Price-based Measurement of Financial Globalization: A Cross-Country Study of Interest Rate Parity

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Abstract : We characterize the relationship between ex post exchange rate depreciation and the interest differential for a set of countries that spans both developed and emerging market economies. Measured ex post uncovered interest differentials are then related to measures of trade and financial openness, financial development, government budget balances, institutional development, and exchange rate regimes. We find that there is wide diversity in the coefficient relating depreciations and interest differentials. Some of these differing results can be attributed to differences in inflation rate, inflation volatility, capital account openness, legal development, and the nature of the exchange rate regime.

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1. Introduction

The evidence of financial globalization is everywhere around us. Capital flows are unprecedentedly large by post-War standards. The stocks of cross-border financial assets and liabilities are growing year by year.

Yet, at the same time, there is ample anecdotal evidence that flows of financial capital have not driven the returns expressed in common currency terms to equality. Some of this can be attributed to the fact that de facto impediments to arbitrage might still exist. Or it could also be that arbitrageurs are not able to access sufficient amounts of capital in order to drive expected profits to zero. This last interpretation appears to be consistent with the large practitioner literature focused the "carry trade".

In this study, we document the extent to which uncovered interest parity holds around the world, across both developed and emerging market economies. In doing so, we can quantitatively assess the extent to which one particular aspect of financial globalization has progressed.

To the extent that the point estimates associated with tests of uncovered interest parity do not have a particular interpretation, in the second part of our empirical examination we focus on the uncovered interest differentials as the object of interest. We examine different hypotheses for explaining deviations from UIP as a function of observables.

While there is a tendency to view the UIP area as a thoroughly mined research topic, we believe that examining the data from different perspectives will yield fruitful insights. Indeed, recent years have seen a resurgence of interest in the area, including the distinction between short and long horizon results (Chinn and Meredith, 2004), and the differences

between the developed country and emerging market experience (Bansal and Dahlquist, 2000; Frankel and Poonawala, 2006).

2. A Framework for Examining Financial Globalization

The uncovered interest differential can be decomposed into:

$$\Delta s^{e}_{t,t+k} - \left(i_{t,k} - i^{*}_{t,k}\right) \equiv \left[\left(f_{t,t+k} - s_{t}\right) - \left(i_{t,k} - i^{*}_{t,k}\right)\right] - \left(f_{t,t+k} - s^{e}_{t,t+k}\right) \quad (1)$$

where $f_{t,t+k}$ is the k-period forward rate, the term in square brackets is called covered interest differential, and the term $(f_{t,t+k} - s^{e}_{t,t+k})$ is sometimes labeled risk premium.

If covered interest parity holds,

$$f_{t,t+k} - s_{t} = (i_{t,k} - i^{*}_{t,k}). \quad (2)$$

i.e., the forward discount equals the interest differential, then one can say that the ex post UIP differential is driven by the existence of exchange risk premium, η, is defined as:

$$f_{t,t+k} = s^{e}_{t,t+k} + \eta_{t,t+k}. \quad (3)$$

Substituting equation (2) into (1) then allows the expected change in the exchange rate from period *t* to period *t+k* be expressed as a function of the interest differential and the risk premium:

$$\Delta s^{e}_{t,t+k} = (i_{t,k} - i^{*}_{t,k}) - \eta_{t,t+k}, \quad (4)$$

Narrowly defined, UIP refers to the proposition embodied in equation (4) when the risk premium is zero. UIP would hold if investors are risk-neutral investors, or the underlying bonds are perfect substitutes.[1] In this case, the expected exchange rate change equals the

[1] Note that some approximations and simplifying assumptions have been made in order to arrive at this expression. See Engel (1996).

current interest differential. Equation (4) is not directly testable, however, in the absence of observations on market expectations of future exchange rate movements. To make UIP testable, it is tested jointly with the assumption of rational expectations. Using the rational expectations methodology, future realizations of s_{t+k} will equal the value expected at time t plus a white-noise error term $\xi_{t,t+k}$ that is uncorrelated with all information known at t, including the interest differential and the spot exchange rate, then one obtains what is commonly, if somewhat misleadingly, known as the UIP regression,

$$\Delta s_{t,t+k} = (i_{t,k} - i^*_{t,k}) - \eta_{t,t+k} + \xi_{t,t+k}, \qquad (5)$$

where the left-hand side of equation (5) is the realized change in the exchange rate from t to t+k.

According to the unbiasedness hypothesis, the last two terms in equation (5) are assumed to be orthogonal to the interest differential. Thus, in a regression context, the estimated parameter on the interest differential will have a probability limit of unity in the following regression:

$$\Delta s_{t,t+k} = \alpha + \beta\,(i_{t,k} - i^*_{t,k}) + \varepsilon_{t,t+k}. \qquad (6)$$

This specification is sometimes termed the "Fama regression"

The combined assumptions of no risk premium in equation (6) (i.e. that UIP holds) and rational expectations is sometimes termed the "risk-neutral efficient-markets hypothesis" (RNEMH). In this case, the disturbance in equation (6) becomes simply the rational expectations forecast error $\xi_{t,t+k}$, which by definition is orthogonal to all information known at time t, including the interest differential.

Unbiasedness is a weaker condition that RNEMH. All that is required is that any risk premium and/or non-rational expectations error be uncorrelated with the interest differential,

while the RNEMH requires in addition that no other regressors known at time *t* should have explanatory power.[2]

Ideally, in assessing the nature of the factors preventing parity conditions from holding, one would like to discriminate between covered interest differentials[3] and the exchange risk premium. However, data limitations preclude us from doing so in this experiment. Specifically, we have only incomplete data on forward rates, and do not observe expected exchange rate changes. In Chinn and Frankel (1994), expectations are proxied with survey based data, which are unavailable to us for all these currencies. Hence, we will conduct the analysis keeping in mind that we impound the covered interest differential and the exchange risk premium into the uncovered interest differential.

3. The Fama Regression Results

Estimates of equation (6) for horizons that range up to one year typically reject the unbiasedness restriction on the slope parameter. For instance, the survey by Froot and Thaler (1990) finds an average estimate for β of -0.88.[4]

Table 1 updates estimates of equation (6) for the period starting as early as 1984 for industrial countries (1990s for the emerging market economies, and later for transition economies) to 2006Q4. The exchange rates were expressed in terms of domestic currencies,

[2] The constant term may reflect a constant risk premium demanded by investors on foreign versus domestic assets. Default risk could play a similar role, although the latter possibility is less familiar because tests of UIP (as well as CIP) generally use returns on assets issued in offshore markets by borrowers with comparable credit ratings.
[3] The covered interest differential is sometimes termed political risk, associated with capital controls or the threat of their imposition. See Aliber (1973), Dooley and Isard (1980) and Frankel (1984) for applications.
[4] Similar results are cited in surveys by MacDonald and Taylor (1992) and Isard (1995).

and the annualized 3-month movements in exchange rates are regressed against differentials in onshore yields of the corresponding maturity.[5]

Panel A of the table encompasses the industrial countries' currencies, while Panel B refers to non-industrial. For the G-7 currencies, the results partly confirm the failure of the unbiasedness hypothesis, similar to findings obtained in other studies.[6] The Japanese yen exhibits a very negative coefficient, while Canada also rejects the null hypothesis of a unit coefficient. Interestingly, during the relatively short sample encompassing the ten years leading up to monetary union in 1999, most of the legacy currencies of the euro exhibit positive estimated β coefficients; in addition, the null hypothesis cannot be rejected.

The contrast with the results obtained in Chinn and Meredith (2004) is interesting, and can be attributed to the shorter, more recent, sample that encompasses the EMS crises of the early 1990's. This explains, for instance, the very positive coefficient for the British pound; restricting the sample to the post-1992 period leads to a negative coefficient (albeit insignificantly different from unity – not reported). These results confirm the findings of Flood and Rose (1996, 2002) who found crisis episodes marked periods where UIP worked quite well.

In panel estimation, whose results are shown in Table 2, interestingly, for both industrial country currencies, and the legacy currencies of the euro area, before monetary union, the coefficient is highly positive.[7] For the former, the coefficient is 2.379, and for the latter 3.634. In both cases, the null of unity is rejected. These high coefficients are mainly

[5] If its number of observations for which both ex post depreciation rates and interest rate differentials exist is less than 12 (i.e., three years of observations), the country is dropped from our sample.
[6] The bias in the forward rate are viewed as exploitable by market participants; see Rosenberg (2002: 72-76) and Yilmaz (2005).
[7] Regression estimations are conducted with country-fixed effects as well as time-fixed effects.

driven by high depreciation of the currencies that experienced the EMS crisis in the early 1990s.

What has happened since the advent of monetary union? It is telling that in the post-1998 period, in the absence of a currency crisis for the euro, the coefficient is *very* negative for individual countries, and statistically significantly different from unity. (Only the German interest rate based regression is reported – at the bottom of Panel A, since all of the coefficients are essentially the same, given the high degree of convergence of onshore interest rates in the euro area; see Chinn and Frankel (2005).)

The results in Panel B of Table 1 present a striking contrast to those for the industrial country currencies. The estimates range from -10 for post-crisis Thailand to +3.3 for Indonesia (during a period spanning its financial crisis). Indeed, there is such a diversity of results that it is very hard to make sense of them. There is no consistency in experiences across regional groupings (some East Asian economies have positive, some negative, coefficients), nor across transition country versus other emerging market or developing country currencies. Indeterminancy in the correlation between ex post depreciation rates and interest rate differentials can also be confirmed by Figures 1 and 2.

One could conjecture that some of the results are driven by what particular special circumstances are affecting a given country during the sample period. Rather going case by case, we resort to a different approach, systematically analyzing the relationship between ex post uncovered interest parity deviations on one hand, and observable institutional and macroeconomic factors. This exercise is undertaken in the next section.

4. Determinants of Deviations

4.1 Some Hypotheses

This means our empirical implementation relies upon examination of *ex post* differentials,

$$DEV \equiv \Delta s_{t,t+k} - \left(i_{t,k} - i^*_{t,k}\right)$$

The standard approach to motivating the use of (2) is that, under the rational expectations hypothesis, the *ex post* realizations are unbiased predictors of the *ex ante* counterparts.

One early study of the unbiasedness hypothesis concludes that for emerging market interest differentials against the US, unbiasedness tends to hold better when in the emerging economy the inflation rate and inflation volatility are high, or per capita incomes are low (Bansal and Dahlquist, 2000).

We index these deviations by currency, average them over the course of a year, to generate for each year τ:

$$\overline{DEV}_{i,\tau} \equiv \frac{1}{4}\sum_{t=1}^{4} DEV_t \qquad (7.1)$$

$$\overline{ADEV}_{i,\tau} \equiv \frac{1}{4}\sum_{t=1}^{4} \left|DEV_t\right| \qquad (7.2)$$

$\overline{DEV}$ is shown in Figures 3 and 4. In the former, $\overline{DEV}$ is compared for different income groups, industrial countries (IDC) and developing/emerging market countries (LDC/EMG). One apparent observation we can make is that the UIP differentials spike into the positive territory when countries are experiencing crises. The two spikes for the non-industrial country group correspond to the tequila crisis of 1994 and the Asian crisis of 1997-

98.[8] The spikes in the differentials corresponding to crises can also be observed in Figure 4 where development of $\overline{DEV}$ is shown for different regional groups. Contrary to anecdotal conjecture that recent globalization may have driven UIP differentials closer to zero, we cannot observe any discernable trend of dwindling differentials.

These deviations are then treated as data to be used in the following regression:

$$\overline{DEV}_{i,\tau} = X_{i,\tau}B + u_{i,\tau} \tag{8.1}$$

$$\overline{ADEV}_{i,\tau} = X_{i,\tau}B + u_{i,\tau} \tag{8.2}$$

Since the deviations impound expectational errors, covered interest differentials and an exchange risk premium, we can think of several sets of hypotheses to examine – and several sets of variables to relate to these deviations.

The first is that these deviations are smaller – and ex post uncovered interest parity holds better – when monetary shocks are larger. On the other hand, if the monetary shocks are more volatile so that the trend in inflation is more difficult to discern, then the deviations will tend to be larger. Bansal and Dahlquist (2000) documented the importance of these factors. To some extent, these variables proxy for the degree to which expectations are likely to be unbiased. When inflation is high, expected inflation is likely to be high. When inflation is variable, large expectational errors are more likely.

If the deviations are a function of political risk, then one might expect impediments to the free flow of capital to be important. There is by now a voluminous literature attempting to measure *de jure* or *de facto* impediments. Because the *de jure* impediments are easier to document, this is where the greatest progress has been made.

[8] For industrial countries that experienced the EMS crisis in the early 1990s, one can make the same generalization. In Figure 4, however, large positive deviations of these countries are averaged out by other non-

We construct an index, which we call *KAOPEN*, based on information regarding restrictions in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).* Specifically, *KAOPEN* incorporates measures indicating the presence of multiple exchange rates, restrictions on current account transactions, on capital account transactions and the requirement of the surrender of export proceeds. The numerical value of this index calculated as the first standardized principal component of the underlying indicator variables.[9] Higher values of this index indicate that a country is more open to cross-border capital transactions.

If an exchange risk premium is driving a wedge between returns expressed in a common currency, then there are numerous candidates. The portfolio balance literature, as surveyed by Frankel (1983) suggests outstanding stocks of government debt, denominated in different currencies, might be of relevance. Without data on a wide set of countries, we opted to rely upon government budget surpluses expressed as a share of GDP as a proxy measure.

We also look into the effect of financial development. The baseline of the theoretical prediction for this variable is that more developed financial markets may affect cross-border capital flows, and thereby contribute to driving arbitrage opportunities across different financial markets to zero (as financial openness may affect). However, measuring the level of financial development can be extremely complex since there are various kinds of financial markets (such as banking, equity, and bond markets) and several aspects of financial development (such as size, activeness, and cost performance/efficiency). Therefore, as we did in Chinn and Ito (2007b), we construct a composite index that measures the overall level of financial development. The index, *FD*, is the first principal component of private credit

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crisis countries.

creation, stock market capitalization, stock market total value, private bond market capitalization, public bond market capitalization, inverted net interest rate margin, and life insurance premium as a ratio to GDP.

We also try some ad hoc measures. First is trade openness, measured as the sum of exports and imports over GDP. This measure is sometimes thought to be correlated with overall openness to flows of capital and goods and services, and so may capture effects not measured well by our *KAOPEN* measure.

Political risk – the effect of actual or incipient restrictions on the mobility of capital – might be correlated with the degree of institutional development. Hence, we assess the empirical importance of institutional development, with the presumption that the higher the level of institutional development, the less likely it will be that the authorities would restrict the mobility of capital.

We also include measures accounting for the exchange rate regime. In principle, parity conditions should not be affected by the nature of the currency regime; however, since our measure is a composite of expectations errors, barriers to capital flows, and risk premia, it is very possible that there is some effect arising from the way in which currency fluctuations are managed. It may also be the case that the type of exchange rate regime selected is correlated with the existence of capital controls. To capture these effects of the type of the exchange rate regimes, we include dummy variables for the crawling peg exchange rate regime as well as for the pegged or fixed exchange rate regime. See Data Appendix for construction of the dummy variables.

[9] This index is used in Chinn and Ito (2006), and described in greater detail in Chinn and Ito (2007a).

Flood and Rose (1996, 2002) examine the UIP during crisis episodes and find that the parity worked quite well during the crises. Therefore, we include a dummy variable for currency crises that is based on the exchange rate market pressure (EMP) index pioneered by Eichengreen et al. (1996). More details about construction of the dummy variable are found in Data Appendix.

We must make one last note before discussing the empirical results. Considering that the exchange rate is in the form of domestic currency value against U.S. dollars, and that the interest rate differentials are calculated against the U.S. interest rate, all the explanatory variables, except for the dummy variables, are included as relative sizes to U.S. levels. This way, we can identify the effects of individual currency countries.

4.2 Empirical Results

We estimated the models for the determinants of UIP deviations using two different definitions of the deviations (eqs. 7.1 and 7.2). It turned out that the models with (the average of) absolute deviations (equation 8.2) yield much better goodness of fit while the models with the simple average of UIP deviations (equation 8.1) yield qualitatively similar results. Therefore, we report and discuss the results from the models with absolute deviations as the dependent variable. The regressions are run with country-specific fixed-effects to capture any latent characteristics of our sample currency countries that are not captured by the explanatory variables.

Panel A of Table 3 reports the results of the regression specifications described above, for a sample spanning all country currencies. It's important to note that the panel is not balanced, nor is the sample size constant over specifications. In the latter case, this outcome is

due to the fact that some of the variables have differing coverage. For instance, the dummy variable for currency crises based on the exchange market pressure (EMP) index in effect has a lower coverage than the other variables. Panel B reports the results for the industrial country currencies, while Panel C reports those results pertaining to the non-industrial countries.

The coefficient estimates in the panels indicate that the deviations do depend upon income per capita. As Bansal and Dahlquist (2000) evidenced, countries with higher per capita income are more likely to deviate from UIP. Augmenting the specification with two inflation variables – the level and the volatility of inflation – seems to affect the per capita income coefficient, but improves the goodness of fit significantly. Across different model specifications, the estimated coefficients on these inflation variables are persistently significant and in line with theoretical predictions. Higher inflation may indicate stronger financial shocks, and therefore, would make it easier for UIP to hold, i.e., it should result in smaller deviations. Higher inflation volatility means higher inflation uncertainty, and therefore, cause more deviations from UIP. Panels B and C show that both income groups share these characteristics.

While financial development does not seem to matter for UIP deviations in the full sample, it does enter in the estimation with correct signs in subgroups, but marginally for industrial countries and insignificantly for non-industrial countries. These results may not lead to ruling out financial development as one of the determinants of UIP deviations completely, however. When the simple UIP deviations are used as the dependent variable (eq. 8.1), the financial development index is found to be marginally significant with a negative sign for IDC and LDC/EMG subgroups (p-value being 12% and 14%, respectively). Financial development may help shrink the deviations from UIP.

Capital account openness does enter with statistical significance. However, we find in the full sample that the greater the degree of openness, the *larger* the deviations. We obtain a similarly puzzling result for our proxy measure of institutional development – namely *LEGAL*. In that case, a higher level of institutional development leads to larger deviations. Interestingly, we can see in Panels B and C that the anomaly is only the case for non-industrial countries. For industrial countries, the measures of both financial openness and legal/institutional development enter the estimation with correct and significant signs; the more financially open and/or institutionally developed, a country tends to deviate less from UIP. Hence, at least, among industrial countries, we can detect theoretically consistent behavior in these variables.

The government budget balance does not enter with any particular significance. However, in the industrial country group, it does enter, but with a wrong sign. Based on the theoretical prediction of the portfolio balance model, the more indebted a country's government is, which we proxy using the government budget balance, the more likely its political risk premium to rise, leading more deviations from the parity condition. That is, the estimated coefficient is theoretically predicted to be negative. However, when $\overline{DEV}$ is regressed as the dependent variable, the coefficient on the budget balance is significantly negative for both the full and industrial country samples. These findings may indicate that government budget surpluses may lead to smaller deviations from UIP, but also to widening the extent of fluctuation around the parity.

Trade openness does not seem to matter for deviations from the parity in the full sample. However, for industrial countries, the sign of the coefficient is persistently negative, though not statistically significant.

Crises periods do appear to raise the uncovered interest differential – seemingly at variance with the finding that uncovered interest parity holds better during crises. But this pair of conflicting results can be reconciled by realizing that the beta from the Fama regression incorporates different information than the deviation we examine. Also, the significantly positive coefficient with a relatively large magnitude can be interpreted as reflecting successful speculative attacks during the crisis period despite governments' defensive policies that usually involve a rise in the interest rate.

One of the most robust results we obtain – albeit with a smaller sample of countries – is that the more rigid the currency regime, the larger the deviations. This finding is consistent with Frankel and Poonawala's (2006) finding that the more managed the currency regime, the more marked the rejection of the unbiasedness hypothesis.

Overall, comparing the regression results for different samples leads us to conclude that a large potion of the goodness of fit for the full sample is driven by the group of non-industrial countries. Although the group of industrial countries also shares many of the characteristics of the correlations found in the full sample, the estimation model does not explain a large portion of the distribution of UIP absolute deviations – persistently low adjusted R-squared is for this sample. This observation is also applicable for the estimation results with the average of UIP plain deviations.

Lastly, we divide our sample by region and examine if there is any cross-regional differences in terms of the determinants of UIP deviations. Naturally, different regions should have different extent of financial integration as is the case of Western Europe and, to some extent, East Asia. Again, we report only the results from the exercise using absolute UIP deviations because of the same reasons.

Table 4 presents the results for Western Europe, 10 European countries that adopted Euro, East Asia and Pacific countries, and Latin American countries. Across different country group, inflation volatility and the crisis dummy persistently enter as significant variables and in consistent manners as in the previous analysis. For Western European or EU countries, in addition to these variables, financial openness and legal/institutional development enter significantly and this time, the signs are consistent with theoretical predictions. Trade openness is now significantly positive for these samples, but with theoretically inconsistent signs. Although it enters with a wrong sign, when the simple UIP deviations are used as the dependent variable, trade openness is found to be a significantly negative determinant, suggesting that trade openness may have played an important role for financial integration in Western Europe and the Euro area.

Additionally, although both government budget balance and financial development index are not found to be significant factors, in the regressions with simple UIP deviations, these two variables are found to be significantly negative contributors to the deviations in these European subsamples (though the finding of financial development is only applicable to the Western European subsample). These findings are consistent with theoretical predictions.

While the European subgroups find more theoretical consistent coefficients, their models' explanatory power is not significantly high. The East Asian & Pacific subsample on the other hand have the opposite issue. It enjoys a high goodness of fit, but the explanatory variables seem to be less significant compared to the European groups. The significantly positive coefficient on inflation rate and that on the currency dummy suggest the possibility that the results of this subsample could be driven by some conditions during crisis periods. With this prior, we reestimate the model for this group while removing observations during

the crisis period (results not reported). As we suspected, we find that both the goodness of fit and the statistical significance for all the explanatory variables except for inflation volatility drop significantly, indicating that the results for East Asian and Pacific countries in Table 4 are mainly by the economic conditions during the crisis period.

5. Concluding thoughts

We have examined the relationship between ex post exchange rate changes and interest differentials for a wide set of currencies. Our study differs from previous ones to the extent that we use appropriate interest rates (money market or government securities, rather than bank deposit rates), appropriately sampled. The countries in our sample are diverse; some are industrial countries, some are transition economies, some are emerging market countries. In addition, we examine the relationship between ex post uncovered interest differentials and macroeconomic and policy variables.

With this diverse sample, we first ran the "Fama" regressions – regress the ex post rate of currency depreciation on the interest rate differentials – for each country. Our evidence about the validity or rejection of the uncovered interest parity is highly diverse and inconclusive. One may conjecture that countries that experienced a currency crisis tend to have a very positive coefficient on the interest rate differentials. However, again, this generalization does not appear to be universal. The goodness of fit for each country's regression is also found to be very low for most of the countries.

Given the wide diversity in the coefficient relating depreciations and interest rate differentials, we explored the determinants of ex post uncovered interest parity deviations by regressing the latter on possible candidate determinants. From this exercise, we find that, as

Bansal and Dahlquist (2000) found, countries with higher per capita income tend to deviate more from the uncovered interest parity. Also, as in their work, our results show that the level of inflation contributes to shrinking deviations from the parity while its volatility helps widen the deviations.

While we find financial development matters marginally for how a country's currency can deviate from the interest differential, we also find that capital account openness and legal/institutional development negatively affect deviations from UIP, as theory suggests, but only for industrial countries. For non-industrial countries, we find anomalously opposite results; more financial open and/or legally developed countries tend to deviate more from the uncovered interest parity.

The government budget balance, which we use as a proxy for the indebtedness of a country, seems to matter only for industrial countries. It may help lessen the deviations from UIP, but at the same time, it may also intensify the volatility of the deviations. Although we expected trade openness may capture some effect of latent factors of globalization (that is not captured by *KAOPEN*), it does not appear to affect UIP deviations.

Crises periods are found to raise the uncovered interest differential, which is at variance with the finding of Flood and Rose (2002). The significantly positive contribution of the crisis dummy may just reflect that successful speculative attacks during the crisis period led to rapid currency depreciation despite governments' high interest rate policies. This finding is common in both industrial and non-industrial country groups.

We also examined the determinants of the UIP differential among different regions. Our findings suggest that, beside the level and volatility of inflation and currency crises, other factors seem to be in motion, especially toward smaller deviations from the parity in the

Western European region. More specifically, financial openness and legal development, and financial development, better budget balances, and trade openness with some mixed evidence, help the rate of currency depreciation to be more in line with the interest differential in this region. These findings are not consistent with what we find with East Asian and Pacific countries; most of the deviations from the uncovered interest parity are explained by high and volatile inflation (supposedly during the crisis) and the existence of crisis itself.

With this paper, while we were able to shed some light on the puzzle of forward premium for a financial integrated area such as Western Europe, the puzzle still remains to be a challenge for other areas including East Asia.

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Data Appendix

The exchange rate data are drawn from the IMF's International Financial Statistics, while the interest rate data are acquired from Bloomberg. The exchange rate and interest rate data are end-of-month. The interest rates are either 3 month Treasury bill yields (denoted as "TB") or money market rates. The sample periods for each of the interest rates are indicated below.

	Country	Starting	Ending
1	Argentine	Apr. 1997	Feb. 2007
2	Australia	Mar. 1989	Feb. 2007
3	Austria	Jan. 1989	Feb. 2007
4	Bahrain	Nov. 2003	Feb. 2007
5	Belgium	Oct. 1989	Feb. 2007
6	Brazil	Nov. 1999	Feb. 2007
7	Bulgaria	Feb. 2003	Feb. 2007
8	Canada	Oct. 1990	Feb. 2007
9	Chile	Jul. 1997	Feb. 2007
10	China	Feb. 1996	Feb. 2007
11	Columbia	Jan. 1984	Feb. 2007
12	Croatia	Jan. 2001	Feb. 2007
13	Czech Rep.	Apr. 1993	Feb. 2007
14	Denmark	Jun. 1988	Feb. 2007
15	Estonia	Feb. 1997	Feb. 2007
16	Finland	Jan. 1995	Feb. 2007
17	France, TB	Jun. 1989	Feb. 2007
18	Germany	Nov. 1989	Feb. 2007
19	Greece	Aug. 1993	Apr. 2001
20	Hong Kong, TB	Oct. 1991	Feb. 2007
21	Hungary, TB	Oct. 1995	Feb. 2007
22	Iceland	Dec. 1999	Feb. 2007
23	India, TB	Aug. 1997	Feb. 2007
24	Indonesia	Apr. 1997	Feb. 2007
25	Ireland	Apr. 1991	Feb. 2007
26	Israel, TB	Nov. 1996	Feb. 2007
27	Italy	Sep. 1994	Feb. 2007
28	Japan	Nov. 1988	Feb. 2007
29	Kazakhstan	Sep. 2001	Feb. 2007
30	Korea	Aug. 2004	Feb. 2007
31	Kuwait	Nov. 2001	Feb. 2007
32	Latvia	Jan. 1998	Feb. 2007
33	Lithuania	Jan. 2001	Dec. 2005
34	Malaysia	Oct. 1989	Feb. 2007
35	Malta	Oct. 1999	Oct. 2006
36	Mauritius, TB	Dec. 1997	Feb. 2007
37	Mexico, TB	Jan. 1991	Feb. 2007

38	Morocco, TB	Dec. 2001	Feb. 2007
39	Netherland	Jan. 1991	Feb. 2007
40	New Zealand	Oct. 1995	Feb. 2007
41	Nigeria	Feb. 2002	Oct. 2006
42	Norway	Jan. 1986	Feb. 2007
43	Pakistan	Oct. 1999	Feb. 2007
44	Peru	Jul. 1998	Feb. 2007
45	Philippines	Dec. 1995	Feb. 2007
46	Poland	Aug. 1996	Feb. 2007
47	Romania	Mar. 1998	Feb. 2007
48	Russia	Sep. 2000	Feb. 2007
49	S. Africa	Feb. 1999	Feb. 2007
50	Singapore	Jun. 1996	Feb. 2007
51	Slovakia	Nov. 2001	Feb. 2007
52	Slovenia	Jan. 2002	Dec. 2006
53	Spain, TB	Nov. 1992	Feb. 2007
54	Sri Lanka	Jan. 2000	Jan. 2007
55	Sweden	Jan. 1987	Feb. 2007
56	Switzerland	Nov. 1989	Feb. 2007
57	Taiwan	Apr. 2000	Feb. 2007
58	Thailand	May. 2002	Feb. 2007
59	Turkey, TB	Sep. 1996	Aug. 2006
60	U.K.	Jan. 1987	Feb. 2007
61	U.S., TB	Jun. 1983	Feb. 2007
62	Venezuela	Jul. 2000	Feb. 2007

CPI, government budget balance (*GSUR*) and trade openness (*OPEN*) data are drawn the IMF's International Financial Statistics and the World Bank's World Development Indicators.

The financial openness indicator is from Chinn and Ito (2007a). The exchange rate regime indicators are originally drawn from Reinhart-Rogoff (2002). We use this index to construct the exchange rate regime dummy variable. Reinhart-Rogoff's index ranges from 1 "no separate legal tender," to 14 "Freely falling" (with increasing flexibility of exchange rate movement) and is a "*de facto*" index in contrast to IMF's "*de jure*" exchange rate regime classification. In this paper, we aggregate the 14 categories into three; namely "floating," "Crawling Peg," and "Fixed/Pegged."

The financial development index (*FD*) is the first principal component of private credit creation (*PCGDP*), stock market capitalization (*SMKC*), stock market total value (*SMTV*), private bond market capitalization (*PVBM*), public bond market capitalization (*PBBM*), inverted net interest rate margin (*INVNETINT*), and life insurance premium as a ratio to GDP (*LIFEINS*). The financial development indicators are drawn from the World Bank's Financial Structure Dataset. See more details in Chinn and Ito (2007b).

The currency crisis dummy variable is derived from the conventional exchange rate market pressure (EMP) index pioneered by Eichengreen *et al.* (1996). The EMP index is defined as a weighted average of monthly changes in the nominal exchange rate, the international reserve loss in percentage, and the nominal interest rate. The weights are inversely related to the pooled variance of changes in each component over the sample countries, and adjustment is made for the countries that experienced hyperinflation following Kaminsky and Reinhart (1999). For countries without data to compute the EMP index, the currency crisis classifications in Glick and Hutchison (2001) and Kaminsky and Reinhart (1999) are used

The level of general legal development is measured by *LEGAL*, which is the first principal component of law and order (*LAO*), corruption (*CORRUPT*), and bureaucracy quality (*BQ*), all drawn from ICRG: *International Country Risk Guide*. For all variables, higher values indicate better conditions.

The inflation and exchange rate depreciation rates are calculated using exact formulas.

Table 1: Results of the "Fama" Regressions

Panel A: Industrial countries

		$\hat{\beta}_i$	**Robust Standard Errors**	**F test for H_0: $a_i = 0$ and $\beta_i = 1$**	**Prob. > F**	**Number of Obs.**	**Adj. R^2**
1	Australia	-0.986	[1.204]	1.405	0.252	72	-0.003
2	Austria (-1998)	0.84	[1.933]	0.023	0.977	39	-0.019
3	Belgium (-1998)	0.58	[1.713]	0.107	0.899	36	-0.025
4	Canada	-0.634	[0.758]	2.327	0.106*	65	-0.009
5	Denmark	0.406	[1.308]	0.113	0.893	75	-0.011
6	Finland (-1998)	-3.726	[3.283]	2.041	0.17	15	-0.02
7	France (-1998)	1.163	[1.950]	0.032	0.968	38	-0.01
8	Germany (-1998)	0.678	[1.903]	0.181	0.836	36	-0.024
9	Greece (-2000)	-0.561	[0.749]	2.302	0.119	29	-0.015
10	Iceland	-1.953	[2.280]	0.974	0.39	29	-0.021
11	Ireland (-1998)	2.825	[1.338]**	1.275	0.295	30	0.175
12	Italy (-1998)	-1.065	[1.979]	0.596	0.564	17	-0.05
13	Japan	-2.926	[1.233]**	5.984	0.004***	73	0.054
14	Malta	-2.832	[1.818]	3.099	0.062*	28	0.039
15	Netherlands (-1998)	0.167	[1.963]	0.32	0.729	31	-0.034
16	New Zealand	-4.203	[2.217]*	3.015	0.06*	45	0.053
17	Norway	0.719	[1.379]	0.198	0.821	84	-0.001
18	Spain (-1998)	1.815	[1.554]	0.245	0.785	24	0.049
19	Sweden	3.128	[2.918]	0.266	0.767	80	0.1
20	Switzerland	-0.502	[1.979]	1.389	0.256	69	-0.013
21	United Kingdom	1.315	[1.615]	0.655	0.522	80	0.004
	Euro Area 1999 – 2006	-4.792	[2.361]**	3.03	0.063*	32	0.073

Notes: OLS point estimates [Robust standard errors in brackets]. *(**)[***] denotes significance at the 10%(5%)[1%]. Constant terms in the regression are not reported. The joint significance for the null hypothesis that $a_i = 0$ and $\beta_i = 1$ is tested and its Wald statistics and p-values are shown.

Table 1: Results of the "Fama" Regressions (con't)

Panel B: Non-industrial countries

		$\hat{\beta}_i$	Robust Standard Errors	F test for H_0: $a_i = 0$ and $\beta_i = 1$	Prob. > F	# of Obs.	Adj. R^2
1	Argentina	0.715	[0.789]	6.422	0.004***	38	0.145
2	Brazil	-0.498	[1.919]	0.396	0.677	28	-0.037
3	Bulgaria	-0.499	[2.558]	0.339	0.718	16	-0.07
4	Chile	1.416	[0.822]*	0.281	0.757	37	0.029
5	China	0.202	[0.091]**	389.177	0.000***	43	0.098
6	Colombia	0.846	[0.302]***	0.427	0.654	92	0.091
7	Croatia	0.161	[1.124]	3.828	0.037**	24	-0.045
8	Czech Republic	0.688	[0.728]	0.39	0.679	55	-0.007
9	Estonia	0.912	[1.047]	0.035	0.966	40	-0.006
10	Hong Kong	-0.122	[0.103]	75.329	0***	61	0.006
11	India	-2.443	[1.706]	4.181	0.023**	38	0.03
12	Indonesia	3.26	[4.428]	1.757	0.187	39	-0.001
13	Israel	0.364	[0.735]	0.412	0.665	41	-0.02
14	Kazakhstan	-0.064	[1.143]	11.419	0.000***	22	-0.05
15	Kuwait	-0.51	[0.620]	7.592	0.004***	21	-0.021
16	Latvia	-0.074	[0.928]	1.424	0.255	36	-0.029
17	Lithuania	-6.139	[3.540]*	3.734	0.044**	20	0.049
18	Malaysia	1.746	[1.441]	0.313	0.732	68	0.005
19	Mauritius	-0.011	[0.041]	478.079	0.000***	25	-0.043
20	Mexico	-0.256	[0.539]	2.948	0.06*	64	-0.014
21	Morocco	-1.976	[1.288]	10.862	0.001***	20	0.046
22	Nigeria	1.005	[0.421]**	9.969	0.003***	14	0.117
23	Peru	0.654	[0.319]**	4.718	0.016**	34	0.142
24	Philippines	-0.269	[1.206]	0.755	0.476	45	-0.022
25	Poland	1.027	[0.416]**	1.669	0.201	42	0.053
26	Romania	1.109	[0.512]**	6.872	0.003***	36	0.337
27	Russia	0.593	[0.173]***	29.442	0.000***	26	0.161
28	Singapore	-1.229	[1.603]	2.71	0.079*	40	-0.016
29	Slovak Republic	-1.574	[1.092]	18.436	0.000***	21	0.022
30	Slovenia	-0.889	[1.461]	1.746	0.206	18	-0.043
31	South Africa	-5.596	[1.681]***	7.752	0.002***	32	0.073
32	Sri Lanka	0.716	[0.733]	0.904	0.417	28	0.01
33	Taiwan	-0.647	[1.494]	0.996	0.384	26	-0.036
34	Thailand	-10.355	[11.155]	1.643	0.223	19	-0.004
35	Turkey	1.138	[0.239]***	1.139	0.333	34	0.323
36	Venezuela, RB	2.521	[1.267]*	1.304	0.293	23	0.388

Notes: OLS point estimates [Robust standard errors in brackets]. *(**)[***] denotes significance at the 10%(5%)[1%]. Constant terms in the regression are not reported. The joint significance for the null hypothesis that $a_i = 0$ and $\beta_i = 1$ is tested and its Wald statistics and p-values are shown.

Table 2: Results of the Panel Estimation with Country-Fixed Effects and Time-Fixed Effects

		$\hat{\beta}_i$	**Standard errors**	**F test for H_0:** $a_i = 0$ and $\beta_i = 1$	**Prob. > F**	**# of Countries included**	**Adj. R^2**
1	Full	0.921	[0.128]***	0.43	0.65	59	0.036
2	Industrialized Countries (IDC)	2.379	[0.443]***	5.56	0.000***	21	0.116
3	Non-IDC (LDC)	0.797	[0.168]***	0.94	0.39	38	0.036
4	Asian Emerging Market Countries	0.823	[1.162]	0.02	0.98	9	0.028
5	Latin America	0.707	[0.289]**	0.7	0.5	7	0.093
6	Middle Eastern Countries	-2.173	[1.114]*	4.08	0.02**	3	0.104
7	Western European IDC	3.098	[0.534]***	9.96	0.000***	17	0.132
8	Euro countries – pre-Euro	3.634	[0.890]***	4.79	0.01***	10	0.135
9	Euro countries – post- Euro	3.251	[2.113]	25.75	0.000***	11	0.236

Notes: Panel Fixed Effects point estimates. *(**)[***] denotes significance at the 10%(5%)[1%]. Constant terms in the regression are not reported. The joint significance for the null hypothesis that $a_i = 0$ and $\beta_i = 1$ is tested and its Wald statistics and p-values are shown. The estimates on the time-fixed effects are not reported.

Table 3: Results of the Fixed-Effects Regressions on the Determinants of UIP Deviations

Panel A: Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Per capita income (in PPP)	0.191	0.422	0.423	0.394	0.503	0.533	0.47	0.406	0.395
	[0.140]	[0.105]***	[0.127]***	[0.132]***	[0.147]***	[0.155]***	[0.161]***	[0.161]**	[0.168]**
inflation rate		-0.702	-0.726	-0.687	-0.516	-0.573	-0.548	-0.489	-0.346
		[0.129]***	[0.134]***	[0.136]***	[0.200]**	[0.207]***	[0.208]***	[0.207]**	[0.214]*
inflation volatility		4.46	4.556	4.559	4.588	4.687	4.66	4.564	4.306
		[0.184]***	[0.188]***	[0.189]***	[0.210]***	[0.215]***	[0.217]***	[0.218]***	[0.231]***
Fin. develop. index			0.008	0.011	0.005	0.007	0.007	0.005	0.003
			[0.006]	[0.006]*	[0.006]	[0.007]	[0.007]	[0.007]	[0.007]
Financial Openness				0.017	0.021	0.022	0.024	0.034	0.046
				[0.011]	[0.012]*	[0.012]*	[0.013]*	[0.013]***	[0.014]***
Gov't budget surplus					0.075	0.04	0.085	-0.001	0.012
					[0.248]	[0.260]	[0.262]	[0.262]	[0.280]
Trade (% of GDP)						0.028	0.028	0.057	0.081
						[0.073]	[0.073]	[0.076]	[0.081]
LEGAL (Legal/inst. develop.)							0.036[11%]	0.047	0.039
							[0.022]	[0.023]**	[0.023]*
Dummy for								0.083	0.068
Crawling Peg Ex.R Regime								[0.031]***	[0.032]**
Dummy for								0.091	0.08
Peg/Fixed Ex.R Regime								[0.037]**	[0.038]**
Dummy for Currency Crisis									0.144
									[0.036]***
Observations	617	611	573	563	494	475	468	468	428
Number of countries	59	59	58	58	56	56	55	55	46
Adjusted R-squared	-0.1	0.54	0.56	0.56	0.6	0.61	0.61	0.61	0.64

Notes: Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported.

Table 3: Results of the Fixed-Effects Regressions on the Determinants of UIP Deviations, continued

Panel B: Industrial Countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Per capita income (in PPP)	0.153	0.296	0.311	0.297	0.282	0.271	0.328	0.364	0.338
	[0.074]**	[0.108]***	[0.113]***	[0.117]**	[0.129]**	[0.132]**	[0.135]**	[0.135]***	[0.130]***
inflation rate		0.126	0.089	-0.172	-0.418	-0.404	-0.463	-0.433	-0.526
		[0.315]	[0.320]	[0.319]	[0.337]	[0.341]	[0.341]	[0.338]	[0.325]*
inflation volatility		1.541	1.556	1.519	2.039	1.996	1.985	2.004	1.77
		[0.371]***	[0.379]***	[0.371]***	[0.462]***	[0.493]***	[0.491]***	[0.501]***	[0.489]***
Fin. develop. index			0.004	0.001	-0.004	-0.004	-0.005	-0.003	-0.007
			[0.004]	[0.004]	[0.004]	[0.005]	[0.005]	[0.005]	[0.005][13%]
Financial Openness				-0.026	-0.039	-0.039	-0.04	-0.036	-0.035
				[0.009]***	[0.009]***	[0.010]***	[0.010]***	[0.011]***	[0.011]***
Gov't budget surplus					0.487	0.497	0.496	0.458	0.484
					[0.163]***	[0.176]***	[0.176]***	[0.175]***	[0.170]***
Trade (% of GDP)						-0.003	-0.012	-0.038	-0.03
						[0.082]	[0.081]	[0.082]	[0.086]
LEGAL (Legal/inst. develop.)							-0.029	-0.025	-0.037
							[0.015]*	[0.016]	[0.015]**
Dummy for								0.019	0.007
Crawling Peg Ex.R Regime								[0.024]	[0.023]
Dummy for								0.06	0.049
Peg/Fixed Ex.R Regime								[0.024]**	[0.024]**
Dummy for Currency Crisis									0.104
									[0.022]***
Observations	319	313	304	299	276	271	271	271	257
Number of countries	22	22	22	22	22	22	22	22	21
Adjusted R-squared	-0.06	0.04	0.04	0.05	0.08	0.07	0.08	0.09	0.19

Notes: Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported.

Table 3: Results of the Fixed-Effects Regressions on the Determinants of UIP Deviations, continued

Panel C: Developing/Emerging Market Countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Per capita income (in PPP)	0.22	0.522	0.559	0.493	0.71	0.778	0.623	0.468	0.507
	[0.265]	[0.163]***	[0.216]**	[0.220]**	[0.251]***	[0.275]***	[0.284]**	[0.296]	[0.321][12%]
inflation rate		-0.793	-0.837	-0.764	-0.54	-0.611	-0.557	-0.422	-0.214
		[0.177]***	[0.189]***	[0.192]***	[0.300]*	[0.315]*	[0.316]*	[0.322]	[0.346]
inflation volatility		4.673	4.775	4.784	4.742	4.846	4.796	4.655	4.336
		[0.254]***	[0.264]***	[0.264]***	[0.304]***	[0.317]***	[0.318]***	[0.326]***	[0.371]***
Fin. develop. index			0.014	0.015	0.006	0.008	0.001	-0.007	-0.016
			[0.011]	[0.012]	[0.016]	[0.017]	[0.017]	[0.018]	[0.020]
Financial Openness				0.039	0.07	0.071	0.083	0.094	0.117
				[0.019]**	[0.023]***	[0.024]***	[0.025]***	[0.026]***	[0.029]***
Gov't budget surplus					-0.258	-0.284	0.069	0.013	0.28
					[0.583]	[0.649]	[0.666]	[0.664]	[0.762]
Trade (% of GDP)						-0.023	-0.03	0.029	0.09
						[0.121]	[0.121]	[0.129]	[0.139]
LEGAL (Legal/inst. develop.)							0.123	0.136	0.13
							[0.046]***	[0.047]***	[0.049]***
Dummy for								0.105	0.084
Crawling Peg Ex.R Regime								[0.062]*	[0.066]
Dummy for								0.124	0.108
Peg/Fixed Ex.R Regime								[0.089]	[0.093]
Dummy for Currency Crisis									0.178
									[0.080]**
Observations	298	298	269	264	218	204	197	197	171
Number of countries	37	37	36	36	34	34	33	33	25
Adjusted R-squared	-0.14	0.57	0.59	0.6	0.64	0.65	0.66	0.66	0.69

Notes: Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported.

Table 4: Results of the Fixed-Effects Regressions on the Determinants of UIP Deviations, by region

	Western Europe (1)	EURO countries (2)	East Asia & Pacific (3)	Latin America (4)
Per capita income (in PPP)	0.395	0.358	0.099	-1.29
	[0.158]**	[0.139]**	[0.252]	[0.732]*
inflation rate	-0.822	-0.259	0.893	-0.558
	[0.369]**	[0.424]	[0.427]**	[0.616]
inflation volatility	2.074	3.288	4.933	2.439
	[0.645]***	[0.676]***	[0.385]***	[0.661]***
Fin. develop. index	0.001	-0.005	-0.016	0.004
	[0.007]	[0.008]	[0.014]	[0.036]
Financial Openness	-0.027	-0.032	0.045	0.135
	[0.014]**	[0.012]***	[0.040]	[0.039]***
Government budget surplus	0.004	0.008	0.137	-0.547
	[0.103]	[0.107]	[0.110]	[0.576]
Trade (% of GDP)	0.646	1.221	-0.151	0.809
	[0.197]***	[0.251]***	[0.566]	[1.156]
LEGAL (Legal/inst. develop.)	-0.038	-0.024	0.092	-0.015
	[0.017]**	[0.014]*	[0.041]**	[0.079]
Dummy for	0.011	0.029	0.174	0.072
Crawling Peg Ex. R Regime	[0.025]	[0.042]	[0.081]**	[0.078]
Dummy for	0.058	0.046	0.117	-0.091
Peg/Fixed Ex. R Regime	[0.025]**	[0.032]	[0.084]	[0.118]
Dummy for Currency Crisis	0.100	-0.013	0.254	0.231
	[0.025]***	[0.028]	[0.063]***	[0.100]**
Observations	203	114	105	55
Number of countries	17	10	11	7
Adjusted R-squared	0.2	0.27	0.91	0.63

Notes: Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported.

Figure 1: Annualized Depreciation and Interest Differentials against US, for industrial countries (for depreciation and interest differential less than 50%).

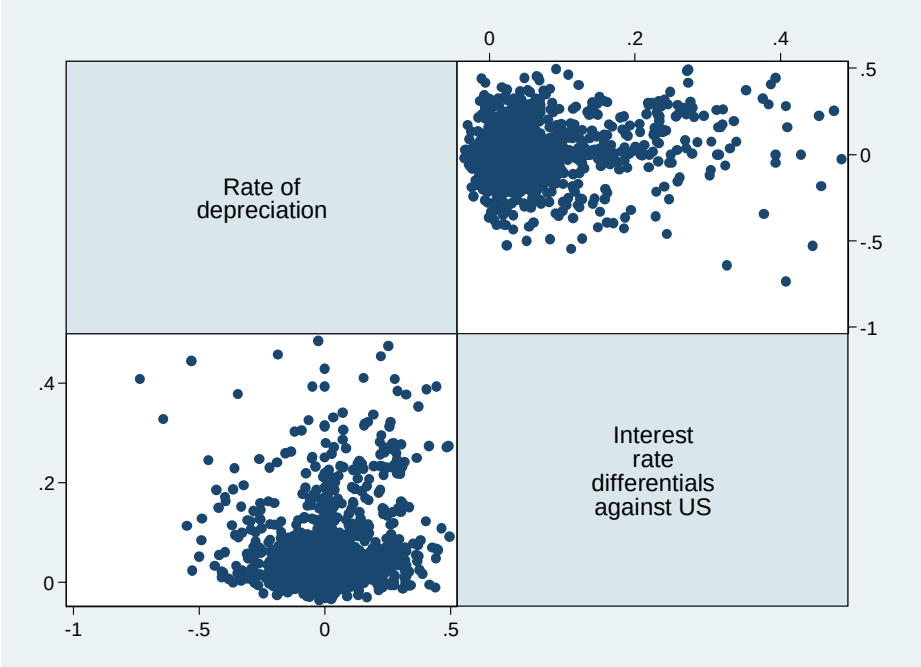

Figure 2: Annualized Depreciation and Interest Differentials against US, for non-industrial countries (for depreciation and interest differential less than 50%).

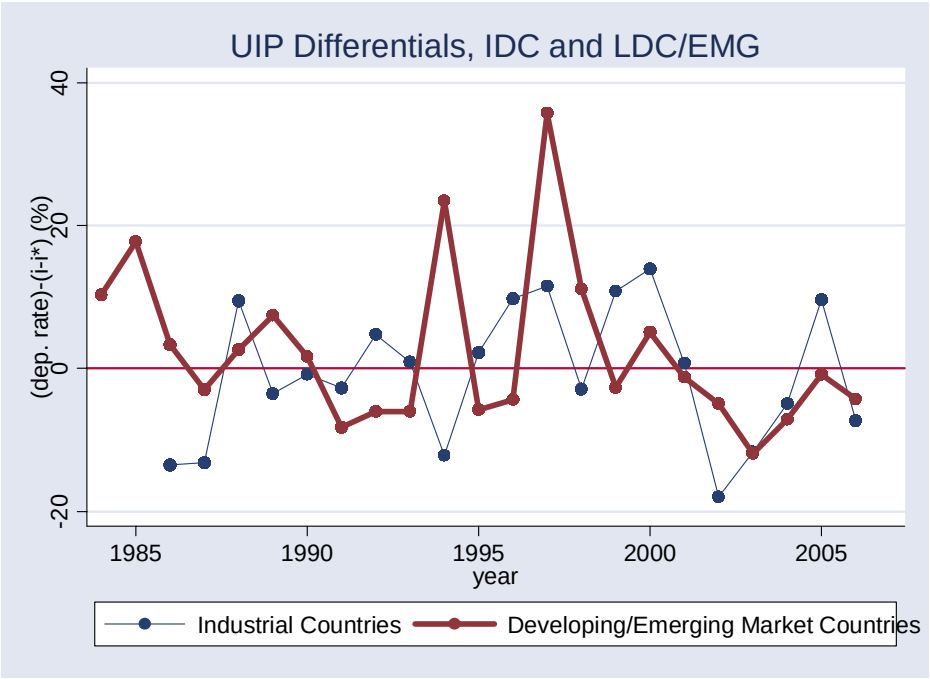

Figure 3: UIP differentials for Industrial and Developing/Emerging Market Countries (unbalanced)

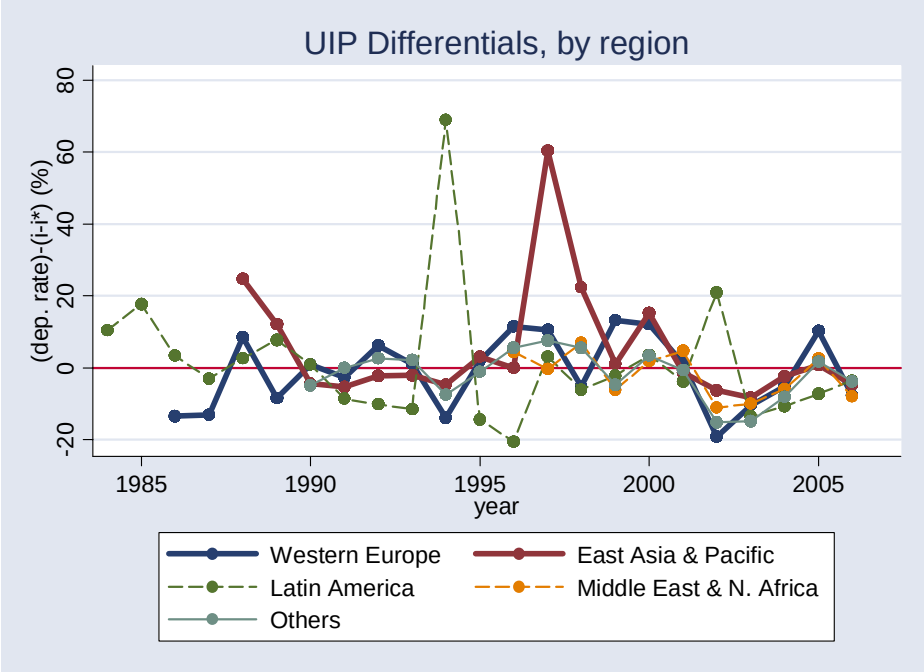

Figure 4: UIP Differentials for Different Regions (unbalanced)