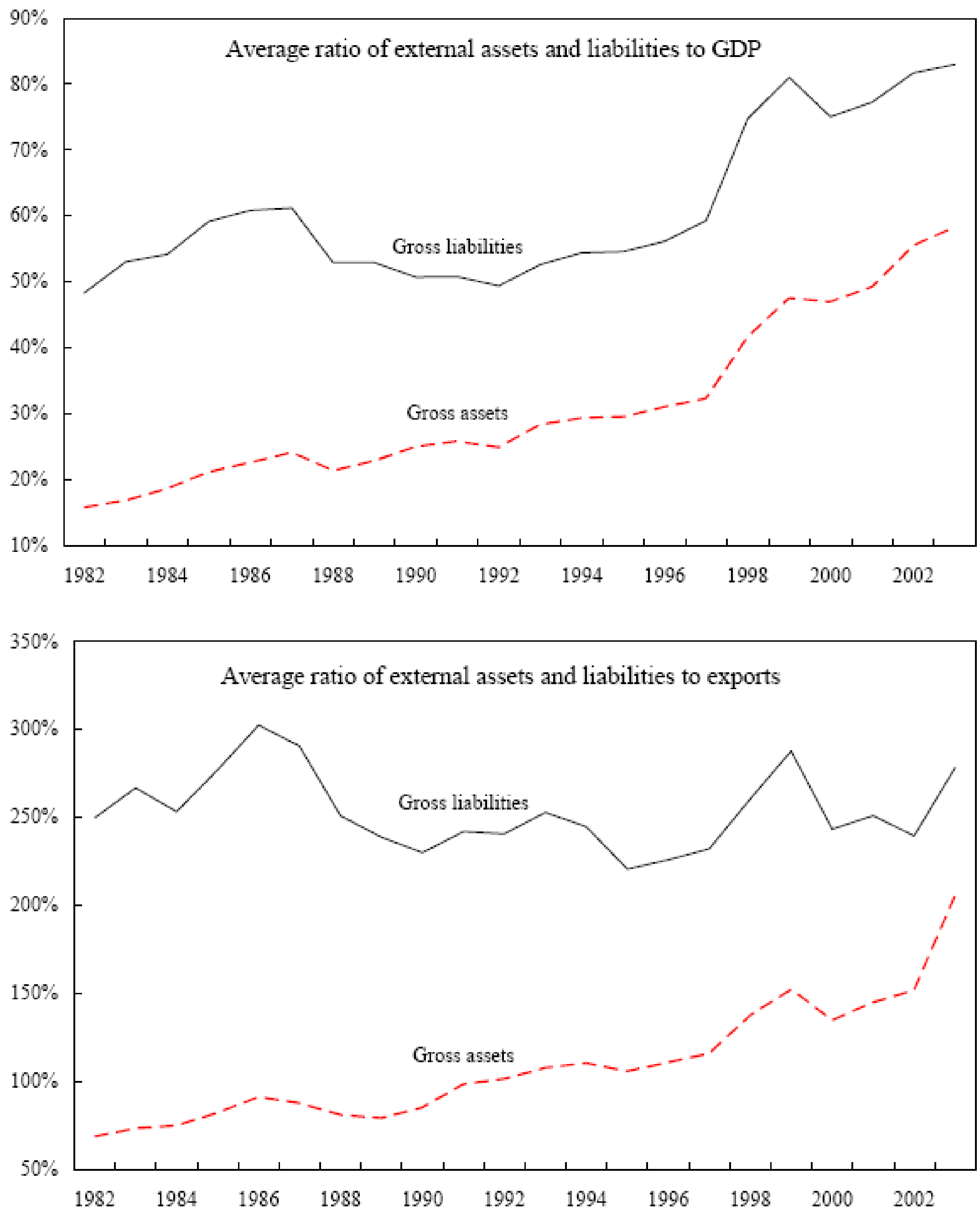
Table 1: De-Facto Openness: Accumulated Stock of Foreign Assets and Liabilities
(Ratio to GDP)

	Emerging Market Economies			**Industrialized Economies**		
Year	Foreign Assets	Foreign Liabilities	Total	Foreign Assets	Foreign Liabilities	Total
1980	7.4	20.9	28.3	33.1	32.1	65.2
1982	9.0	28.4	37.4	38.2	37.9	76.1
1985	12.9	32.8	45.7	46.6	46.4	93.0
1990	15.7	28.1	43.7	61.4	62.9	124.3
1995	26.7	46.1	72.8	70.9	71.8	142.8
2000	40.8	60.0	100.8	121.2	125.1	246.4
2004	53.7	66.1	119.8	158.5	164.8	323.4

Source: Constructed using data from Lane-Milesi-Feretti (2006).
Notes: Emerging Market Economies include: Argentina, Brazil, Chile, Colombia, Mexico, Venezuela, China, India, Indonesia, Korea, Malaysia, Philippines, Taiwan province of China, Thailand, Czech Republic, Hungary, Poland, Russia, Israel, South Africa, Turkey

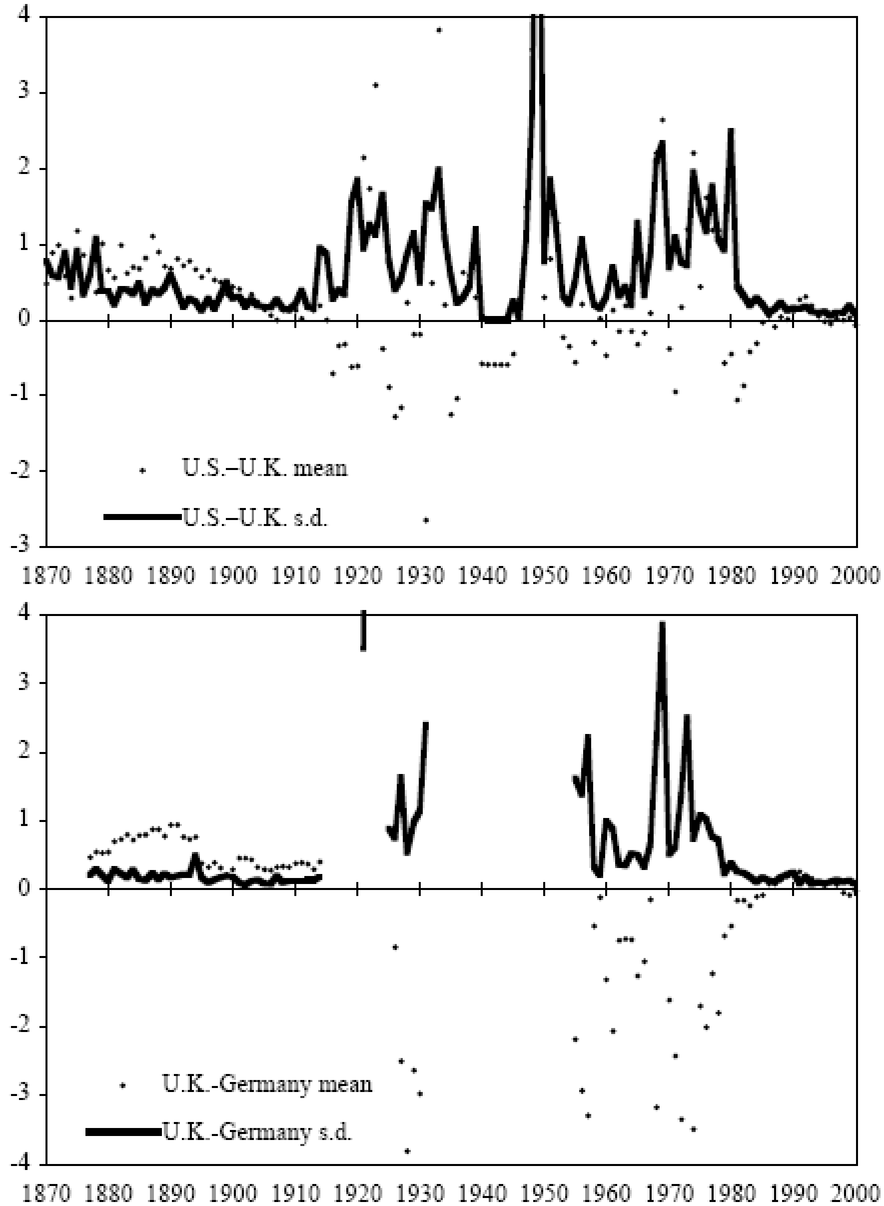
Figure 1: Average External Assets and Liabilities, Emerging Markets



Source: Lane and Milesi-Ferreti, 2004. Emerging Market Economies include: Argentina, Brazil, Chile, Colombia, Mexico, Venezuela, China, India, Indonesia, Korea, Malaysia, Philippines, Taiwan province of China, Thailand, Czech Republic, Hungary, Poland, Russia, Israel, South Africa, Turkey.

Figure 2: Covered Interest Differentials US-UK and UK-Germany

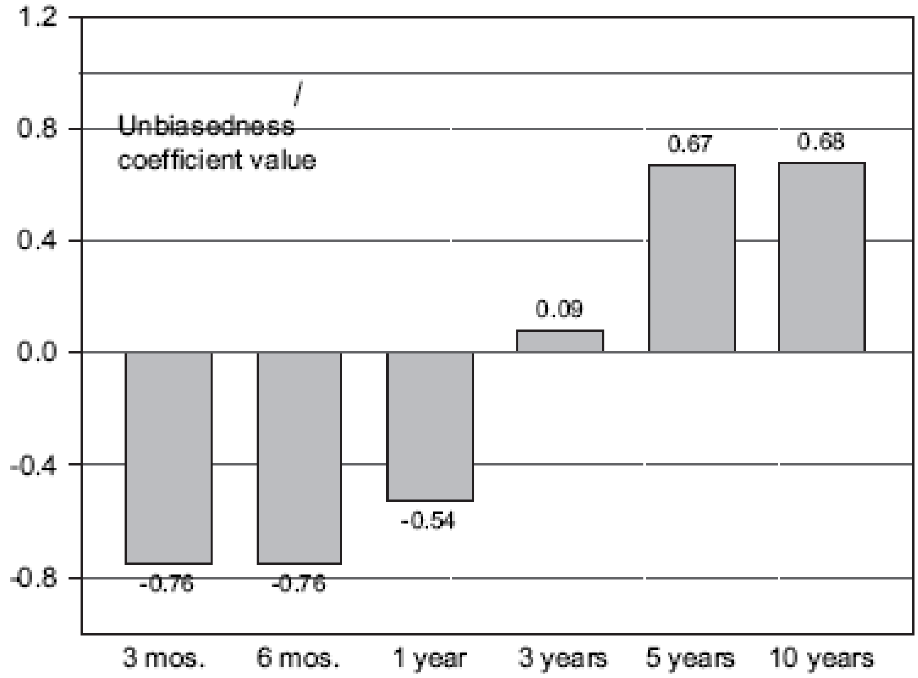
1870-2003



Note: Annual samples of monthly data

Source: Obstfeld and Taylor (2004)

Figure 3: Panel beta coefficients for Euro-deposit rates at different horizons for 6 major currencies against US$.



Source: Chinn (2006)

Figure 4: Unbiasedness Over Time

Notes: Rolling 5-year DM–$ unbiasedness regressions. The figure graphs the 208 slope coefficients obtained from the unbiasedness regression based on rolling monthly 5-year sub-samples for the DM–$ exchange rate beginning with the sample from March 1973 until February 1978, ending with the 5-year sample from December 1990 through to November 1995. The dashed lines give the conventional two OLS standard error confidence bands.
Source: Baillie and Bollerslev (2000)