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PRICE-BASED MEASUREMENT OF FINANCIAL GLOBALIZATION: A CROSS-COUNTRY STUDY OF INTEREST RATE PARITY BY

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Abstract. We characterize the relationship between ex post exchange rate depreciation and the interest differential for both developed and emerging market economies. The measured ex post uncovered interest differentials in terms of both levels and absolute values are then related to a set of variables that capture macroeconomic and policy conditions. We find that a wide diversity in the coefficient relating depreciations and interest differentials can be attributed to differences in inflation volatility, financial development, capital account openness, legal development and the nature of the exchange rate regimes. The robust results are mainly found in the emerging market country grouping.

1. INTRODUCTION

The evidence of financial globalization is everywhere. Capital flows are unprecedentedly large. 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 on the 'carry trade'.

In this study, we document the extent to which uncovered interest parity (combined with the rational expectations hypothesis) holds around the world, across both developed and emerging market economies. In doing so, we can quantitatively assess the extent to which one particular – price based – aspect of financial globalization has progressed.

The first part of our study focuses on the coefficient relating ex post depreciation to the interest differential. With continuing globalization, we would expect to see increasing co-movement of these two variables, so that a typical investor could not obtain a higher rate of return in one country compared with another. To the extent that the point estimates associated with these types

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of tests of uncovered interest parity do not have a particular interpretation, in the second part of our empirical examination we focus on the ex post uncovered interest deviations; they perhaps decrease over time as globalization proceeds. Given that other factors might be changing over time as well, we investigate whether the deviations – and their absolute values – are changing in response to changes in observable macroeconomic and policy variables.

While there is a tendency to view the interest rate parity 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).

In Section 2, a framework for thinking about interest rates and exchange rates as they relate to interest rate parity conditions, is reviewed. Section 3 implements a series of time series regressions of ex post depreciations on interest differentials. Section 4 examines the empirical determinants of the ex post deviations from interest rate parity, as well as the absolute values of those deviations.

2. A FRAMEWORK FOR EXAMINING FINANCIAL GLOBALIZATION

The uncovered interest differential can be decomposed into

$$(i_{t,k} - i^*_{t,k}) \equiv [(i_{t,k} - i^*_{t,k}) - (f_{t,t+k} - s_t)] + (f_{t,t+k} - s^e_{t,t+k}) + \Delta s^e_{t,t+k}, \qquad (1)$$

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,

$$f_{t,t+k} - s_t = (i_{t,k} - i^*_{t,k}), \qquad (2)$$

that is, the forward discount equals the interest differential, then one can say that the ex ante uncovered interest parity (UIP) differential is driven by the existence of exchange risk premium, ς, that is defined as:

$$f_{t,t+k} = s^e_{t,t+k} + \eta_{t,t+k}. \qquad (3)$$

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,

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

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

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

expected exchange rate change equals the 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 $\hat{\imath}_{t,\,t+k}$ 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,

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

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:

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

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 $\hat{\imath}_{t,\,t+k}$, which by definition is orthogonal to all information known at time t, including the interest differential.

Unbiasedness is a weaker condition than 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.

[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.

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 (the 1990s for the emerging market economies, and later for transition economies) to 2006:4. The exchange rates were expressed in terms of domestic currencies, and the annualized three-month movements in exchange rates are regressed against differentials in onshore yields of corresponding maturity.[5]

Panel A of the table encompasses the industrial countries' currencies, while Panel B refers to non-industrial countries. 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 European Monetary System crises of the early 1990s. This explains, for instance, the very positive coefficient for the UK 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.[7]

Our panel regression estimates (reported in Table 2) indicate that, for both industrial country currencies and legacy currencies of the euro area before monetary union, the slope coefficient is highly positive.[8] For the former, the coefficient is 1.994, and for the latter 3.619. In both cases, the null of unity is rejected. These high coefficients are mainly 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? When the Fama regression is applied to the euro-dollar exchange rate and the euro money market rate, the coefficient is very negative and statistically significantly

[4] Similar results are cited in surveys by MacDonald and Taylor (1992) and Isard (1995).

[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) and Yilmaz (2005).

[7] Flood and Rose argue that the reason why UIP tends to work well during currency crises is that speculative attacks on a currency often prompt the monetary authority to raise the policy interest rate to defend the currency and that exact action is usually offset by a large expected currency depreciation.

[8] Regression estimations are conducted with country-fixed effects as well as time-fixed effects.

Table 1. Results of the 'Fama' Regressions

Panel A: Industrial countries

		$\hat{\beta}_i$	*Robust standard errors*	*F test for* H_0: $\alpha_i = 0$ *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†	–4.891	2.361**	3.13	0.06*	32	0.08

OLS point estimates. *, **, *** denotes significance at the 10%, 5% and 1% level. Constant terms in the regression are not reported. The joint significance for the null hypothesis that $\alpha_i = 0$ and $\beta_i = 1$ is tested and its Wald statistics and *p*-values are shown. † – The regression is applied to the euro-dollar exchange rate and the euro money market rate for the period of 1999:1–2006:4.

Panel B: Non-industrial countries

		$\hat{\beta}_i$	*Robust standard errors*	*F test for* H_0: $\alpha_i = 0$ *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

Table 1. Continued.

		$\hat{\beta}_i$	*Robust standard errors*	*F test for* H_0: $\alpha_i = 0$ *and* $\beta_i = 1$	*Prob. > F*	*# of Obs.*	*Adj.* R^2
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

OLS point estimates Robust standard errors in brackets. *, **, *** denotes significance at the 10%, 5% and 1% level. Constant terms in the regression are not reported. The joint significance for the null hypothesis that $\alpha_i = 0$ 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: $\alpha_i = 0$ *and* $\beta_i = 1$	*Prob. > F*	*# of Countries included*	*Adj.* R^2
1	Full	0.912	0.128***	0.43	0.62	59	0.04
2	Industrialized Countries (IDC)	1.994	0.410***	3.63	0.03***	21	0.11
3	Non-IDC (LDC)	0.797	0.168***	0.94	0.39	38	0.04
4	Asian Emerging Market Countries	0.823	1.162	0.02	0.98	9	0.03
5	Latin America	0.707	0.289**	0.7	0.50	7	0.09
6	Middle Eastern Countries	–2.173	1.114*	4.08	0.02**	3	0.10
7	Western European IDC	2.514	0.486***	7.06	0.000***	17	0.13
8	Euro countries – pre-Euro	3.619	0.893***	6.31	0.000***	10	0.13

Panel fixed effects point estimates. *, **, *** denotes significance at the 10%, 5% and 1% level. Constant terms in the regression are not reported. The joint significance for the null hypothesis that $\alpha_i = 0$ 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.

different from unity, partly reflecting the absence of a currency crisis for in the post-1998 period. (The regression result is reported at the bottom of Panel A.)

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

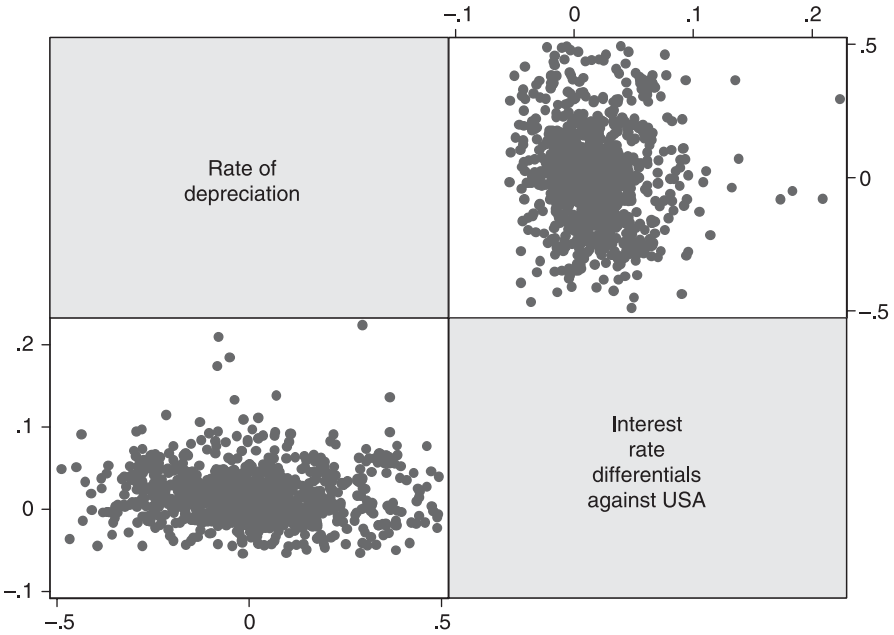

Figure 1. Annualized depreciation and interest differentials against the USA, for industrial countries (for depreciation and interest differential less than 50%)

Thailand to +3.3 for Indonesia (during a period spanning the financial crisis). Indeed, there is such a diversity of results that it is very difficult to discern any sort of pattern. There is no consistency in experiences across regional groupings (some East Asian economies have positive, and some have negative, coefficients), nor across transition country compared with other emerging market or developing country currencies. The lack of an obvious correlation between ex post depreciation rates and interest rate differentials is also confirmed by inspection of Figures 1 and 2.

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

4. DETERMINANTS OF DEVIATIONS

4.1. *Some hypotheses*

Return to equation (1), we do not, of course, observe the last term on the right hand side of the equation, but note that one could subtract the ex post depreciation from both sides of this equation to obtain

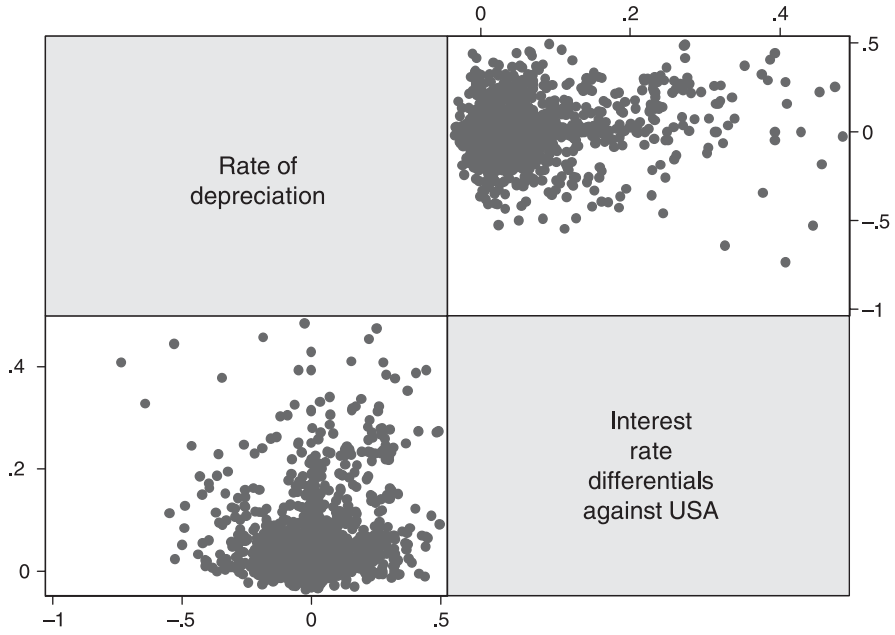

Figure 2. Annualized depreciation and interest differentials against the USA, for non-industrial countries (for depreciation and interest differential less than 50%)

$$(i_{t,k} - i^*_{t,k}) - \Delta s_{t+k} \equiv [(i_{t,k} - i^*_{t,k}) - (f_{t,t+k} - s_t)] + (f_{t,t+k} - s^e_{t,t+k}) - \{\Delta s_{t+k} - \Delta s^e_{t,t+k}\}. \quad (7)$$

We then define our ex post deviation as

$$DEV_{t,k} \equiv (i_{t,k} - i^*_{t,k}) - \Delta s_{t,t+k}.$$

This implies that the deviation is a function of the covered interest differential in square brackets, the exchange risk premium in parentheses and the negative of the forecast error in curled brackets. *DEV* will be our primary variable of interest in this section.

We also calculate the absolute value of this variable,

$$ADEV_{t,k} \equiv |(i_{t,k} - i^*_{t,k}) - \Delta s_{t,t+k}|.$$

We index these variables by currency, and generate annual variables as averages of the quarterly data. We then denote these annual averages with 'overbars'. $\overline{DEV}$ is shown in Figure 3. In the figure, $\overline{DEV}$ is used to make comparisons 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 negative territory when countries are experiencing crises. The two spikes for the non-industrial country group

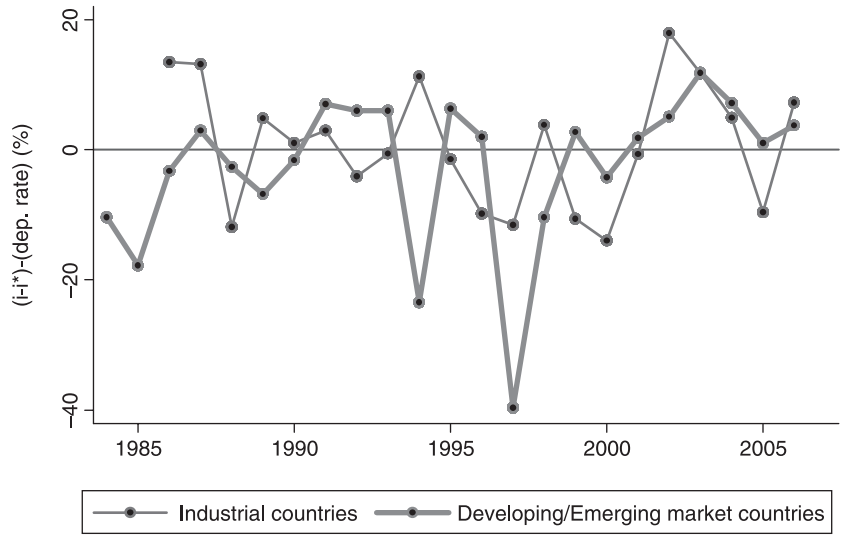

Figure 3. UIP differentials for industrial and developing/emerging market countries (unbalanced)

correspond to the tequila crisis of 1994 and the Asian crisis of 1997–98.[9] Contrary to the widespread view that globalization has driven interest parity deviations closer to zero, we cannot observe a clear, discernable trend of shrinking differentials. Figure 4 illustrates the cross-sectional standard deviation of interest parity deviations for the country pairs, data for which are available from 1998. The pattern is consistent with that displayed in Figure 3.[10] After experiencing a high level of volatility in the midst of the 1997–98 Asian crisis, interest parity differentials have become somewhat more stable, but in terms of the volatility, there does not seem to be any definitive trend.

Since we are interested in what factors contribute to the variability of interest parity deviations, we examine the determinants of both $\overline{DEV}_{i,t}$ and $\overline{ADEV}_{i,t}$.

We treat these constructed variables as data to be used in the following regressions,

$$\overline{DEV}_{i,\tau} = X_{i,\tau} B_D + u_{i,\tau} \tag{8}$$

and

$$\overline{ADEV}_{i,\tau} = X_{i,\tau} B_A + u_{i,\tau} \tag{9}$$

where τ indexes time in years.

[9] For industrial countries that experienced the EMS crisis in the early 1990s, one can make the same generalization. In Figure 3, however, large negative deviations of these countries are averaged out by other non-crisis countries.

[10] The figure illustrates the annual standard deviations of the original quarterly UIP deviations based on a balanced dataset for 37 countries (19 industrialized countries and 18 developing/emerging market countries).

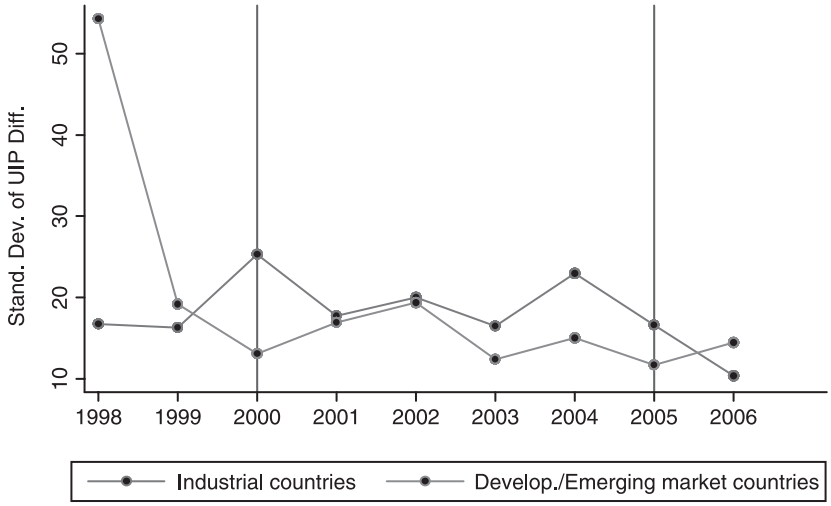

Figure 4. Volatility of UIP differentials for industrial and developing/emerging market countries (balanced)

We estimate the regressions in a panel time series context, using annual data and including time fixed effects. The estimation method is a robust regression which downweights outliers.[11]

We control for per capita income in all the regressions because it seems to proxy for many factors. Exclusion of per capita income does not change the results in any substantive way.

As we have already discussed in the context of equation (1), the deviations from the interest parity condition are composed of three types of deviations: covered interest differentials or political risk; the exchange risk premium; and the (negative of the) forecast error. Consequently, we can think of the determinants of these three entities as the determinants of the deviations from the interest parity condition (although each determinant might have offsetting effects on each individual component).

The first hypotheses we investigate is that these deviations are smaller – and ex post uncovered interest parity holds better – when monetary shocks are larger. However, if the monetary shocks are more volatile, the trend in inflation is more difficult to discern and the deviations will tend to be larger. Bansal and Dahlquist (2000) documented the importance of these factors. The variables for the rate and volatility of inflation should proxy for the degree to which expectations are likely to be unbiased and testing these variables is relevant to the forecast error component in equation (1). When inflation is high, expected

[11] We also implemented the regressions using panel OLS. The results were sensitive to the inclusion or exclusion of outliers, so we decided to focus on the robust regression results.

inflation is likely to be high. When inflation volatility is high, large expectational errors are more likely.

Second, the interest parity deviations might be a function of capital controls or capital account openness that affects covered interest differentials or political risk. To measure this, we use Chinn and Ito's (2006, 2007a) de jure capital account openness index (*KAOPEN*).[12] *KAOPEN* is based on information regarding restrictions in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* (*AREAER*). Specifically, *KAOPEN* is the first standardized principal component of the variables that indicates the presence of multiple exchange rates, restrictions on current account transactions, on capital account transactions and the requirement of the surrender of export proceeds. Higher values of this index indicate that a country is more open to cross-border capital transactions.[13]

If an exchange risk premium is driving a wedge between returns expressed in a common currency, then there are numerous other candidates. The portfolio balance literature, as surveyed by Frankel (1984) suggests outstanding stocks of government debt, denominated in different currencies, might be of relevance. Without data on a wide set of countries, we opt 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, based on the prior condition 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 cross-border capital flows). 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, we construct a composite index that measures the overall level of financial development. The index, *FD*, is the first principal component of private credit creation, stock market capitalization, stock market total value 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 economic openness and so may capture some aspects of de facto financial openness not captured by our de jure *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.

[12] There is by now a voluminous literature attempting to measure de jure or de facto impediments to free flow of capital. Because the de jure impediments are easier to document, this is where the greatest progress has been made. For a comparison across different indexes to measure the extent of capital account openness, refer to Chinn and Ito (2007a), Edison *et al.* (2002) and Kose *et al.* (2006).

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

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. As a proxy measure of legal/institutional development, we use *LEGAL*.[14]

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 'intermediate' exchange rate regime as well as for the fixed exchange rate regime, following the definitions by Levy-Yeyati and Sturzenegger (2005). See Data Appendix for construction of the dummy variables.

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 the US dollar and that the interest rate differentials are calculated against the US interest rate, all the explanatory variables, except for the dummy variables, are included as relative sizes to US levels. This way, we can identify the effects of individual currency countries.

4.2. *Empirical results*

We conduct the investigation in two steps. First, we examine the determinants of the level of the deviations. Second, we assess the factors that are important to the behaviour of the absolute value of the deviations. In each case, we analyse the full-sample results, then stratify by the level of economic development of the home country (the USA is always defined as the foreign country).[15]

Panel A of Table 3 reports the results of the regression specifications described above, for a sample spanning all country currencies. It is important

[14] *LEGAL* is the first principal component of anti-corruption measures (*CORRUPT*), bureaucratic quality (*BC*) and law and order (*LAO*). Higher values of this variable indicate higher levels of legal and institutional development. *CORRUPT*, *BC* and *LAO* are extracted from the ICRG dataset. See, for example, Chinn and Ito (2006).

[15] For the countries that adopted the euro, the interest parity differential is calculated using the legacy currencies and domestic money market rates up to the year before the adoption. From 1999 on, only the differentials calculated using the euro-dollar exchange rate and the three-month euro money market rate are included instead of the differentials of individual member countries. For such differentials, the regressors are the averages of the member countries' variables (inflation rate and volatility, financial openness and budget balances) or figures based on regional aggregates (such as trade openness based on aggregate GDP, exports and imports).

Table 3. Results of the robust regressions on the determinants of interest parity deviations

Panel A: Full Sample

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Per capita income (in PPP)	–0.022	–0.013	–0.008	–0.001	–0.003	–0.003	0.017	0.031	0.031
	[0.005]***	[0.006]**	[0.007]	[0.008]	[0.008]	[0.008]	[0.012]	[0.013]**	[0.013]**
inflation rate		0.133	0.162	0.074	0.015	0.016	–0.008	0.006	0.003
		[0.050]***	[0.051]***	[0.053]	[0.056]	[0.056]	[0.056]	[0.059]	[0.060]
inflation volatility		0.215	0.199	0.247	0.28	0.279	0.296	0.259	0.273
		[0.109]**	[0.111]*	[0.112]**	[0.115]**	[0.115]**	[0.115]**	[0.121]**	[0.125]**
Fin. develop. index			–0.006	–0.006	–0.005	–0.005	-0.006	–0.007	–0.007
			[0.002]**	[0.003]**	[0.003]**	[0.003]*	[0.003]**	[0.003]**	[0.003]**
Chinn-Ito financial openness				–0.008	–0.008	–0.008	–0.006	–0.006	–0.006
index (*KAOPEN*)				[0.004]**	[0.004]**	[0.004]**	[0.004][13%]	[0.004]	[0.004]
Government budget surplus					0.164	0.165	0.144	0.151	0.155
					[0.109]	[0.110]	[0.109]	[0.122]	[0.122]
Trade (% of GDP)						0.000	0.000	0.000	0.000
						[0.001]	[0.001]	[0.001]	[0.001]
Legal/institutional develop.							–0.014	–0.02	–0.02
(*LEGAL*)							[0.006]**	[0.006]***	[0.007]***
'Intermediate' exchange rate								0.013	0.013
regime								[0.014]	[0.014]
Fixed exchange rate								0.005	0.005
regime								[0.010]	[0.010]
Currency crisis									–0.004
									[0.022]
Observations	554	547	512	502	456	456	448	424	422
Adjusted *R*-squared	0.4	0.42	0.44	0.43	0.42	0.42	0.43	0.41	0.41

Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported. Higher values of *KAOPEN* and *LEGAL*, indicate better conditions, that is, a more open capital account and more developed legal systems and institutions, respectively. For the definitions on the 'intermediate' and fixed exchange regime dummies, refer to Data Appendix.

Table 3. Continued.

Panel B: Industrial countries

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Per capita income (in PPP)	–0.038	–0.013	–0.013	–0.005	–0.071	–0.07	–0.065	–0.062	–0.062
	[0.027]	[0.029]	[0.031]	[0.033]	[0.039]*	[0.039]*	[0.041]	[0.044]	[0.044]
inflation rate		0.856	0.817	0.875	0.717	0.717	0.715	0.772	0.769
		[0.296]***	[0.305]***	[0.313]***	[0.326]**	[0.328]**	[0.330]**	[0.366]**	[0.368]**
inflation volatility		–0.51	–0.466	–0.552	–0.766	–0.754	–0.729	–0.538	–0.54
		[0.494]	[0.499]	[0.501]	[0.508]	[0.511]	[0.517]	[0.611]	[0.614]
Fin. develop. index			–0.004	–0.003	0.000	0.000	0.000	0.002	0.002
			[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.005]
Chinn-Ito financial openness				–0.003	–0.004	–0.004	–0.003	–0.001	–0.002
index (*KAOPEN*)				[0.006]	[0.007]	[0.007]	[0.007]	[0.009]	[0.009]
Government budget surplus					0.393	0.39	0.413	0.446	0.448
					[0.152]**	[0.153]**	[0.163]**	[0.181]**	[0.182]**
Trade (% of GDP)						0.000	0.000	0.000	0.000
						[0.001]	[0.001]	[0.001]	[0.001]
Legal/institutional develop.							–0.006	–0.008	–0.008
(*LEGAL*)							[0.011]	[0.012]	[0.012]
'Intermediate' exchange rate								–0.026	–0.026
regime								[0.020]	[0.020]
Fixed exchange rate								–0.001	–0.001
regime								[0.012]	[0.012]
Currency crisis									–0.004
									[0.029]
Observations	256	250	244	239	235	235	235	220	220
Adjusted *R*-squared	0.60	0.62	0.63	0.63	0.63	0.62	0.62	0.60	0.60

Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported. Higher values of *KAOPEN* and *LEGAL*, indicate better conditions, that is, a more open capital account and more developed legal systems and institutions, respectively. For the definitions on the 'intermediate' and fixed exchange regime dummies, refer to Data Appendix.

Table 3. Continued.

Panel C: Developing/emerging market countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Per capita income (in PPP)	–0.019	–0.011	0.000	0.008	0.01	0.012	0.037	0.06	0.057
	[0.008]**	[0.008]	[0.009]	[0.010]	[0.011]	[0.011]	[0.013]***	[0.013]***	[0.014]***
inflation rate		0.189	0.126	0.071	0.008	0.027	–0.005	0.002	0.015
		[0.053]***	[0.057]**	[0.059]	[0.062]	[0.062]	[0.059]	[0.057]	[0.059]
inflation volatility		0.217	0.295	0.324	0.38	0.346	0.37	0.289	0.238
		[0.116]*	[0.121]**	[0.122]***	[0.125]***	[0.125]***	[0.115]***	[0.115]**	[0.123]*
Fin. develop. index			–0.009	–0.011	–0.012	–0.007	–0.01	–0.011	–0.011
			[0.003]***	[0.004]***	[0.004]***	[0.005]	[0.004]**	[0.004]***	[0.004]**
Chinn-Ito financial openness				–0.006	–0.006	–0.003	–0.001	–0.003	–0.002
index (*KAOPEN*)				[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
Government budget surplus					0.069	0.087	–0.054	–0.035	–0.03
					[0.172]	[0.174]	[0.162]	[0.168]	[0.172]
Trade (% of GDP)						–0.017	–0.002	–0.007	–0.009
						[0.013]	[0.013]	[0.013]	[0.013]
Legal/institutional develop.							–0.029	–0.041	–0.039
(*LEGAL*)							[0.009]***	[0.010]***	[0.010]***
'Intermediate' exchange rate								0.05	0.051
regime								[0.016]***	[0.017]***
Fixed exchange rate								0.027	0.03
regime								[0.014]*	[0.015]**
Currency crisis									0.029
									[0.028]
Observations	298	297	268	263	221	221	213	203	201
Adjusted *R*-squared	0.23	0.3	0.29	0.3	0.27	0.27	0.33	0.39	0.37

Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported. Higher values of *KAOPEN* and *LEGAL*, indicate better conditions, that is, a more open capital account and more developed legal systems and institutions, respectively. For the definitions on the 'intermediate' and fixed exchange regime dummies, refer to Data Appendix.

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. 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. Bansal and Dahlquist (2000) document that countries with higher per capita income are more likely to deviate from UIP. However, as a home country's per capita income rises, the gap between the home country and the USA shrinks, which can result in a smaller risk premiums, that is, smaller interest parity deviations. Our analysis presents mixed results. With simpler models, higher income seems to shrink the size of the deviations. However, as more regressors are included, so does the sample size shrink and the opposite correlation seems to be true; countries with higher per capita income tend to deviate from the interest parity. Of course, this is a statement regarding the average level of the deviation, as distinct from the slope coefficient relating ex post depreciation to interest differentials, so there is no necessary inconsistency.

Augmenting the specification with two inflation variables – the level and the volatility of inflation – seems to affect the per capita income coefficient and improves the goodness of fit slightly. Higher inflation may indicate stronger financial shocks and, therefore, would make it easier for UIP to hold, that is, it should result in smaller deviations.[16] But no such correlation is found on the estimated coefficients of the inflation level. Higher inflation volatility, on the other hand, means higher inflation uncertainty and, therefore, causes more deviation from UIP. We find results consistent with this prediction persistently across different model specifications.

Financial development seems to reduce the deviation, as does greater financial openness, though only the former is found to be consistently significant across different model specifications. Inclusion of the Chinn-Ito capital account openness index (*KAOPEN*) increases the statistical significance associated with inflation volatility. However, the government's budget surplus does not seem to matter for the level of UIP deviations.

One interesting aspect is an increase in our measure of institutional – or legal – development tends to shrink the deviation. To the extent that political risk declines with institutional development, this outcome is consistent with our priors.

Interestingly, we do not find a statistically significant role for exchange rate regimes and financial crises. However, this result depends upon the estimation method. Using standard OLS yields significant coefficients here.

Moving to the country grouping results, we obtain countries a substantially different picture in the case of the industrial countries. The first observation is that, relative to the full sample, the proportion of variance explained rises,

[16] Stronger financial shocks can mean a higher predictability of inflation that can be well incorporated in both the nominal interest rate and exchange rate, leading to smaller deviations from UIP.

even as the number of statistically significant variables declines. This outcome arises because the deviations are smaller. However, with less cross-country and cross-time variation, fewer of the right hand side variables exhibit statistical significance.

Second, inflation rates tend to increase the size of deviations. The effect is fairly pronounced and seems to be relatively constant across specifications (about 0.8%, implying that each one percentage point increase in inflation relative to US inflation induces a 0.8 percentage point increase in the deviation). Almost no other variable has an impact, except the government budget surplus. In that case, the impact on the deviation is positive. One might have expected the opposite, in terms of the conventional portfolio balance story – a higher surplus means a smaller supply of government debt (holding all else constant), and hence a smaller exchange risk premium.

When the examination is restricted to the developing countries/emerging markets, one obtains lower proportions of the variation of the deviation to be explained. Inflation rates do not have a robust impact on the deviation, but inflation volatility does have a large positive, and statistically significant, impact. The latter is consistent with the deviations containing a large expectations-surprise component (although the importance of inflation volatility is also consistent with certain models of the exchange risk premium).

Financial development shrinks the size of the deviations. This effect is quite consistent in magnitude across specifications. In addition, the institutional variable (legal development) is also significant in this sample.

One interesting distinction between the results for the two country groups relates to the impact of exchange rate regimes. While regimes of more exchange rate fixity tend to be associated with greater more positive deviations in the developing country subsample, no similar finding is obtained for the industrial country subsample.

Turning to the examination of the absolute value of the deviations (results reported in Table 4), many statistically significant coefficients are obtained. We attribute this finding to the fact that many of the variables are probably operating on the components of the differential in offsetting directions. The statistical significance is likely to be due to the fact that there is wide variation in the full sample. The same characteristic is exhibited in the developing country subsample, but not in the industrial country subsample.

In the full sample, higher inflation and higher inflation volatility induces larger absolute deviations. Both financial development and financial openness are also associated with smaller deviations. As was the case in the previous analysis, what is true in the full sample is not necessarily true in the industrial country subsample. Rather, it is clear that the results for the full sample are mainly driven by the non-industrial country subsample.

First, although it does not have a consistent impact on the deviations in the industrial country grouping, inflation volatility does increase deviations in the less developed country grouping. Capital account openness shrinks the deviations in the full sample as well as the developing country subsample, but its effect is not significant in the industrial country grouping. The same observation can

Table 4. Results of the robust regressions on the determinants of interest parity deviations in absolute values

Panel A: Full sample

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Per capita income (in PPP)	0.02	0.03	0.04	0.048	0.054	0.054	0.035	0.049	0.046
	[0.005]***	[0.005]***	[0.006]***	[0.007]***	[0.007]***	[0.007]***	[0.011]***	[0.012]***	[0.012]***
inflation rate		0.108	0.099	0.071	0.068	0.068	0.096	0.081	0.083
		[0.047]**	[0.048]**	[0.050]	[0.051]	[0.051]	[0.051]*	[0.052]	[0.052]
inflation volatility		0.295	0.344	0.336	0.284	0.29	0.216	0.162	0.108
		[0.102]***	[0.103]***	[0.104]***	[0.105]***	[0.105]***	[0.105]**	[0.107]	[0.109]
Fin. develop. index			–0.009	–0.009	–0.007	–0.007	–0.008	–0.009	–0.009
			[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***
Chinn-Ito financial openness				–0.009	–0.011	–0.011	–0.011	–0.014	–0.014
index (*KAOPEN*)				[0.003]**	[0.004]***	[0.004]***	[0.004]***	[0.004]***	[0.004]***
Government budget surplus					–0.192	–0.191	–0.184	–0.081	–0.078
					[0.100]*	[0.100]*	[0.099]*	[0.108]	[0.107]
Trade (% of GDP)						0	–0.001	–0.001	–0.001
						[0.001]	[0.001]	[0.001]	[0.001]
Legal/Institutional develop.							0.013	0.01	0.011
(*LEGAL*)							[0.005]**	[0.006]*	[0.006]*
'Intermediate' exchange rate								–0.002	0.001
regime								[0.012]	[0.012]
Fixed exchange rate								–0.024	–0.023
regime								[0.009]***	[0.009]***
Currency crisis									0.051
									[0.019]***
Observations	554	547	512	502	456	456	448	424	422
Adjusted *R*-squared	0.21	0.23	0.25	0.22	0.24	0.24	0.24	0.25	0.26

Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported. Higher values of *KAOPEN* and *LEGAL*, indicate better conditions, that is, a more open capital account and more developed legal systems and institutions, respectively. For the definitions on the 'intermediate' and fixed exchange regime dummies, refer to Data Appendix.

Table 4. Continued.

Panel B: Industrial countries

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Per capita income (in PPP)	0.003	0.001	–0.001	–0.015	–0.044	–0.046	–0.037	0.002	0
	[0.020]	[0.022]	[0.024]	[0.025]	[0.030]	[0.030]	[0.031]	[0.034]	[0.033]
inflation rate		0.113	0.068	0.029	–0.137	–0.142	–0.238	0.142	0.161
		[0.221]	[0.234]	[0.240]	[0.248]	[0.249]	[0.253]	[0.280]	[0.278]
inflation volatility		–0.468	–0.453	–0.551	–0.733	–0.706	–0.515	0.421	0.35
		[0.369]	[0.384]	[0.384]	[0.385]*	[0.387]*	[0.396]	[0.467]	[0.464]
Fin. develop. index			0.001	0.000	0.000	0.000	0.001	–0.002	–0.002
			[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.004]	[0.004]
Chinn-Ito financial openness				0.002	0.002	0.002	0.002	–0.009	–0.008
index (*KAOPEN*)				[0.005]	[0.005]	[0.005]	[0.005]	[0.007]	[0.007]
Government budget surplus					0.074	0.076	0.165	–0.093	–0.096
					[0.116]	[0.116]	[0.125]	[0.138]	[0.137]
Trade (% of GDP)						0.000	0.000	–0.001	–0.001
						[0.000]	[0.000]	[0.001]	[0.001]
Legal/institutional develop.							–0.014	–0.004	–0.003
(*LEGAL*)							[0.009]	[0.009]	[0.009]
'Intermediate' exchange rate								0.035	0.037
Regime								[0.016]**	[0.015]**
Fixed exchange rate								0.013	0.012
Regime								[0.010]	[0.009]
Currency crisis									0.023
									[0.022]
Observations	256	250	244	239	235	235	235	220	220
Adjusted *R*-squared	0.63	0.61	0.59	0.57	0.6	0.59	0.59	0.55	0.56

Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported. Higher values of *KAOPEN* and *LEGAL*, indicate better conditions, that is, a more open capital account and more developed legal systems and institutions, respectively. For the definitions on the 'intermediate' and fixed exchange regime dummies, refer to Data Appendix.

Table 4. Continued.

Panel C: Developing/emerging market countries

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Per capita income (in PPP)	–0.007	0.002	0.02	0.032	0.031	0.031	0.038	0.048	0.046
	[0.008]	[0.008]	[0.008]**	[0.009]***	[0.010]***	[0.010]***	[0.012]***	[0.013]***	[0.013]***
inflation rate		0.177	0.097	0.061	0.049	0.048	0.043	–0.018	–0.015
		[0.054]***	[0.051]*	[0.053]	[0.054]	[0.054]	[0.056]	[0.053]	[0.055]
inflation volatility		0.177	0.309	0.324	0.254	0.252	0.245	0.391	0.378
		[0.117]	[0.108]***	[0.109]***	[0.108]**	[0.109]**	[0.108]**	[0.107]***	[0.114]***
Fin. develop. index			–0.017	–0.017	–0.014	–0.016	–0.016	–0.016	–0.014
			[0.003]***	[0.003]***	[0.003]***	[0.004]***	[0.004]***	[0.004]***	[0.004]***
Chinn-Ito financial openness				–0.012	–0.014	–0.015	–0.015	–0.012	–0.013
index (*KAOPEN*)				[0.004]***	[0.004]***	[0.005]***	[0.005]***	[0.005]***	[0.005]***
Government budget surplus					–0.079	–0.088	–0.08	0.193	0.214
					[0.149]	[0.151]	[0.152]	[0.157]	[0.160]
Trade (% of GDP)						0.005	0.008	0.017	0.015
						[0.011]	[0.012]	[0.012]	[0.012]
Legal/Institutional develop.							–0.009	–0.017	–0.017
(*LEGAL*)							[0.009]	[0.009]*	[0.009]*
'Intermediate' exchange rate								–0.013	–0.01
Regime								[0.015]	[0.016]
Fixed exchange rate								–0.063	–0.064
regime								[0.013]***	[0.014]***
Currency Crisis									–0.003
									[0.026]
Observations	298	297	268	263	221	221	213	202	201
Adjusted R-squared	0.02	0.1	0.21	0.22	0.2	0.2	0.21	0.33	0.32

Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported. Higher values of *KAOPEN* and *LEGAL*, indicate better conditions, that is, more open capital account, and more developed legal systems and institutions, respectively. For the definitions on the 'Intermediate' and Fixed exchange regime dummies, refer to Data Appendix.

be made about the effect of financial development. Institutional development – as measured by the *LEGAL* variable – appears to be somewhat anomalous. The effect of institutional development is significantly positive in the full sample. However, it is associated with smaller deviations in the industrial and developing country subsamples – though only significantly so for the latter – which is consistent with theoretical predictions. Overall, it might be the case that there is insufficient variability in the industrial country grouping to capture interesting effects.

One interesting divergence we detect is that the greater rigidity of an exchange rate regime has negative effects on the absolute deviation for developing countries while having no significant effects among industrial countries.[17] We conjecture that for emerging markets, the largest effect of the fixed exchange rate regime is to reduce exchange rate forecast errors, whereas for industrial countries, there is no such effect.

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 extents of financial integration as is the case in Western Europe and, to some extent, East Asia. For this purpose, we apply specification (9) in Table 4 to regional samples and conduct the estimation using absolute interest parity deviations.

Table 5 presents the results for Western Europe, East Asian and Pacific developing countries and Latin American countries. It is no surprise that the Western Europe subsample exhibits results similar to that of the industrial country groupings. Latin America's results appear to be different from the results for East Asia and the Pacific, although the coefficients are not often statistically significant – an unsurprising outcome given the small sample size of the former.

Interestingly, for East Asian and Pacific developing countries, financial and trade openness and government budget surplus are found to be significant determinants, but all with wrong signs. Countries with somewhat managed or fixed exchange rate regimes tend to have smaller interest parity deviations, possibly reflecting an easier predictability of exchange rate movements. While higher inflation and higher per capita income also contribute to smaller deviations, financial development has a significantly negative effect on the deviation. Lastly, the significantly negative coefficient on the crisis dummy (with a relatively large magnitude) is consistent with the finding of Flood and Rose (1996, 2002). Considering that this sample includes the countries that experienced the Asian crisis, namely Indonesia, Malaysia, and the Philippines, crisis episodes do seem to bring countries' currency behaviour more into line with the parity condition.

[17] This finding is not intuitive given Frankel and Poonawala's (2006) finding that the more managed the currency regime, the more marked the rejection of the unbiasedness hypothesis. However, what this result indicates is that deviations could be small, but still be negatively correlated with interest differentials and vice versa.

Table 5. Results of the Robust Regressions on the Determinants of Interest Parity Deviations, by region

	Western Europe (1)	*Developing East Asia & Pacific* (2)	*Latin America* (3)
Per capita income (in PPP)	–0.036	–0.091	0.089
	[0.034]	[0.016]***	[0.067]
inflation rate	0.317	–0.263	0.258
	[0.242]	[0.102]**	[0.419]
inflation volatility	–0.611	–0.01	0.643
	[0.423]	[0.107]	[0.486]
Financial development index	–0.007	–0.006	0.114
	[0.003]**	[0.004]*	[0.056]*
Chinn-Ito financial openness	0.007	0.023	0.003
index (*KAOPEN*)	[0.006]	[0.006]***	[0.013]
Government budget surplus	–0.05	0.214	–0.551
	[0.129]	[0.126]*	[1.000]
Trade (% of GDP)	0.024	0.029	0.143
	[0.014]	[0.010]***	[0.171]
Legal/institutional develop.	0.001	0.011	–0.073
(*LEGAL*)	[0.007]	[0.007]	[0.034]**
'Intermediate' exchange rate	0.04	–0.035	0.019
Regime	[0.012]***	[0.011]***	[0.048]
Fixed exchange rate	0.006	–0.054	–0.01
Regime	[0.008]	[0.012]***	[0.056]
Currency crisis	0.032	–0.18	–0.026
	[0.016]**	[0.018]***	[0.074]
Observations	157	79	53
Adjusted *R*-squared	0.78	0.86	0.47

Standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. Constant terms are not reported. Higher values of *KAOPEN* and *LEGAL*, indicate better conditions, that is, a more open capital account and more developed legal systems and institutions, respectively. For the definitions on the 'intermediate' and fixed exchange regime dummies, refer to Data Appendix.

5. CONCLUSION

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 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.

Our analysis has highlighted the fact that the coefficient from the Fama regression is not always informative with respect to ex post interest parity deviations. Factors that tend to correlate with failure to reject the UIP null hypothesis sometimes correlate with larger – not smaller – interest parity deviations.

Some of our results are intuitive. We find that financial development, capital account openness, and legal/institutional development negatively affect deviations from UIP, as theory suggests, but only for developing/emerging market countries.

Another key finding is that the results depend – sometimes in surprising ways – on how wide the sample is. In general, the industrial country results are distinct from the full sample and developing country sample results. This suggests that the lower degree of variability in the industrial country variables makes it harder to identify the strength of certain relationships.

We also examined the determinants of the absolute value of interest parity deviations between different regions, namely Western Europe, developing East Asia and the Pacific, and Latin America. Our findings suggest that, despite some anomalous results, some variables appear to behave consistently with theoretical predictions. More specifically, while higher levels of per capita income and the volatility of inflation tend to increase the size of interest rate parity deviations in absolute terms, higher levels of financial development, financial openness and legal development tend to reduce it. Also, the countries that experience a currency crisis tend to exhibit smaller deviations, as past studies have suggested.

While we have shed some light upon the cross-country, and cross-regional, variation in how ex post changes in exchange rates co-vary with interest differentials, we have by no means answered all questions. Nonetheless, in documenting how differentials vary with observable factors, we have hopefully set the stage for more research into the reasons why rates of return expressed in common currency terms have not been equalized.

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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 three-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	Argentina	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	Colombia	Jan. 1984	Feb. 2007
12	Croatia	Jan. 2001	Feb. 2007
13	Czech Republic	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	South Africa	Feb. 1999	Feb. 2007

	Country	*Starting*	*Ending*
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	UK	Jan. 1987	Feb. 2007
61	USA, 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 the updated database for the classification used by Levy-Yeyati and Sturzenegger (2005). 2005 classifications are based on 2004 data. The dummy for the 'fixed exchange rate regime' is assigned a value of one if the Levy-Yeyati-Sturzenegger (LYS) index takes the value of '5 = fix.'. The dummy for the 'intermediate exchange rate regime' is assigned a value of one if the LYS index takes the value of either '4 = dirty/crawling peg' or '3 = dirty'.

The financial development index (*FD*) is the first principal component of private credit creation (*PCGDP*), stock market capitalization (*SMKC*), stock market total value (*SMTV*) 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.