MPRA

Munich Personal RePEc Archive

The Economics of Uncovered Interest Parity Condition for Emerging Markets: A Survey

Alper, C. Emre; Ardic, Oya Pinar and Fendoglu, Salih

Bogazici University

30. May 2007

THE ECONOMICS OF UNCOVERED INTEREST PARITY

CONDITION FOR EMERGING MARKETS: A SURVEY

C. Emre Alper,* Oya Pinar Ardic and Salih Fendoglu

Department of Economics,Bogazici University, Bebek 34342, Istanbul, Turkey.

May 30, 2007

Abstract

Financial account liberalizations since the second half of the 1980s paved way for the burgeoning literature that investigates foreign exchange market efficiency in emerging markets via testing for the uncovered interest parity (UIP) condition. This paper provides a broad and critical survey on this recent literature as well as a general understanding on the topic through reviewing the related literature on developed economies where recent methodological advances in time series econometrics have provided favorable results, questioning the previously documented UIP puzzle. The literature on emerging markets suggests that these countries deserve a special treatment by taking into account the existence of additional types of risk premia, high inflation episodes, financial contagion, peso problem, simultaneity problem, asymmetricity, and the determination of *de facto* structural breaks.

Keywords. Uncovered Interest Parity; Forward Premium Bias; Emerging Markets.

JEL No. F31.

---

*Corresponding author. Tel: +90 (212) 359-7646. Fax: + 90 (212) 287-2453. E-mail: alper@boun.edu.tr.

1 Introduction

The uncovered interest parity (UIP) condition, a cornerstone in assessing foreign exchange market efficiency, has confronted a vast number of empirical tests which have produced unfavorable results until recently.[1] The UIP condition is a no-arbitrage condition between investing in a domestic currency denominated asset and a foreign currency denominated asset such that

$$(1 + i_{t,k}) = \left(1 + i_{t,k}^*\right) \frac{S_{t+k}^e}{S_t} \tag{1}$$

where $i_{t,k}$ and $i_{t,k}^*$ are the interest rates on domestic and foreign currency denominated assets with k periods to maturity respectively, S_t denotes the nominal exchange rate as the domestic currency value of one unit of foreign currency at time t, and S_{t+k}^e denotes the current market expectation of the nominal exchange rate of $t + k$ given all available information at t.

A proper documentation of the assumptions underlying this equation is crucial in interpreting the empirical evidence on the UIP condition. These assumptions can be stated as follows: investors are risk neutral; transaction costs are negligible; underlying assets are identical in terms of liquidity, maturity and default risk; and there is a sufficient number of investors with ample funds available for arbitrage.

Previous empirical literature reaches an estimable UIP condition by log-approximation of equation (1) and imposing rational expectations:[2]

$$\Delta_k s_{t+k} = i_{t,k} - i_{t,k}^* \quad \text{where} \quad \Delta_k s_{t+k} = s_{t+k} - s_t. \tag{2}$$

The UIP condition, hence, can be assessed empirically through estimating

$$\Delta_k s_{t+k} = \beta_0 + \beta_1 (i_{t,k} - i_{t,k}^*) + u_{t+k} \tag{3a}$$

and testing the joint hypothesis of $\beta_0 = 0$, $\beta_1 = 1$, and u_{t+k} is orthogonal to the information available at t. In addition, assuming the covered interest parity (CIP) condition, i.e. $f_t^k -$

$s_t = i_{t,k} - i^*_{t,k}$, where f^k_t denotes the k-period forward exchange rate at t, one can test for the UIP condition through estimating

$$\Delta_k s_{t+k} = \beta_0 + \beta_1(f^k_t - s_t) + u_{t+k} \tag{3b}$$

and testing the same hypothesis as above.[3]

Earlier empirical literature on the UIP condition mostly focuses on developed economies rather than emerging markets because of lack of data. Recently, increases in the degree of financial liberalization in emerging markets enabled many researchers to analyze foreign exchange market efficiency in these economies. It is the lack of a comprehensive survey reviewing this recent literature that motivates this study.

Briefly, our reading of the literature highlights the following points: For developed economies, the recent literature on the UIP condition benefitting from the recent advances in time-series econometrics provides favorable results. This literature suggests that the UIP puzzle documented by the previous studies can in fact be a statistical artifact. For emerging markets, the empirical literature on the UIP condition reveals that these countries indeed deserve a special treatment due to emerging-market-specific macroeconomic conditions including incomplete institutional reforms, weaker macroeconomic fundamentals, and shallow financial markets. The conditions that merit special treatment while testing for the UIP condition for emerging markets are the existence of additional types of risk premia, peso problem, simultaneity problem, financial contagion, high inflation episodes, asymmetricity, and the determination of *de facto* structural breaks, to name a few. We will focus on these points in the text.

The rest of the paper proceeds as follows: The next section provides a general understanding of the UIP condition through examining the literature on developed economies, Section 3 presents the related work on emerging market economies, and Section 4 concludes.

2 Uncovered Interest Parity and Developed Economies

Earlier empirical evidence for developed economies within the context of the UIP condition is generally unfavorable. Specifically, the majority of the papers documented the so-called "forward premium bias" (or forward discount anomaly), that is, the forward premium predicts the spot exchange rate movement in the wrong direction, i.e. β_1 is negative in equation (3b).[4] This result is by and large robust to the estimation techniques and the data set, as exposed in the surveys of Froot and Thaler (1990), Taylor (1995), Lewis (1995), Engel (1996), Sarno (2005), Chinn (2006) and Isard (2006). Froot and Thaler (1990) report only few studies where β_1 in equation (3b) is positive and even in those, the estimates are less than the hypothesized value of one. Lewis (1995) emphasizes that accounting for discrete changes in the economic environment may improve the empirical results. Engel (1996) highlights the existence of time-varying risk premium as a source of forward premium puzzle, and reports the limited success of the risk premium literature in explaining the forward premium bias. Sarno (2005) reviews the literature that focuses on nonlinear dynamics of deviations from the UIP condition and that incorporates term structure models. Chinn (2006) analyzes the robustness of the results with respect to the time horizon.

Traditionally, departures from the UIP condition are attributed to non-rationality of market expectations and/or risk aversion of agents that demand a premium for investing in "risky" assets. Essentially, these two are tested jointly while estimating equation (3a) or (3b), and a rejection of the UIP condition implies that rational expectations and/or risk neutrality assumptions do not hold.

In addition to the aforementioned "text-book" reasons, it is possible to state other reasons for the unfavorable empirical evidence for the UIP condition. These include existence of transaction costs, possible effects of central bank interventions, existence of limits to speculation, and the possibility that investors may care for real rather than nominal returns.[5]

We next analyze each of these potential sources of deviations from the UIP condition

briefly, first by focusing on what we call as "traditional/text-book" reasons that undermines the UIP condition. Thereafter, we present studies benefiting from recent methodological advances that may shed light on the highly stylized forward premium bias.

(i) Rational expectations assumption does not hold, i.e. $s_{t+k} = E[s_{t+k}|I_t] + \eta_{t+k}$ where the forecast error η_{t+k} depends on the information available at time t, which yields excess returns even when agents are risk-neutral. In particular, under such non-rational expectations, we have the following UIP regression:

$$\Delta_k s_{t+k} = \beta_0 + \beta_1(f_t^k - s_t) + \eta_{t+k} + u_{t+k} \tag{4}$$

where u_{t+k} is a white-noise disturbance term. Both the experimental (see Marey, 2004a-b, and references therein) and survey evidence (see MacDonald, 2000; and Pesaran and Weale, 2006; for a review of this literature) on the formation of market expectations of the exchange rate reveals that market participants form their expectations in a non-rational way.

(ii) Risk neutrality assumption does not hold and risk-averse investors demand a premium for holding assets that are perceived to be risky. Accordingly, defining the risk premium as $\rho_t = f_t^k - s_{t+k}^e$ within the context of equation (3b), the risk-premium adjusted UIP condition can be stated as

$$\Delta_k^e s_{t+k} = \beta_0 + \beta_1\left(f_t^k - s_t\right) - \rho_t + u_{t+k} \tag{5}$$

where u_{t+k} is a white-noise error term. Since tests for the UIP condition involve a joint hypothesis that comprises of rational expectations and risk-neutrality, one can use survey-based expected depreciation data to isolate the effect of risk neutrality. In this vein, for instance, MacDonald (2000), and Chinn and Frankel (2002) rely on survey-based data on the bilateral US dollar exchange rate for different forecast horizons, and document that the UIP slope coefficient is significantly different from one, justifying the presence of a time-varying risk premium.

Next, we consider the literature on the "not-so-traditional" reasons for the observed deviations from the UIP condition. As aforementioned, a more complete picture can be

drawn by accounting for transaction costs (Hollifield and Uppal, 1997; Verdelhan, 2006), possible effects of central bank interventions (McCallum, 1994; Anker, 1999; Christensen, 2000; Baillie and Osterberg, 2000; Alexius, 2002; Chinn and Meredith, 2004; Mark and Moh, 2007), existence of limits to speculation (Lyons, 2001; Villanueva, 2005; Sarno et al. 2006), and the possibility that investors may care for real rather than nominal returns (Engel, 1996).

In a general equilibrium setting, along with Dumas (1992), Hollifield and Uppal (1997) show that the segmentation of international commodity markets through proportional transaction costs drives the β_1 coefficient downward. However, they also document that this transaction cost cannot account for the forward premium bias in its entirety. In particular, the negative estimates of β_1 observed in the empirical literature cannot be replicated by these models even in the presence of unrealistically high transaction costs and extreme risk aversion parameters. Verdelhan (2006) uses slow-moving external habit preferences (following Campbell and Cochrane, 1999) together with time-varying risk-free rates and transaction costs, and demonstrates that forward premium bias can be rationalized by such a model, regardless of the type of transaction cost.

The existence of central bank interventions may also distort the UIP condition. In particular, as McCallum (1994) highlights, monetary authorities' reaction to exchange rate movements through policy rates leads to the joint determination of the expected depreciation and the interest rate differential. In the context of empirical applications of the UIP condition, this implies a simultaneity bias, causing lower and possibly negative β_1 estimates. Christensen (2000), however, documents that negative β_1 estimates cannot only be justified by the estimated parameter values of the monetary policy reaction function suggested by McCallum. Chinn and Meredith (2004) extend McCallum's model by including output and inflation in the monetary policy reaction function and document that deviations from the UIP condition are primarily due to monetary policy reactions to temporary disturbances in the exchange rate. In a parallel vein, Alexius (2002) constructs a model in which a central bank minimizes an expected discounted loss function which comprises of recent inflation,

6

output and interest rate movements. Her results suggest a negative β_1 coefficient when the central bank pursues interest rate smoothing. Moreover, Mark and Moh (2007) develop a continuous-time model of UIP in which central banks' policies to contain interest differential within a certain band can lead to forward premium bias. They are able to corroborate the empirical evidence that forward premium bias intensifies during periods in which central banks are intervening. In addition, Anker (1999) documents that a pure interest rate smoothing policy of a central bank cannot account for the observed forward premium bias in its entirety. Baillie and Osterberg (2000) estimate the effect of interventions in the foreign exchange market by central banks on the level and variance of *ex post* deviations from the UIP condition within a FIGARCH framework. They report for the U.S. and Germany that these interventions drive excess currency returns over the UIP-implied level for some certain sub-periods.[6]

Limits to speculation hypothesis (LSH) suggests that investors engage in a specific trading strategy only if that strategy yields a sufficiently large excess return per unit of risk (Sharpe ratio). This hypothesis suggests the possibility of a band of inaction in which the forward premium bias does not imply a profitable opportunity to exploit (Lyons, 2001; Sarno et al., 2006). This implication of LSH is confirmed by Villanueva (2005). In particular, Villanueva documents that spot exchange rate undershoots in response to a positive interest differential shock, which is possibly due to the aforementioned band of inaction.

When rational risk-neutral agents care about real rather than nominal returns on financial assets, then the no-arbitrage condition for the forward exchange market becomes

$$E_t \left[\frac{F_t^k - S_{t+k}}{\pi_{t,t+k}} \right] = 0.$$

where $\pi_{t,t+k}$ is the k-period domestic inflation. Under the assumption that all the variables are log-normally distributed, the basic estimable UIP equation (3b) becomes:

$$\Delta_k s_{t+k} = \beta_0 + \beta_1 \left(f_t^k - s_t \right) + \theta_1 \text{var}_t(s_{t+k}) + \theta_2 \text{cov}_t(s_{t+k}, \pi_{t+k}) + u_{t+k} \qquad (6)$$

where the variance and covariance terms arise from Jensen's inequality, and u_{t+k} is white noise. Yet, many researchers have reported insignificant Jensen's inequality terms (JIT),

7

and document that omitting JIT does not cause any problems empirically (Frankel, 1993; and for a survey Engel, 1996). Nevertheless, if JIT are found to be significant, which is more probable for a relatively volatile economy, then the omission may cause biased β_1 estimates.

As a result of recent advances in time series econometrics, a number of studies show that forward premium bias can be treated as a statistical artifact rather than an economic puzzle, and hence argue that UIP works better than it seems.

Recent papers report favorable results for extremely short investment horizons or long-term maturities, suggesting that previous unfavorable results are confined to mid-horizons or -maturities only. Chaboud and Wright (2005) report favorable results for the UIP condition for intra-day frequencies, while Alexius (2001), Chinn and Meredith (2005) and Chinn (2006) conclude that temporary disturbances to the UIP condition abate over maturities longer than a year. These imply that, for extremely short investment horizons, exchange rate risks vanish whereas for long horizons, the effects of monetary policy actions, the volatility of risk premia, and market expectations are lessened.

Baillie and Bollerslev (2000) argue that earlier rejections of the UIP condition are mostly due to factors such as small-sample bias, unstable β_1 estimates over different sub-periods, and high persistence in forward premium. Similarly, Maynard and Phillips (2001) demonstrate that differences in the persistence of exchange rate changes and of forward premia may induce forward premium bias. Specifically, OLS estimation of the UIP condition with a stationary dependent variable and a near-unit root regressor induces a left-tailed limiting distribution, which in turn causes β_1 to converge to zero. Liu and Maynard (2005) argue that high persistence in forward premium can provide a partial explanation of the bias. Through a stochastic partial break model, Sakoulis and Zivot (2005) show that ignoring structural breaks may cause spurious persistence in forward premium, which may result in forward premium bias. Similarly, Choi and Zivot (2007) show that accounting for structural breaks significantly reduces the observed persistence in the forward premium. Hence, the frequently observed forward premium bias may be a statistical artifact, resulting from estimating unbalanced test regressions, or disregarding structural breaks, or both.

Linear estimation of the UIP condition may also cause a forward premium bias when the true data generating process reveals strong nonlinearity, which is confirmed by smooth transitive regression (STR)estimations of Sarno et al. (2006) and Baillie and Kilic (2006). Using excess currency return as the transition variable, Sarno et al. show that forward premium bias becomes persistent yet economically small as the expected exchange rate change is closer to the UIP-implied level. Baillie and Kilic (2006) use lagged/risk-adjusted forward premium as the transition variable and conclude that forward premium bias occurs when the premium is small and/or negative and UIP is less likely to be rejected when the premium is larger. These results favoring nonlinearity/asymmetricity within the UIP context are also in line with the earlier literature documenting that positive versus negative (Bansal, 1997; Bansal and Dahlquist, 2000), and normal versus extreme (Huisman et al., 1998) forward premia/interest differential deserve different treatments. In particular, through empirical analyses, Bansal, and Bansal and Dahlquist show that the UIP condition is more likely to hold when the interest differential is negative, whereas Huisman et al. report that for extreme and positive forward premia, the UIP condition cannot be rejected. Hence, the stylized substantial departures from the UIP condition may not mean foreign exchange market inefficiency when the data shows strong nonlinearity.

Albuquerque (2006) estimates equation (3b), treating forward premium as endogenous, and using lagged values of forward premia and interest rates as instruments. The results of two and three-stage least squares with time-varying fixed effects reveal positive and significant slope coefficients, weakening the forward premium bias.

In addition, Maynard (2006) questions the conventional regression-based analyses and directly tests the forward rate unbiasedness hypothesis using sign and covariance-based tests, and reports that the previously documented forward premium puzzle may in fact be a statistical artifact.

To sum up, the existence of persistent deviations from the UIP condition has remained a highly debated topic in international finance. In particular, earlier literature documents that the forward premium/interest differential predicts the movements in the exchange rate

9

in the wrong direction. Yet, recent studies show that the problem is mostly confined to the mid-horizon investments only. Employing methodological advances, recent literature reveal that the puzzle may in fact be a statistical artifact, i.e. ignoring structural breaks, confining the UIP estimation to a linear framework, and ignoring high persistence in the data may lead to spuriously unfavorable results within the context of the UIP condition.

3 Uncovered Interest Parity and Emerging Market Economies

Many emerging markets have begun liberalizing their financial accounts in the late 1980s and the early 1990s, as seen in Table 1.[7] However, their degrees of financial liberalization are still by and large less than those observed in developed economies.[8] Emerging market economies are mostly characterized by incomplete institutional reforms, relatively volatile economic conditions, weaker macroeconomic fundamentals and shallow financial markets. Since the UIP condition holds under the assumptions of perfect capital mobility, risk neutrality, identical assets in terms of liquidity, maturity and default risk, and negligible transaction costs, each of these characteristics, then, may contribute to deviations from the UIP condition for these economies. Loosely speaking, incomplete institutional reforms may contribute to higher default risks and positive transaction costs, whereas relatively volatile economic conditions and weaker macroeconomic fundamentals may contribute to higher currency and default risks both in magnitude and volatility. In light of these, it is plausible to expect that the UIP condition is less likely to hold in emerging markets than in developed economies.

We first survey the comparative empirical literature on developed and emerging market economies within the context of the UIP. This strand of literature attempts to shed light on whether emerging markets and developed economies should be differentiated within the context of UIP estimations. After underlining these differences, we provide a detailed discussion for each item.

Bansal and Dahlquist (2000), Flood and Rose (2002) and Frankel and Poonawala (2006)

Country	De jure Liberalization Date	Country	De jure Liberalization Date
Argentina	Nov-89	Malaysia	Dec-88
Bangladesh	Nov-89	Mexico	May-89
Brazil	May-91	Pakistan	Feb-91
Chile	Jan-92	Phillippines	Jun-91
Columbia	Feb-91	South Africa	Nov-96
Egypt	Nov-91	Sri Lanka	Jan-91
Greece	Dec-87	Taiwan	Jan-91
India	Nov-92	Thailand	Sep-87
Indonesia	Sep-89	Trinidad and Tobago	Apr-94
Jamaica	Sep-91	Tunisia	Jun-95
Jordan	Dec-95	Turkey	Aug-89
Kenya	Jan-95	Venezuela	Jan-90
Korea	Jan-92	Zimbabwe	Jun-93

Source: Bekaert et al. (2002) and country sources.

Table 1: *De jure* liberalization dates of major emerging markets

take the structural differences between emerging markets and developed economies into account in their estimations, and contrary to initial expectations, document less unfavorable results for emerging markets. In particular, Bansal and Dahlquist (2000) study a total of 28 developed and emerging economies using monthly data for the period 1976-1998 and report that UIP deviations lessen for countries with lower per capita GNP, lower credit ratings, higher average inflation and higher inflation volatility. Using higher data frequencies, Flood and Rose (2002) test for the UIP condition for 13 developed and 10 emerging market economies for the 1990s and also report favorable results for high-inflation economies and those countries who experience at least one exchange rate regime switch throughout the sample period. Using forward market data for emerging markets, Frankel and Poonawala (2006) analyze the forward premium bias explicitly for a set of 21 developed and emerging market economies for the period December 1996-April 2004 and document that forward premium bias is less severe in emerging markets.[9]

There are several issues arising from these studies: First, so far there is no empirical support for the *a priori* expectation that UIP is less likely to hold in emerging markets. This may be because of high inflation and easy-to-follow pattern of macroeconomic fundamentals in emerging markets.[10] Also, *de jure* capital controls in these markets may not be binding, as emphasized by Kose (2006) and Carvalho and Garcia (2007). Second, the results seem

to be robust to the sample choice, possible correlation of shocks among emerging markets, but not to the choice of base currency.[11]

The results of the aforementioned studies, therefore, indicate that it is possible to differentiate emerging markets and developed economies in terms of testing for UIP. Hence, emerging markets merit a special treatment in this respect.

The UIP literature on emerging markets differs from that on developed economies due to emerging market specific conditions, which shape how we classify the related literature. In particular, first, compared to developed economies, the presence of relatively volatile economic conditions and the ongoing structural changes in emerging markets emphasize regime-change analysis. Second, the peso problem, namely, the anticipated but not materialized changes in the exchange rate resulting in systematic deviations from the UIP condition is expected to be mostly confined to emerging markets, as this phenomenon may be intensified under severe structural changes. Third, monetary authorities in countries that suffer from "fear of floating" are inclined to overstabilize the exchange rate movements. Hence this makes simultaneity bias more pronounced for emerging markets. Fourth, since emerging markets are characterized by volatile economic conditions and incomplete institutional reforms, it is more plausible to expect risk premia offered by these country assets. The rest of this section presents a detailed analysis of each of these points.[12]

3.1   Structural Changes and the Uncovered Interest Parity

The existence of relatively frequent structural breaks in emerging markets constitute the first difference between these and the developed economies within the context of testing for the UIP condition. In this regard, it is of crucial importance to identify the *de facto* break date appropriately, since imposing a *de jure* structural break date and testing for the UIP condition before and after that date may yield misleading results.[13]

As foreign exchange markets are liberalized, excess returns over the UIP-implied level are expected to decay gradually both in magnitude and volatility. Using *de jure* financial liberalization dates for nine emerging market economies, Francis et al. (2002) document

that the impact of financial liberalization on the UIP condition is ambiguous. In particular, they report that the three Latin American countries in their study exhibit an increase in the magnitude and volatility of excess currency returns after liberalization; whereas for the five Asian countries and Turkey, excess returns are generally lower in the post-liberalization period. Moreover, employing a three-factor Fama-French model (Fama and French, 1993) with time-varying factors and betas, they conclude that the time-varying risk premium differs significantly in the pre- and post-liberalization periods for all countries but one, with no general pattern attributable to all countries. Splitting the sample in a pre-determined way, Mansori (2003) explores whether the introduction of euro and the adoption of accession partnerships with the EU have an effect on the UIP condition for the Central European economies. His findings suggest that the UIP condition holds for the period 1994-2002, and the analyzed structural breaks do not seem to matter.[14]

Previous empirical studies take the timing of the regime-switch in a pre-determined way by using the official declaration date as given. Although setting a regime switch date for estimation purposes is unescapable, as Bekaert et al. (2002) point out, *de facto* date of structural break does not need to coincide with the official declaration date. In particular, Bekaert et al. (2002) study the timing of regime switches in 20 emerging market economies for the period 1980-1996 with a focus on equity markets and show that the endogenous regime switch date occurs mostly within 3 years of one of the major liberalization dates.

Goh et al. (2006) recognize the importance of determining the regime switch date endogenously, and incorporate this in a UIP framework. They study Malaysia for the period 1978-2002, which covers episodes of interest rate liberalization, currency crisis, exchange rate controls and economic recessions, making Malaysia a good candidate for such an analysis. Particularly, they employ the switching ARCH model of Hamilton and Susmel (1994) in which the regime change is analyzed through endogenizing the timing of the regime change. The regime change is taken as shifts in the conditional volatility of deviations from the UIP condition over different regimes and the timing of the regime switch is estimated through a first-order Markov process. Goh et al. show that deviations from the UIP condition are

found to be fluctuating within a narrower margin around a level closer to zero, as the country takes a step for liberalization, and political and macroeconomic stability is assured.[15]

To sum up, although the existence of relatively frequent structural breaks in emerging markets calls for identifying break dates appropriately, the UIP literature on emerging markets so far seems to have understudied this phenomenon. Accordingly, identifying and modeling structural breaks provide a room for improvement for further research on the UIP condition for emerging markets.

3.2 The Peso Problem and the Uncovered Interest Parity

Another difference between the emerging markets and the developed economies within the context of UIP testing is that the peso problem is expected to be more pronounced for the emerging markets. In particular, when a market expects a discrete change in the exchange rate which is not materialized at that extent for a prolonged period, namely in the presence of the peso problem, deviations from the UIP condition may occur through the following mechanism: when market expectations about the future value of the exchange rate are not fulfilled for a prolonged period, the realized value of the exchange rates deviates from the expected exchange rate systematically. Since market expectations are reflected in the forward premium, this persistent deviation causes forward premium to be a biased predictor of the future exchange rate (Lewis, 1995). Next, by following Lewis, we demonstrate formally how the peso problem causes such a bias in empirical UIP analyses.

The expected future exchange rate depends on whether and to what extent the current and expected future fundamentals are compatible with the path of the exchange rate. The path of fundamentals are affected by current and future macroeconomic policies. This can motivate the following decomposition of the expected exchange rate of $t + 1$ formed at t into two parts:

$$E_t s_{t+1} = p_t E_t(s_{t+1}|\text{B}) + (1 - p_t) E_t(s_{t+1}|\text{A}) \tag{7}$$

where A and B denote two different economic states driven by different policy choices, and

14

p_t is the probability that the state of economy will switch from the current state A to a new state B at $t + 1$. Suppose the current state is preserved. Then the forecast error can be decomposed into two components, the rational expectations forecast error and the unfulfilled expectations about the policy change, as:

$$s_{t+1}^A - E_t s_{t+1} = \eta_{t+1}^A + p_t \widetilde{\Delta} s_{t+1} \tag{8}$$

where $\eta_{t+1}^A = s_{t+1}^A - E_t(s_{t+1}|A)$ is the rational expectations forecast error, $\widetilde{\Delta} s_{t+1} = E_t(s_{t+1}|A) - E_t(s_{t+1}|B)$ represents the expectations about the policy change, and the superscript A denotes state A. Accordingly, using equation (3b), together with equation (8), implies the following estimable UIP equation:

$$s_{t+1}^A - s_t = \beta_0 + \beta_1(f_t^1 - s_t) + \varepsilon_{t+1} \tag{9}$$

where $\varepsilon_{t+1} = \eta_{t+1}^A + p_t \widetilde{\Delta} s_{t+1} + u_{t+1}$, and u_{t+1} is a white noise error term. Note that ε_{t+1} is no longer a zero-mean stationary process since it depends not only on white-noise error terms, η_{t+1}^A and u_{t+1}, but also on expected policy changes, $p_t \widetilde{\Delta} s_{t+1}$. Accordingly, under the assumptions of risk neutrality and independently-formed exchange rate expectations over the two states, one can show that

$$\text{cov}(\varepsilon_{t+1}, f_t^1 - s_t) = p_t \left[(1 - p_t) \, \text{var}(E_t(s_{t+1}|A)) - p_t \, \text{var}(E_t(s_{t+1}|B)) \right] \neq 0 \tag{10}$$

which implies a biased slope term when equation (3b) is estimated under the incorrect assumption that the error term is white-noise. Moreover, it can be shown that when the probability, p_t, is sufficiently high, the peso problem causes a downward bias in the slope term.

As this bias dissipates when the state changes from A to B, it is possible to compare the results of the two regressions: the one that excludes the period in which the state is expected to change, i.e. the peso problem prevails, and the other that uses the whole sample. This approach has been pursued by Flood and Rose (1996) and Sachsida et al. (2001).

Flood and Rose (1996) document for the countries in the European Monetary System that the exclusion of the realignment dates of bilateral DM central parities implies a 0.5

decrease in the UIP slope coefficient over the period March 1979-March 1994. Hence, this implies that the unfavorable evidence for the UIP condition for these economies may be attributable to the inclusion of the pre-realignment dates during which the peso problem is likely to prevail. Unlike Flood and Rose who analyze the slope term, Sachsida et al. (2001) examine the intercept term in equation (3a), since the presence of a significant intercept estimate may imply a risk premium that can be attributable to the peso problem. Their analysis of Brazil for the period 1984-1998, indeed, implies a higher intercept estimate for the period 1994-1998 that coincides with the Real Plan, indicating the possibility of the peso problem in this period. Carvalho et al. (2004) include other Latin American countries such as Argentina, Chile and Mexico and report that the country-specific intercept term for Brazil decreases as the sample covers the flexible regime period of 1999-2001. This can imply the presence of peso problem for Brazil in the pre-floating regime period.

The extent of the peso problem for emerging markets within the context of the UIP condition seems to be a relatively unexplored area of research. This is because the market expectations should be modeled explicitly and different states of the economy should be identified appropriately to account for the peso problem. In addition, since it is not only the exchange rate regime change, but also policy changes that have implications on macroeconomic fundamentals, further research on the peso problem in emerging markets should also consider policy changes as well. In this sense, exploring country-specific financial instruments that can significantly reflect the market sentiment about policy change (Sercu and Vinaimont, 2006), or analyzing monetary policy announcements that may signal future states of the economy (Kaminsky, 1993) may provide valuable insights.

3.3 Monetary Policy Actions and the Uncovered Interest Parity

The third difference between the emerging markets and the developed economies within the UIP context is that the likelihood of the simultaneity bias which is induced by central banks' tendency to over-react to exchange rate movements is expected to be higher for emerging markets. In other words, monetary authorities' inclination to contain exchange

16

rate movements is expected to be more pronounced in these countries due to high levels of currency substitution.[16] McCallum (1994) formally shows that monetary authorities' policy reactions to contain exchange rates by using interest rate as a policy tool lead to the joint determination of the expected depreciation and the interest differential. Ferreira (2004) extends McCallum's model by recognizing that central banks also take into account recent inflation and output gap movements, and analyzes the presence of simultaneity bias for emerging markets.[17] His results suggest that monetary policy actions indeed induce a simultaneity bias for the emerging market countries included in the analysis.

Monetary policy actions, particularly, monetary sterilization of capital inflows, may also have implications for observed (and possibly persistent) deviations from the UIP condition. In particular, *ceteris paribus*, capital inflows put a downward pressure on domestic interest rate and hence on deviations from the UIP condition, when the central bank does not completely sterilize these inflows. Therefore, deviations from the UIP condition might be persistent due to monetary sterilization despite large and persistent capital inflows. Along with this argument, Cavoli and Rajan (2006) analyze the persistent deviations from the UIP condition for five East Asian countries for the period preceeding the crisis of 1997. They report that large capital inflows to these countries had a negligible impact on deviations from the UIP condition, and argue that given that capital is not perfectly mobile, monetary sterilization policies of central banks can explain why deviations from the UIP condition persist during the pre-crisis period.

A further supporting evidence for the effect of monetary policy actions on deviations from the UIP condition is drawn by Poghosyan et al. (2007) who relate the foreign exchange risk premium, $f_t^k - s_{t+k}^e$, to the central bank's interventions in the foreign exchange market and ratio of deposits in domestic to foreign currencies. Poghosyan et al. report for Armenia during 1997-2005 that the central bank's such interventions indeed induce foreign exchange risk premium and hence deviations from the UIP condition.

Although monetary authorities in emerging markets are expected to be more inclined to react to exchange rate movements, the effect of such a "simultaneity" on the UIP condition

for emerging markets so far received less attention. The few studies that explicitly analyze the effect of monetary policy actions on the UIP condition document that central bank policies indeed have implications for deviations from the UIP condition.

3.4 Risk Premium and the Uncovered Interest Parity

Within the context of testing for the UIP condition for developed economies, it is possible to consider the existence of a premium due to exchange rate risk if investors are risk averse. However, for emerging market economies, one has to also consider the possibility of having a premium for default risk and another for political risk as well.[18] The existence of these additional premia can be justified by incomplete institutional reforms, weaker macroeconomic fundamentals, more volatile economic conditions and shallow financial markets in emerging markets. Hence, *a priori*, it is plausible to expect that emerging market assets offer a higher and possibly time-varying premium to investors for bearing such risks.

As mentioned before, tests of the UIP condition do not involve a simple hypothesis, but rather a joint one. Besides imposing rational expectations to arrive at an estimable equation, one has to assume that agents are risk neutral, underlying assets are identical in terms of liquidity, maturity, and default risks, and there exist deep financial markets and perfect capital mobility. Therefore, the rejection of the UIP condition indicates one or more of these assumptions fail. If the assumption of rational expectations can be retained, then the failure of the UIP condition in the context of emerging markets can be attributable to the failure risk neutrality and/or the failure of one or more other assumptions.[19] For example, when identical asset assumption fails, even risk-neutral investors will require a premium for default risk.

These points together imply that it may be important to address the issue of risk premium explicitly for emerging markets since even when agents have rational expectations and are risk neutral, the other assumptions underlying the UIP condition are likely to be violated given the aforementioned characteristics of these countries.

We next clarify the notion of risk premium and introduce the related literature on

emerging markets through the following classification: Those that decompose the interest rate differential, $i_{t,k} - i_{t,k}^*$, into appropriate components to account for various types of risks, and those that investigate the risk premium through modern portfolio theory.

3.4.1 Decomposing the Interest Rate Differential and the Risk Premium

In a rational expectations-UIP setting, the risk premium on the domestic currency can be defined as the expected excess return above the UIP-implied level, as:

$$\rho_t = (i_{t,k} - i_{t,k}^*) - \Delta_k^e s_{t+k} \tag{11}$$

where ρ_t denotes the risk premium.[20] In the context of developed economies, as risk-neutral investors only care about expected returns, risk aversion is equivalent to asking for an exchange rate risk premium. For emerging markets, however, as political and default risk probabilities are included in expected returns, even risk-neutral investors would demand premia for these additional risks. Therefore, ρ_t includes these risk premia both for risk-neutral and risk-averse investors and also exchange rate risk premium if investors are risk averse. Accordingly, lumping all these risks together within a single term and analyzing how this term behaves over time may not be a suitable methodology for cases where these premia are not highly positively correlated.

In line with this criticism, the interest rate differential in equation (11) can be augmented through acknowledging that investors in question, in fact, have the option of choosing among four alternatives instead of two, i.e. a domestic asset denominated in domestic currency $(i_{t,k})$, a domestic asset denominated in foreign currency under domestic jurisdiction $(i_{t,k}^f)$, a domestic asset denominated in foreign currency under foreign jurisdiction $(i_{t,k}^{EB})$, and a foreign asset denominated in foreign currency $(i_{t,k}^*)$.[21] Hence, the interest rate differential in equation (11) can be rewritten as:

$$i_{t,k} - i_{t,k}^* = \left(i_{t,k} - i_{t,k}^f\right) + \left(i_{t,k}^f - i_{t,k}^*\right)$$

$$= \left(i_{t,k} - i_{t,k}^f\right) + \left(i_{t,k}^{EB} - i_{t,k}^*\right) + \left(i_{t,k}^f - i_{t,k}^{EB}\right) \tag{12}$$

The first term in parentheses, $i_{t,k} - i_{t,k}^f$, comprises of two identical assets in terms of jurisdiction. This term, which can be named as currency premium, reflects only the risks associated with exchange rate movements, as the assets differ only in terms of currency of denomination. The second term, $i_{t,k}^{EB} - i_{t,k}^*$, includes two assets under the same currency and jurisdiction. This term is named as default risk premium, as the assets differ only in terms of the issuer country. The third term, $i_{t,k}^f - i_{t,k}^{EB}$, comprises of two assets that are identical in terms of issuer and currency but differ in their jurisdictions. This term is called political risk premium since the difference between the yields of these assets reflects the cost of shifting them across jurisdictions. The summation of the last two terms, $i_{t,k}^{EB} - i_{t,k}^*$ and $i_{t,k}^f - i_{t,k}^{EB}$, is conventionally named as the country premium, as the assets that constitute this premium are denominated under the same currency.[22]

Accordingly, ρ_t in equation (11) can be augmented as

$$\rho_t = (i_{t,k} - i_{t,k}^*) - \Delta_k^e s_{t+k} = \left(i_{t,k} - i_{t,k}^f - \Delta_k^e s_{t+k}\right) + \left(i_{t,k}^{EB} - i_{t,k}^*\right) + \left(i_{t,k}^f - i_{t,k}^{EB}\right)$$

$$= \rho_t^E + \rho_t^D + \rho_t^P \tag{13}$$

where ρ_t^E denotes the exchange rate risk, ρ_t^D denotes the default risk, and ρ_t^P denotes the political risk. Within the UIP context, we can state that ρ_t^E reflects departures from the assumption of risk neutrality of the investors, ρ_t^D reflects departures from the assumption of identical default risk of the assets that constitute the interest differential, and ρ_t^P reflects the departures from the assumption of perfect mobility of assets across jurisdictions.

Data availability is a major problem in analyzing different components of risk premium for emerging market assets. For example, it might be difficult for an emerging market economy to borrow in her own currency for long maturities. Therefore, if such a country would like to increase the average maturity of her debt stock, she would have to borrow in terms of foreign currency. This implies potential maturity mismatch problems when calculating ρ_t^E and ρ_t^P.[23] To the extent that data availability problems can be remedied, several studies analyze different components of risk premium for emerging market assets. This literature can be classified as those that decompose the interest rate differential to analyze currency

and country premia; those that relate the combined risk premium ρ_t or individual components of it, i.e. ρ_t^E or ρ_t^D, to macroeconomic fundamentals which might reflect market perception of risk; and those that analyze time-series properties of risk premium as defined in equation (11).

Frankel and Okongwu (1996) and Domowitz et al. (1998) analyze currency and country premia for Mexico in the early 1990s. They report that both the currency and country premia are economically large, with the currency risk premium being higher and more volatile. Accordingly, one may conjecture that deviations from the UIP condition for Mexico during this period stem mainly from currency related risks rather than country risks. A number of studies relate the currency and country premia with macroeconomic variables that are expected to gauge market perception of risk such as Werner (1996), Schmukler and Serven (2002), Rojas-Suarez and Sotelo (2007), Bratsiotis and Robinson (2007), and Poghosyan et al. (2007).

Schmukler and Serven (2002) explore the patterns and determinants of currency premium for Argentina under the currency board. Their results suggest that imports-to-international reserves, current account deficit-to-GDP and public deficit-to-GDP ratios, and the liquidity positions of local banks, as well as macroeconomic conditions in other emerging markets reflect an exchange rate risk premium, ρ_t^E, for Argentina.

Using eurobond interest rate as a proxy for default risk, ρ_t^D, Rojas-Suarez and Sotelo (2007) analyze the relationship between default risk and interest rates on domestic assets for various Latin American countries. Their results show that there is a unidirectional Granger causality from ρ_t^D to i_t and i_t^f, implying that if ρ_t^D is not taken into account, the UIP regressions will produce biased estimates. In addition, redefining ρ_t^D as $i_{t,k}^{EB} - i_{t,k}^*$, they report that default risk premium is indeed related to macroeconomic fundamentals, such as ratios of external debt-to-government revenue, government liabilities held by banks-to-total bank assets, as well as global liquidity conditions.

Werner (1996) relates the time-varying risk premium to the relative share of foreign currency denominated government debt through a simple portfolio model of Dornbusch

(1983). He questions the seemingly high level of confidence in the announced currency band of Mexico -as inferred from the relatively low interest differential- prior to the Mexican crisis of 1994. After adjusting the interest differential by such a time-varying risk premium, Werner reaches a better *ex ante* measurement for the realized devaluation. By employing a similar framework for the East Asian crisis of 1997, Bratsiotis and Robinson (2005) proxy the risk premium term using relative share of foreign currency denominated private debt. They document that once the UIP condition is corrected for such a time-varying risk premium, it can then be used to forecast exchange rate depreciation prior to crisis.

Similarly, Poghosyan et al. (2007) relate the risk premium to two factors, i.e. the ratio of deposits in domestic to foreign currencies, and foreign exchange market interventions of central bank. Using the Armenian data for the period 1997-2005, they test whether the risk premium can account for the forward premium bias, and whether there exists a maturity effect. The results show that risk premium rises as maturity increases. Moreover, regressing excess currency return on its own lags within a GARCH-in-mean framework, where the conditional variance in the mean equation reflects time-varying risk premium, they reject both risk neutrality and rational expectations hypotheses.

Another strand of literature examines the time-series properties of risk premium, ρ_t, to shed light on market integration of the countries in question. Among others, Holtemoller (2005) examines the monetary integration of the European Union accession countries through investigating the time path of ρ_t as defined in equation (11).[24] Intuitively, the magnitude and the volatility of the risk premia in these accession countries are expected to decay gradually along the path of monetary integration. Accordingly, Holtemoller investigates time series properties of ρ_t for each country and questions whether it has a declining trend both in magnitude and volatility. ρ_t can be stationary only when domestic and the foreign interest rates have the cointegrating vector (1,-1), and exchange rate changes are stationary. Holtemoller assumes the latter and tests whether the domestic and the Euro-zone interest rates are cointegrated in this particular way. Within the context of regression-based UIP analysis, a non-stationary risk premium term implies that domestic and foreign

22

assets are not close substitutes, since their nominal returns diverge in a persistent way. His findings suggest that the risk premia for all countries but Estonia and Lithuania are either non-stationary or stationary with a non-declining trend. In addition, the estimated volatilities of risk premia for these economies are found to be relatively high throughout the sample period, which can be an evidence against the UIP condition.[25]

3.4.2   Asset Pricing Models and Risk Premium

Previous literature regards the expected excess return over the UIP-implied level as a premium for investors bearing risks associated with investing in an asset under different currency of denomination or jurisdiction. In the context of the capital asset pricing model (CAPM), however, only the "systematic" portion of expected excess return is regarded as a risk premium. In other words, an asset or portfolio having an excess return can be interpreted as offering a risk premium to the extent that the aforementioned risks, i.e. currency or country risks, cannot be diversified by holding a well-diversified portfolio of assets that includes it. The CAPM, then, can be used to extract the systematic portion of excess currency returns. Loosely speaking, if the systematic risk is significant, the treatment of excess returns as risk premia, as in the previous section, may be justified.[26]

There exists a vast number of studies testing various versions of the CAPM for emerging markets, yet all confined to equity markets.[27] Given that a country's equities and bonds share common dynamics of risks in the international setting, equity-market related risk measurements can shed light on risks related to investing in fixed-income securities. Henceforth, we present studies on the CAPM which are explicitly related to the UIP framework for emerging market economies, i.e. Bansal and Dahlquist (2000), Francis et al. (2002) and Tai (2003).

Following the cross-sectional approach of Fama and Macbeth (1973), Bansal and Dahlquist (2000) conduct a single-factor asset pricing test together with various country-specific attributes for 34 developed and emerging market currency returns within the UIP context. They investigate whether excess currency returns can be attributable to systematic risk and

document that it is the country-specific attributes and not the systematic risks that matter.

Suspecting that the limited success of the previous result in relating excess currency returns to systematic risks may be due to the choice of a single-factor model, Francis et al. (2002) employ a three-factor Fama-French model (Fama and French, 1993) for nine emerging markets for the period 1980-2000. They incorporate size and value factors and note that these factors may reflect financial risks and future growth opportunities for an economy, as suggested by Liew and Vassalou (2000). Francis et al. document that excess currency returns over the UIP-implied level are significantly driven by systematic risks. Using a multivariate GARCH framework, they report that excess currency returns for emerging markets can be attributable to time-varying risk premia.[28]

Tai (2003) employs an international CAPM model assuming away PPP for four East Asian countries during January 1986-July 1998. The results reported by Tai (2003) are in line with those of Francis et al. (2002), i.e. excess currency returns are driven by systematic risk factors. In particular, Tai explores whether excess returns from forward exchange rate contracts are due to time-varying risk premia. The results show that systematic risk factors are significant in explaining excess currency returns for the countries in the sample. Hence, Tai argues that deviations from the UIP condition are attributable to the existence of time-varying risk premia especially in the form of currency risks.

To sum up, there exists significant risk premia for emerging market assets. Moreover, through decomposing the risk premia into currency, political and default risks, empirical studies cited in this section report that the latter risks, which are generally negligible for developed economies, are significant for emerging market assets. Similarly, studies that employ variants of the CAPM suggest that risk premia are indeed offered by these country assets. Accordingly, ignoring the existence of these risks while estimating the UIP condition through equations (3a) or (3b) induces an omitted variable bias.

4 Conclusion

Recent methodological advances challenge the earlier unfavorable empirical literature on the UIP condition for developed economies. Indeed, it has been documented that these unfavorable results are mostly due to constraining the estimation to a linear framework, ignoring the possibility of high persistence in the data, and are not valid for long- and extremely short-investment horizons.

Do emerging markets merit a special treatment while testing for the UIP condition? To our understanding of the literature, the short answer to this question is yes. Emerging markets have been by and large characterized by weaker macroeconomic fundamentals, more volatile economic conditions, shallower financial markets, and incomplete institutional reforms. These structural differences between the developed and the emerging markets have implications for the empirical tests of the UIP condition. In particular, the assumptions of negligible transaction costs, perfect substitutability of the underlying assets and the existence of deep financial markets are likely to be violated for emerging markets. These, in turn, imply non-negligible transaction costs as well as default and political risks for the emerging market assets, on top of the exchange rate risk which may also be relevant for developed economies. Accordingly, while testing for the UIP condition, if emerging markets are analyzed with the same methodology as developed economies, one would expect relatively unfavorable results for the emerging markets.

It is remarkable, however, that the empirical studies that analyze both the developed and the emerging market economies using conventional methodology document less unfavorable results for the emerging market economies. These comparative studies, in general, argue that this finding can be attributable to high inflation rates and easy-to-follow pattern of macroeconomic fundamentals in these economies.

The aforementioned distinctive characteristics of emerging markets, having implications for deviations from the UIP condition, shape how we classify the related literature that specifically focus on emerging markets. Namely, first, recurrent financial turmoils and on-

going structural changes in emerging markets emphasize structural-break analysis. Second, significant policy changes which are anticipated but not materialized for prolonged periods are more likely to be observed for emerging markets. This point highlights the existence of the peso problem for emerging markets. Third, due to widespread "fear of floating" of central banks in emerging markets, monetary authorities in these countries over-react to large swings in exchange rate movements. Such policy actions by the monetary authority lead to the simultaneity problem, which should be taken into account while testing for the UIP condition. Lastly, besides exchange rate risks, emerging market assets are likely to be prone to default and political risks. Hence, while testing for the UIP condition, these additional risks should be incorporated for emerging markets. In accordance with these points, we classify the emerging market specific studies under four broad categories.

The first strand of literature, which focuses on structural-break analysis, reveals that along the financial liberalization processes, in general, deviations from the UIP condition abates. Our understanding of this literature is that in analyzing the UIP condition, structural break dates should indeed be taken into account and be endogenized. Future research on this topic may address the difference between *de jure* and *de facto* break dates as well as endogenous structural breaks.

With regards to the second and the third points, we identify evidence for the peso problem and the simultaneity problem for emerging markets in the literature. The existence of these points, as warranted (albeit by a limited number of studies), indicates that potential unfavorable evidence for the UIP condition may not necessarily imply foreign exchange market inefficiency for emerging markets.

The fourth strand of literature has decomposed *ex post* deviations from the UIP condition appropriately, and documented that besides exchange rate risks, default and political risks, which are also reported to be related to macroeconomic fundamentals, play a role in driving departures from the UIP condition. In practice, so far, the calculation of these different types of risks has not been feasible due to data unavailability as financial markets in emerging markets are shallow and the time span is short. Over time, with the accumulation

of new data, these risks can be incorporated appropriately.

Last but not the least, we would also like to emphasize the following points: The choice of the base currency may have different implications for deviations from the UIP condition for different regions. Testing for the UIP condition under different inflation episodes, i.e. high and not-so-high inflation, may also be important. Asymmetricity deserves a special emphasis, as higher (possibly extreme) interest differentials are more likely to reflect market perception of risk towards these economies. Finally, due to the contagious nature of financial crises, international investors may not differentiate between emerging markets, and therefore deviations from the UIP condition for an emerging market may have an impact on others.

Acknowledgements

Notes

[1] See Froot and Thaler (1990), Lewis (1995), Taylor (1995), Engel (1996), Sarno (2005), Isard (2006), and Chinn (2006) for related literature surveys.

[2] Throughout the paper, excluding the interest rates, variables in lowercase letters denote the natural logarithms. In the literature, exchange rates are expressed in natural logarithms to avoid the Siegel's paradox: $E_t \left[\frac{1}{S_{t+k}} \right] \neq \frac{1}{E_t S_{t+k}}$. See Edlin (2002) for a detailed discussion on the Siegel's paradox.

[3] Essentially, if the CIP condition holds, estimating (3b) implies testing for the UIP condition as well as the forward rate unbiasedness hypothesis, i.e. $f_t^k = s_{t+k}$.

[4] We use deviations from the UIP condition and the forward premium bias interchangeably throughout Section 2. Yet, for Section 3 where we present the studies that focus on emerging market economies, we differentiate between using equation (3a) and (3b), as the CIP condition may not hold for emerging market economies (Kumhof, 2001).

[5] The range of potential issues that have implications for deviations from the UIP condition is certainly non-exhaustive. For instance, departures from the UIP condition may be related with deviations from the purchasing power parity (PPP) condition (possibly in the long run), as adjustments in capital and commodity markets towards equilibrium may be interdependent (Juselius, 1995). Hence, the UIP condition can be tested together with the PPP condition within a cointegration framework, and a joint testing of these parity conditions may improve the empirical results in the sense the UIP condition may hold only when it is tested jointly with the PPP (Ozmen and Gokcan, 2004). There are also term structure models in which the term structure of the forward premium may impart useful information on the spot exchange rate movement (see, for instance, Clarida and Taylor, 1997; Clarida et al., 2003) or in which the term structure of interest rates is analyzed together with the UIP condition (*inter alia*, Bekaert et al., 2007).

[6] Another implication of the monetary policy action within the UIP context is the possibly-delayed overshooting of the nominal exchange rate in response to a positive interest rate shock. This phenomenon, conventionally named as delayed overshooting, is supported empirically by Eichenbaum and Evans (1995) who document for the U.S. for the late 1970s and 1980s that a contractionary monetary policy that leads to a persistent increase in the domestic interest rate is followed by a currency depreciation only after several

months. Gourinchas and Tornell (2004) and Bacchetta and van Wincoop (2006) relate delayed overshooting as a potential reason for deviations from the UIP condition to departures from rational expectations.

[7]See Mody (2004) for a discussion on which market economies can be labeled as "emerging".

[8]Among others, Edwards (2007) and Kose et al. (2006) provide indices for the degree of capital mobility for both the developed and emerging market economies, elaborating that although emerging markets have achieved a significant degree of capital market integration in the recent years, it is still less than that for the developed economies. See Kose et al. (2006) for an additional discussion on measuring *de jure* and *de facto* degree of capital market integration.

[9]Employing a different methodology, Tanner (1998) analyzes sample properties of *ex post* deviations from the UIP condition, and report that the deviations are stationary with a close-to-zero mean for both emerging and developed markets. Note that by analyzing deviations from the real interest parity condition, Ferreira and Leon-Ledesma (2007) do not corroborate these less unfavorable findings for the UIP condition for emerging markets. In particular, Ferreira and Leon-Ledesma report stationary real interest rate differential albeit around a positive mean for emerging markets, as opposed to stationary around a zero mean real interest differentials for developed economies. The results of Ferreira and Leon-Ledesma imply that *ex ante* PPP and/or UIP does not hold for emerging markets, yet it is hard to extract which one exists or dominates.

[10]This point is further confirmed by Bacchetta and van Wincoop (2006) who demonstrate that persistent inflation shocks induce an exchange rate depreciation together with an increase in interest differential. In addition, Alvarez et al. (2006) show that the volatility of the risk premia is lower for economies experiencing high and chronic inflation rates, which implies that the UIP slope estimates are expected to be closer to one for these economies.

[11]For a further discussion on the choice of base currency, see Lee (2006).

[12]Testing for other interest parity conditions, i.e. covered and real interest parities, may have implications for interpreting empirical evidence on the UIP condition. Hence, on occasion, we also refer to these.

[13]Note, also, that structural changes, particularly financial liberalizations do not occur at a specific date, and hence should be represented as gradual processes.

[14]Some empirical studies on other parity conditions take into account regime switch dates. Mansori (2003) tests for the CIP condition before and after the *de jure* break date. Baharumshah et al. (2005) analyze the effect of liberalization on real interest differentials for ten Asian emerging markets *vis-á-vis* Japan and use a common *ad hoc* break date for the whole sample. They report that real interest parity holds for the post-liberalization era.

[15]Using endogenously determined structural breaks, Singh and Banerjee (2006) and Ferreira and Leon-Ledesma (2007) analyze the stationarity of deviations from the real interest parity condition for a set of emerging markets. Both studies report stationary real interest differentials when structural breaks are taken

into account.

[16]Calvo and Reinhart (2002) document that monetary authorities' fear of large currency swings, fear of floating, is pervasive especially among emerging markets.

[17]The emerging market countries included are Argentina, Brazil, Chile, Mexico, and Turkey. The time period is May 1995-March 2004.

[18]Dooley and Isard (1980) define political risk as risk due to potential changes in capital account restrictions and hence possibility of future deviations from perfect capital mobility. Aliber (1973) is the first to define this concept.

[19]Chinn and Frankel (2002) use survey-based exchange rate data for ten emerging markets for the period 1988-1994 and document that actual depreciation and survey-based expected depreciation move together for three high-inflation emerging markets. This indicates that for such countries rational expectations assumption can be retained.

[20]As aforementioned, when investors take into account real rather than nominal returns, the definition of risk premium as in equation (11) should be augmented by the JIT.

[21]Suppose domestic refers to an emerging market, and foreign denotes the U.S. Accordingly, the choices are (i) an emerging market government bond denominated in domestic currency, e.g. *Cetes* for Mexico, (ii) an emerging market government bond denominated in foreign currency, e.g. *Tesobonos* for Mexico, (iii) an emerging market eurobond, and (iv) the U.S. T-bond, all having the same maturity.

[22]Country premium can also be approximated by analyzing time-series properties of deviations from the CIP condition since the CIP condition rules out currency risks. See, for example, Kumhof (2001).

[23]To circumvent the potential maturity mismatch problem, Rojas-Suarez and Sotelo (2007) test whether the underlying asset yields and the expected depreciation/forward premium move together in the long run.

[24]These countries are the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic and Slovenia. The start of the sample period varies between January 1994 and March 2002, and the end of the period varies between June 2002 and October 2004. The reference interest rate is Euribor with 3-month maturity.

[25]Analyzing time-series properties of deviations from the real interest parity condition, Singh and Banerjee (2006) and Ferreira and Leon-Ledesma (2007) report stationary albeit around a positive mean real interest differentials for the emerging markets in their sample.

[26]See Fama and French (2004) for a comprehensive survey on the CAPM.

[27]Bekaert and Harvey (2003) provide discussions on emerging equity markets as well as a survey of this literature. For most recent empirical works, see Girard and Omran (2007), Iqbal and Brooks (2007), Misirli and Alper (2007) and Tai (2007).

[28]In addition, Francis et al. report that the systematic component of excess returns, i.e. risk premium,

for emerging markets were significantly affected by capital market liberalizations. The risk premia for Latin American countries in their sample have increased after liberalizations, whereas they have decreased for East Asian countries and Turkey.

References

[1] Albuquerque, R. (2006). The Forward Premium Puzzle in a Model of Imperfect Information: Theory and Evidence. Mimeo, Boston University.

[2] Alexius, A. (2001). Uncovered Interest Parity Revisited. *Review of International Economics* 9: 505-517.

[3] Alexius, A. (2002). Can endogenous monetary policy explain the deviations from UIP? Working Paper No. 2002-17, Uppsala University, Sweden.

[4] Aliber, R. Z. (1973). The Interest Rate Parity Theorem: A Reinterpretation. *Journal of Political Economy* 81(6): 1451-1459.

[5] Alvarez, F., Atkeson, A., and Kehoe P. J. (2006). Time-Varying Risk, Interest Rates, and Exchange Rates in General Equilibrium. Research Department Staff Report No. 371, Federal Reserve Bank of Minneapolis.

[6] Anker, P. (1999). Uncovered Interest Parity, Monetary Policy and Time-Varying Risk Premia. *Journal of International Money and Finance* 18: 835-851.

[7] Bacchetta, P., and van Wincoop, E. (2006). Incomplete Information Processing: A Solution to the Forward Discount Puzzle. *Proceedings, Federal Reserve Bank of San Francisco*, June.

[8] Baharumshah, A. Z., Hawa, C. T., and Fountas, S. (2005). A panel study on real interest rate parity in East Asian countries: Pre- and post-liberalization era. *Global Finance Journal* 16: 69-85.

[9] Baillie, R.T., and Bollerslev, T. P. (2000). The Forward Premium Anomaly is not as Bad as you Think. *Journal of International Money and Finance* 19: 471-488.

[10] Baillie, R.T., and Kilic, R. (2006). Do asymmetric and nonlinear adjustments explain the forward premium anomaly?. *Journal of International Money and Finance* 25(1): 22-47.

[11] Baillie, R.T., and Osterberg, W. P. (2000). Deviations from daily uncovered interest rate parity and the role of intervention. *Journal of International Financial Markets, Institutions and Money* 10: 363-379.

[12] Bansal, R. (1997). An Exploration of the Forward Premium Puzzle in Currency Markets. *Review of Financial Studies* 10: 369-403.

[13] Bansal, R., and Dahlquist, M. (2000). The Forward Premium Puzzle: Different Tales from Developed and Emerging Economies. *Journal of International Economics* 51: 115-144.

[14] Bekaert, G., Harvey, C. R., and Lumsdaine, R. L. (2002). Dating the integration of world equity markets. *Journal of Financial Economics*, 65(2): 203-247.

[15] Bekaert, G., Harvey, C. R. (2003). Emerging markets finance. *Journal of Empirical Finance* 10: 3-55.

[16] Bekaert, G., Wei, M., and Xing, Y. (2007). Uncovered Interest Rate Parity and the Term Structure. *Journal of International Money and Finance*, forthcoming.

[17] Bratsiotis, G. J., and Robinson, W. (2006). Currency composition of debt, risk premia and the 1997 Korean crisis. *Economic Modelling* 22: 459-471.

[18] Calvo, G. A., and Reinhart, C. M. (2002). Fear of Floating. *Quarterly Journal of Economics* 107(2): 379-408.

[19] Campbell, J. Y., and Cochrane, J. H. (1999). By force of habit: A consumption-based explanation of aggregate stock market behavior. *Journal of Political Economy* 107(2): 205-251.

[20] Carvalho, J.V., Sachsida, A., Loureiro, P. R. A., and Moreira, T. B. S. (2004). Uncovered Interest Parity in Argentina, Brazil, Chile, and Mexico: A Unit Root Test Application with Panel Data. *Review of Urban and Regional Development Studies* 16: 263-269.

[21] Carvalho, B., and Garcia, M. (2007). Ineffective controls on capital inflows under sophisticated financial markets: Brazil in the nineties. In Edwards, S., and Garcia M. (Eds.), *Financial Markets Volatility and Performance in Emerging Markets*, (Inter-American Seminar on Economics), University of Chicago Press, forthcoming.

[22] Cavoli, T., and Rajan, R. S. (2006). Capital Inflows Problem in Selected Asian Countries in the 1990s Revisited: The Role of Monetary Sterilization. *Asian Economic Journal* 20(4): 409-423.

[23] Chaboud, A. P., and Wright, J. H. (2005). Uncovered interest parity: it works, but not for long. *Journal of International Economics* 66: 349-362.

[24] Chinn, M., and Frankel, J. (2002). Survey Data on Exchange Rate Expectations: More Currencies, More Horizons, More Tests. In Allen, W., Dickinson, D. (Eds.), *Monetary Policy, Capital Flows and Financial Market Developments in the Era of Financial Globalisation: Essays in Honour of Max Fry*, Routledge, London and New York, pp. 145-167.

[25] Chinn, M., and Meredith, G. (2004). Monetary Policy and Long Horizon Uncovered Interest Parity. *IMF Staff Papers* 51(3): 409-430.

[26] Chinn, M., and Meredith, G. (2005). Testing Uncovered Interest Parity at Short and Long Horizons During the post-Bretton Woods Era. NBER Working Paper No. 11077.

[27] Chinn, M. (2006). The (partial) rehabilitation of interest rate parity in the floating rate era: Longer horizons, alternative expectations, and emerging markets. *Journal of International Money and Finance* 25: 7-21.

[28] Christensen, M. (2000). Uncovered Interest Parity and Policy Behavior: New Evidence. *Economics Letters* 69: 81-87.

[29] Choi, K., and Zivot, E. (2007). Long memory and structural changes in the forward discount: An empirical investigation. *Journal of International Money and Finance* 26(3): 342-363.

[30] Clarida, R. H., and Taylor, M. P. (1997). The Term Structure of Forward Exchange Premiums and the Forecastability of Spot Exchange Rates: Correcting the Errors. *The Review of Economics and Statistics* 79(3): 353-361.

[31] Clarida, R. H., Sarno. L., Taylor, M. P., and Valente, G. (2003). The out-of-sample success of term structure models as exchange rate predictors: a step beyond. *Journal of International Economics* 60: 61-83.

[32] Domowitz, I., Glen, J., and Madhavan, A. (1998). Country and Currency Risk Premia in an Emerging Market, *The Journal of Financial and Quantitative Analysis* 33(2): 189-216.

[33] Dooley, M. P., and Isard, P. (1980). Capital Controls, Political Risks, and Deviations from Interest-Rate Parity. *Journal of Political Economy* 88(2): 370-384.

[34] Dornbusch, R. (1983). Exchange rate and the macroeconomics of exchange rate determination. In Hawkins, R., Levich, R.M., Whilborg, C. (Eds.), *Research in International Business and Finance* 3, London-England: JAI Press, pp.3-27.

[35] Dumas, B. (1992). Dynamic Equilibrium and the Real Exchange Rate in Spatially Seperated World. *Review of Financial Studies* 5: 153-180.

[36] Edlin, A. S. (2002). Forward Discount Bias, Nalebuff's Envelope Puzzle, and the Siegel Paradox in Foreign Exchange. *Topics in Theoretical Economics* 2(1), Article No. 3.

[37] Edwards, S. (2007). Financial Openness, Currency Crises and Output Losses. In Edwards, S., and Garcia M. (Eds.), *Financial Markets Volatility and Performance in Emerging Markets*, (Inter-American Seminar on Economics), University of Chicago Press, forthcoming.

[38] Eichenbaum, M., and Evans, C. L. (1995). Some empirical evidence on the effects of shocks to monetary policy on exchange rates. *Quarterly Journal of Economics* 110(4): 975-1009.

[39] Engel, C. (1996). The Forward Discount Anomaly and the Risk Premium: A Survey of Recent Evidence. *Journal of Empirical Finance* 3: 123-192.

[40] Fama, E., MacBeth, J.D. (1973). Risk, return, and equilibrium: Empirical tests. *Journal of Political Economy* 71: 607-636.

[41] Fama, E., and French, K. (1993). Common Risk Factors in the Returns on Stocks and Bonds. *Journal of Financial Economics* 53: 427-465.

[42] Fama, E., and French, K. (2004). The Capital Asset Pricing Model: Theory and Evidence. *Journal of Economic Perspectives* 18(3): 25-46.

[43] Ferreira, A. L. (2004). Leaning Against Parity. Working Paper Series 04-13, University of Kent.

[44] Ferreira, A. L., and Leon-Ledesma, M. (2007). Does the Real Interest Rate Parity Hold?, Evidence for Emerging and Developing Countries. *Journal of International Money and Finance* 26(3): 364-382.

[45] Flood, R., and Rose, A. (1996). Fixes: Of The Forward Discount Puzzle. *The Review of Economics and Statistics* 78(4): 748-752.

[46] Flood, R., and Rose, A. (2002). Uncovered Interest Parity in Crisis. *IMF Staff Papers* 49(2): 252-266.

[47] Francis, B., Hasan, I., and Hunter, D. (2002). Emerging Market Liberalization and the Impact on Uncovered Interest Rate Parity. *Journal of International Money and Finance* 21: 931-956.

[48] Frankel, J. (1993). *On exchange rates.* Cambridge: MIT Press.

[49] Frankel, J., and Okongwu, C. (1996). Liberalized Portfolio Capital Inflows in Emerging Markets: Sterilization, Expectations, and the Incompleteness of Interest Rate Convergence. *International Journal of Finance and Economics* 1(1): 1-23.

[50] Frankel, J., and Poonawala, J. (2006). The Forward Market in Emerging Currencies: Less Biased than in Major Currencies. NBER Working Paper No. 12496.

[51] Froot, K. A., Thaler, R. H. (1990). Anomalies: Foreign Exchange. *Journal of Economic Perspectives* 4: 179-192.

[52] Girard, E., Omran, M. (2007). What are the risks when investing in thin emerging equity markets: Evidence from the Arab world. *International Financial Markets, Institutions and Money* 17: 102-123.

[53] Goh, S.K, Lim, G.C., and Olekalns, N. (2006). Deviations from uncovered interest parity in Malaysia. *Applied Financial Economics* 16: 745-759.

[54] Gourinchas, P., and Tornell, A. (2004). Exchange rate puzzle and distorted beliefs. *Journal of International Economics* 64: 303-333.

[55] Hamilton, J. D., and Susmel, R. (1994). Autoregressive conditional heteroskedasticity and changes in regime. *Journal of Econometrics* 64(12): 307-333.

[56] Hollifield, B., and Uppal, R. (1997). An Examination of Uncovered Interest Parity in Segmented International Commodity Markets. *Journal of Finance* 52: 2145-2170.

[57] Holtemoller, O. (2005). Uncovered interest rate parity and analysis of monetary convergence of potential EMU accession countries. *International Economics and Economic Policy* 2: 33-63.

[58] Huisman, R., Koedijk, K. G., Kool, C., and Nissen, F. (1998). Extreme Support for Uncovered Interest Parity. *Journal of International Money and Finance* 17: 211-228.

[59] Iqbal, J., and Brooks, R. (2007). Alternative beta risk estimators and asset pricing tests in emerging markets: The case of Pakistan. *Journal of Multinational Financial Management* 17: 75-93.

[60] Isard, P. (2006). Uncovered Interest Parity. IMF Working Paper No. 06/96.

[61] Juselius, K. (1995). Do purchasing power parity and uncovered interest rate parity hold in the long run? An example of likelihood inference in a multivariate time-series model. *Journal of Econometrics* 69(1): 211-240.

[62] Kaminsky, G. (1993). Is There a Peso Problem? Evidence from the Dollar/Pound Exchange Rate, 1976-1987. *American Economic Review* 83(3): 450-472.

[63] Kose, M.A, Prasad, E., Rogoff, K., and Wei, S.-J. (2006). Financial Globalization: A Reappraisal. IMF Working Paper No. 06/189.

[64] Kumhof, M. (2001). International Capital Mobility in Emerging Markets: New Evidence from Daily Data. *Review of International Economics* 9(4): 626-640.

[65] Lee, B.-J. (2006). Uncovered Interest Parity Puzzle: Cross-sectional and Time-series Analysis. Mimeo, University of Notre Dame.

[66] Lewis, K. (1995). Puzzles in International Financial Markets. In Grossman, G. M. and Rogoff K. (Eds.) *The Handbook of International Economics*, vol. III. Elsevier Science, Amsterdam, pp. 1913-1971.

[67] Liew, J., and Vassalou, M. (2000). Can Book-to-Market, Size, and Momentum be Risk Factors that Predict Economic Growth? *Journal of Financial Economics* 57: 221-245.

[68] Liu, W., and Maynard, A. (2005). Testing forward rate unbiasedness allowing for persistent regressors. *Journal of Empirical Finance* 12: 613-628.

[69] Lyons, R. K. (2001). *The Microstructure Approach to Exchange Rates*. Cambridge and London: MIT Press.

[70] MacDonald, R. (2000). Expectations Formation and Risk in Three Financial Markets: Surveying what the Surveys Say. *Journal of Economic Surveys* 14(1): 69-100.

[71] Mansori, K. S. (2003). Following in Their Footsteps: Comparing Interest Parity Conditions in Central European Economies to the Euro Countries, CESifo Working Paper No. 1020.

[72] Marey, P. S. (2004a). Uncovered interest parity tests and exchange rate expectations. *Computing in Economics and Finance* 54, Society for Computational Economics.

[73] Marey, P. S. (2004b). Exchange rate expectations: controlled experiments with artificial traders. *Journal of International Money and Finance* 23: 283-304.

[74] Mark, N.C., and Moh, Y.K. (2007). Occasional Interventions and Occasional Violations of Uncovered Interest Parity in the Dollar-DM Market. *Journal of Empirical Finance*, forthcoming.

[75] Maynard, A., and Phillips, P.C.B. (2001). Rethinking an old empirical puzzle: econometric evidence on the forward discount anomaly. *Journal of Applied Econometrics* 16(6): 671-708.

[76] Maynard, A. (2006). The forward premium anomaly: statistical artifact or economic puzzle? New evidence from robust tests. *Canadian Journal of Economics* 39 (3): 1244-1281.

[77] McCallum, B. T. (1994). A Reconsideration of the Uncovered Interest Parity Relationship. *Journal of Monetary Economics* 33: 105-132.

[78] Misirli, U., and Alper, C. E. (2007). The Drivers of Expected Returns in Istanbul Stock Exchange: Fama-French Factors and Coskewness. *Applied Economics*, forthcoming.

[79] Mody, A. (2004). What Is An Emerging Market? IMF Working Paper, No. 04/177.

[80] Ozmen, E., and Gokcan, A. (2004). Deviations from PPP and UIP in a financially open economy: the Turkish evidence. *Applied Financial Economics* 14: 779-784.

[81] Pesaran, H. M., Weale, M. (2006). Survey Expectations. In Elliott, G., Granger C.W.J. and Timmermann A. (Eds.), *Handbook of Economic Forecasting*, North-Holland.

[82] Poghosyan, T., Kocenda, E., and Zemcik, P. (2007). Modeling Foreign Exchange Risk Premium in Armenia. *Emerging Markets Finance and Trade*, forthcoming.

[83] Rojas-Suarez, L., and Sotelo, S. (2007). The Burden of Debt: An Exploration of Interest Behavior in Latin America. *Contemporary Economic Policy*, forthcoming.

[84] Sachsida, A., Ellery Jr., R., and Teixeira, J. R. (2001). Uncovered Interest Rate Parity and the Peso Problem: the Brazilian Case. *Applied Economics Letters* 8: 179-181.

[85] Sakoulis, G., and Zivot, E. (2005). Time-Variation and Structural Change in the Forward Discount: Implications for the Forward Rate Unbiasedness Hypothesis. Mimeo, Department of Economics, University of Washington.

[86] Sarno, L. (2005). Towards a Solution to the Puzzles in Exchange Rate Economics: Where Do We Stand?. *Canadian Journal of Economics* 38: 673-708.

[87] Sarno, L., Valente, G., and Leon H. (2006). Nonlinearity in Deviations from Uncovered Interest Parity: An Explanation of the Forward Bias Puzzle. IMF Working Paper No. 06/136.

[88] Schmukler, S. L., and Serven, L. (2002). Pricing Currency Risks under Currency Boards. *Journal of Development Economics* 69(2): 367-391.

[89] Sercu, P., and Vinaimont, T. (2006). The forward bias in the ECU: Peso risks vs. fads and fashions. *Journal of Banking and Finance* 30: 2409-2432.

[90] Singh, M., and Banerjee, A. (2006). Testing Real Interest Parity in Emerging Markets. IMF Working Paper No. 06/249.

[91] Tai, C.-S. (2003). Can currency risk be a source of risk premium in explaining forward premium puzzle? Evidence from Asia-Pacific forward exchange markets. *International Financial Markets, Institutions and Money* 13: 291-311.

[92] Tai, C.-S. (2007). Market integration and contagion: Evidence from Asian emerging stock and foreign exchange markets. *Emerging Markets Review*, forthcoming.

[93] Tanner, E. (1998). Deviations from Uncovered Interest Parity: A Global Guide to Where the Action is. IMF Working Paper No. 98/117.

[94] Taylor, M. P. (1995). The Economics of Exchange Rates. *Journal of Economic Literature* 33(1): 13-47.

[95] Verdelhan, A. (2006). A Habit-Based Explanation of the Exchange Rate Risk Premium. Mimeo, Boston University.

[96] Villanueva, O. M. (2005). FX Dynamics, Limited Participation, and the Forward Bias Anomaly. *The Financial Review* 40: 67-93.

[97] Werner, A. M. (1996). Mexico's Currency Risk Premia in 1992-94: A Closer Look at the Interest Differentials. IMF Working Paper No. 96/41.