Uncovered Interest Parity and Financial Market Volatility

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Our paper addresses the relationship between exchange rates changes and interest rate differentials in the UIP framework, by taking into account capital market and foreign exchange market volatility. We use eight currencies, of which five are Central and Eastern European and three are developed markets currencies, and their relationship to the US dollar. We use OLS regressions to capture the influence of volatility on UIP testing. We find that UIP is not validated, overall and in times of high volatility, but the direction in the exchange rate change indicated by the interest rate differential follows the UIP framework. The relationship between interest rate differentials and exchange rates changes is weak and taking into account market volatility does not significantly alter our results.

Key words: *exchange rates, volatility, uncovered interest parity*
JEL classification: *F31, G15*

1. INTRODUCTION[1]

1.1. Interest rate parity: an overview

For open economies, the concept of interest rate parity is an important component of the macroeconomic analysis and one of the basic models used in international finance. The validation of interest parity

[1] This paper presents results achieved within the research project "Modeling the interaction between the capital market and the foreign exchange market. Implications for financial stability in emerging markets", Project code IDEI_1782, Project's financer: CNCSIS, PNII/IDEI.

has essential implications for international corporate finance decisions and for international investments. Interest rate parity has been developed in two forms, known as covered interest parity (CIP) and uncovered interest parity (UIP) or international Fisher effect. Both forms of interest parity provide simple relationships between money market variables, more specifically interest rates, and foreign exchange market prices, as spot or forward exchange rates.

Investors at any time t dispose of two basic alternatives in terms of holding assets: one alternative refers to holding assets denominated in their domestic currency, while the other alternative refers to holding assets denominated in foreign currencies. When the domestic alternative offers an interest rate denoted by r between times t and $t+1$, the payoff of this investment at time $t+1$ equals $(1+r)$. To benefit from the interest rate provided by the foreign investment alternative, denoted by r^*, the investor must first convert his amount in the domestic currency in foreign currency units using the spot exchange rate at time t, s_t[1], then invest in foreign assets, obtaining at time $t+1$ a payoff equal to $s_t \times (1+r_t)$, which is afterwards reconverted in domestic currency units. If the domestic and foreign assets differ only with respect to the currencies of denomination, and if investors have the opportunity to cover their exposure to exchange rate risk by converting their know proceeds in foreign currencies at time $t+1$, $s_t \times (1+r_t)$, at the forward exchange rate at time t for maturity $t+1$, f_t, then market equilibrium leads to the *covered interest parity*:

$$\frac{f_t}{s_t} = \frac{1+r}{1+r^*} \quad \text{or, rewriting,} \quad (1+r) = f_t(1+r^*)/s_t \qquad (1)$$

If condition (1) did not hold, risk-free covered interest arbitrage is possible, with investors borrowing in one currency, converting the amounts in the other currency at the spot rate, investing the proceeds at the other interest rate, selling the resulting amounts in the forward

[1] The spot exchange rate is denominated in units of the domestic currency per one unit of the foreign currency – or is a direct quote from the perspective of the domestic currency.

market and repaying the loan to end up with a net positive and known amount at time $t+1$.

Instead of covering their foreign currency positions in the forward market, investors have the opportunity of leaving their positions uncovered at time t and waiting until time $t+1$ in order to convert the amount $s_t \times (1+r_t)$ in the spot market, at the spot rate prevailing at time $t+1$, s_{t+1}. Under this arrangement, known as *uncovered interest rate parity*, markets will reach an equilibrium point when the return on the domestic currency equals the expected value at time t of the return provided by the uncovered position in the foreign currency:

$$\frac{E_t(s_{t+1})}{s_t} = \frac{1+r}{1+r^*} \quad \text{or, rewriting,} \quad (1+r) = E_t(s_{t+1})(1+r^*)/s_t \qquad (2)$$

Rearranging the terms of equation (1) above, we obtain

$$\frac{f_t - s_t}{s_t} = \frac{1+r}{1+r^*} - 1 \text{, or for small values of } r^*, \quad \frac{f_t - s_t}{s_t} \approx r - r^* \qquad (3)$$

Equation (3) may be interpreted as the observable premium or discount on the foreign currency implied by the interest rate differential between the two currencies, as follows: whenever the interest rate in the domestic currency, r, is higher than the foreign currency interest rate, r^*, the forward rate is higher than the spot rate, which implies a forward premium on the foreign currency and a forward discount on the domestic currency; conversely, whenever the interest rate in the domestic currency, r, is smaller than the foreign currency interest rate, r^*, the forward rate is smaller than the spot rate, which implies a forward discount on the foreign currency and a forward premium on the domestic currency.

On other hand, rearranging the terms of equation (2) leads to

$$\frac{E_t(s_{t+1}) - s_t}{s_t} = \frac{1+r}{1+r^*} - 1$$

, or for small values of r^*,

$$\frac{E_t(s_{t+1}) - s_t}{s_t} \approx r - r^* \qquad (4)$$

Equation (4) understanding follows the interpretation for equation (3), only that now the interest rate differential between the two currencies is linked to the spot exchange rate prevailing in the market at time *t* and the expectations related to the value of the spot rate at time *t+1*: whenever the interest rate in the domestic currency, r, is higher than the foreign currency interest rate, r^*, the investors in the market expect the future spot rate to increase as compared to the current spot rate, which indicates an expected appreciation of the foreign currency and an expected depreciation of the domestic currency in the spot market; conversely, whenever the interest rate in the domestic currency, r, is smaller than the foreign currency interest rate, r^*, the investors in the market expect the future spot rate to decrease as compared to the current spot rate, which indicates an expected depreciation of the foreign currency and an expected appreciation of the domestic currency in the spot market. Thus, the uncovered interest parity differs from the covered interest parity by a dynamic element introduced through the relationship between the observed values of the money market and foreign exchange market variables at time *t* and the value of the spot exchange rate that participants in the market anticipate at time *t* to prevail at time *t+1*. This relationship has important implications for exchange rate forecasting, as Porter (1971) suggests: if the UIP condition was valid at all time horizons, the observed values of the spot exchange rate and the term structures of domestic and foreign interest rates could be used to infer the expected future time path of the spot exchange rate.

1.2. Empirical evidence on interest rate parity

UIP has been tested jointly with the assumption that participants in the foreign exchange market form rational expectations, typically in such a way that future realizations of the spot rate will equal the value expected at time *t*, plus an error term that is uncorrelated with all information known at time *t*. The two assumptions imply that

$s_{t+1} = f_t + u_{t+1}$ and, consequently,

$s_{t+1} - s_t = (r_t - r^*) + u_{t+1}$,

where *u* stands for the prediction error. Therefore, UIP has been tested empirically by estimating the values of α and β coefficients in model specifications such as the following:

$s_{t+1} = \alpha_0 + \alpha_1 f_t + u_{t+1}$ or $s_{t+1} - s_t = \beta_0 + \beta_1 (r_t - r^*) + u_{t+1}$,

where it is assumed that the error terms have zero means and are serially uncorrelated.

Isard (2006) distinguishes two issues in the empirical assessment of UIP: the size of the prediction errors, and the question of whether the predictions are systematically biased. On the first issue, previous research conducted by Isard (1978), Mussa (1979) and Frenkel (1981) shows that interest rate differentials are able to explain only a small proportion of the subsequent changes in spot rates, and it has been generally interpreted as implying that observed changes in spot rates are mainly the result of unexpected information about economic developments, government policies and other factors. On the second issue, the hypothesis of unbiasedness can be assessed by testing whether $(\alpha_0, \alpha_1) = (0,1)$ or $(\beta_0, \beta_1) = (0,1)$. Tests generally support the value of α_1 as being equal to unity, but do not support the same value for β_1, at least for prediction horizons lower than one year. When the prediction horizons are enlarged to five up to twenty years, the evidence is much more favourable to unbiasedness: Flood and Taylor (1997) find that β_1 becomes insignificantly different from unity, when using data for developed economies, and when exchange rates and interest rate differentials are averaged over non-overlapping five- to twenty-year periods.

Lothian and Wu (2003) argue that the failures of UIP that have been so widely documented are a coincidence of two empirical artefacts: (1) the unique sample period of the 1980s and (2) the noise induced by small UIP deviations. They use an ultra long time series that spans over two centuries and run regressions conditional on large deviations from UIP to find that traditional regressions yield positive slope estimates over the sample period and become negative only when the sample is dominated by the period of the 1980s. Also, they find that large interest rate differentials have significantly stronger forecasting powers for currency movements than small interest differentials. As a result, they contradict the so-called UIP puzzle overwhelmingly evidenced by the literature (see, for example, Bakshi and Naka, 1997; Bekaert, 1995; Flood and Rose, 1996; Wu and Zhang, 1997). Flood and Rose (1996) compared a flexible exchange rate regime to the fixed regime used in the European Monetary System (EMS) and concluded that the UIP theory fares better under the fixed than under the flexible regime. Using daily data for 23 developed countries, Flood and Rose (2001) also report that the UIP condition holds up rather well for the 1990s. Bansal and Dahlquist (2000) examined the weekly data for 28 countries and concluded that there may exist a non-linear asymmetric relationship in UIP for positive and negative forward premiums. They found that the violation of the UIP is not pervasive and the puzzle is largely to be found in the case of high-income countries, and in particular when U.S. interest rates are higher than foreign rates.

Alexius (2001) also considered the long-run relationship of UIP using the long-term government bond yields for 13 OECD countries and the U.S., and found that the slope estimates are generally positive. More recently, authors have addressed a series of circumstances that may influence the validation or invalidation of UIP. Besides the specificities of the 1980s, investigated by Lothian and Wu (2003), other possible circumstances may play a role in the UIP testing, such as: (1)

UIP validation may be different in times of crisis as compared to normal times, as in these circumstances both exchange rates and interest rates may display higher volatilities; (2) UIP may be influenced by financial markets' integration; (3) deviations from UIP are the basis for interest rate defences of fixed exchange rates, as Flood and Rose (2001) suggest.

The empirical evidences for the relationship between emerging markets currencies exchange rates and interest rates are less frequent as compared to the case of developed markets currencies. Nevertheless, the existing literature generally finds violations of CIP and UIP for emerging markets, as suggested by Backé and Schardax (2009), Ito and Chinn (2007) and Di Giovanni and Shambaugh (2008). Backé and Schardax (2009) examine a sample of 18 emerging market currencies, including 6 currencies from emerging Europe and confirm earlier evidence for the existence of a forward premium puzzle for emerging market economies. Also, they extend the model in order to explore the systematic relationship between excess return from investments in foreign currency and country-specific economic fundamentals. Their results show that, compared to currencies from developed economies, the smaller bias in the forward exchange rates of emerging market currencies could be related to the better predictability of currency returns for emerging market currencies. Ito and Chinn (2007) investigate the relationship between ex post exchange rate depreciation and the interest rate differential for a sample of developed and emerging market currencies, and then relate the ex post uncovered interest rate differentials to a set of macroeconomic and policy related variables. They find that a wide diversity in the coefficient relating depreciations and interest rate differentials can be attributed to differences in inflation volatility, financial development, capital account openness, legal development and the nature of exchange rate regimes. In terms of interest rate impact on foreign countries economic conditions, Di Giovanni and Shambaugh (2008) explore the connection between interest rates in major industrial countries and annual real output growth in other countries and show that high foreign interest rates have a contractionary effect on annual real GDP growth in the domestic economy, but this effect is specific for countries with fixed exchange rates.

The issue of capital markets volatility as a factor influencing UIP validation has been recently researched, with the rather general finding that UIP holds better in times of high market volatility and/or large interest rate differentials, while in times of lower volatility tests seem to reject the UIP condition. In one of the few attempts to test UIP on emerging markets, Cairns et al. (2007) conclude that in times of heightened global equity and bond market volatility, high-yielding currencies tend to depreciate, while low-yielding ones tend to serve as "safe haven", but the entire spectrum of currencies' sensitivity to global volatility is represented among Asia-Pacific currencies.

The influence of volatility on the UIP validity has been recently tested using regime-switching models that allow for exchange rate switches between volatility regimes over time. The use of regime switching models to exchange rate data has been proposed by Engel and Hamilton (1990), Bekaert and Hodrick (1993), Bollen et al. (2000), Dewachter (2004), Huisman and Mahieu (2006), and Ichiue and Koyama (2008). Huisman and Mahieu (2006) use weekly data for the 1992 to 2006 period for developed countries' currencies against the US dollar and apply a regime switching methodology that allows the exchange rate to switch between two regimes over time: the first regime is a UIP regime in which changes in exchange rates are described by the observed interest rate differential between the two currencies involved, while the second regime is a random walk with drift. Based on the estimated regime probabilities, the authors investigate whether specific interest rate market conditions can be related to the periods with a high probability of being in the UIP regime. They conclude that an exchange rate switches between periods in which it is likely to be in a random walk regime and periods in which it is likely to be in an UIP regime, but the exchange rate is more likely to be in the UIP regime in high volatility periods and periods with large absolute interest rate differentials. Ichiue and Koyama (2008) advance as a possible explanation for the UIP invalidation in low volatility times the market participants' carry-trade activities, and as an explanation for the UIP validation in high volatility times the rapid unwinding of carry-trade. They also observe that low-interest rate currencies appreciate less frequently, but once the appreciation occurs, its movement is faster that when they depreciate, and the authors also interpret this as a result of carry-trade unwinding.

Our paper addresses the relationship between exchange rates changes and interest rate differentials in the uncovered interest parity framework, by taking into account the implications of capital market and foreign exchange market volatility on the UIP validation. The paper is structured as follows: Section 2 presents the data used in our analysis and the research methodology, Section 3 outlines the main results and Section 4 concludes.

2. DATA AND RESEARCH METHODOLOGY

We use the exchange rates against the US dollar and the interest rates reported by European Central Bank, all collected from Datastream, for a number of five currencies from Central and Eastern Europe – Polish zloty (PLZ), Czech koruna (CZK), Romanian leu (RON), Turkish Lira (NTL), and Russian rubble (RUR) – and for three developed markets currencies – Japanese yen (JPY), Swiss franc (SWF) and British pound (GBP). We also use VDAX as a measure of capital market volatility[1]. The analysis is conducted over the period between April, 13th, 1994 and April 13th, 2009, but the period is different from one currency to the other, depending on data availability. All returns used in our analysis are logarithmic.

[1] VDAX expresses the implied volatility of the Deutsche Börse DAX Index anticipated on the derivatives market. The VDAX indicates in percentage points the volatility to be expected in the next 30 days for the DAX. The basis for the calculation of this index is provided by the DAX option contracts.

Our testing of uncovered interest parity follows a two-step procedure: first, we use OLS regressions to summarize the empirical facts about interest rate differentials and changes in exchange rates over the entire 1994 – 2009 period; second, we explore the influence of capital market and foreign exchange market volatility on the validation of uncovered interest parity.

3. ANALYSIS OF OLS REGRESSIONS OVER THE 1994-2008 PERIOD

We first test the uncovered interest rate parity in a classical way, using a regression of the form:

$$(s_{t+1} - s_t) \cdot 52 = \alpha + \beta \cdot (r_t - r_t^*) + \varepsilon_{t+1} \tag{5}$$

where *s* denotes the exchange rate of the selected currency against the US dollar, *r* is the domestic interest rate and *r** is the US interest rate. We run the regressions for a null hypothesis of $\alpha = 0$ and $\beta = 1$. We use non-overlapping weekly data for the OLS analysis with one-week interest rates, to avoid possible estimation biases in standard errors that typically arise from the use of overlapping data. The regression of the form (5) tests for a relationship between the change in exchange rate and interest rate differential such as

$$E(s_{t+1} - s_t) = (r_t - r_t^*) \cdot n / 52 \tag{6}$$

which means that an arbitrage relationship should exist, where the expected exchange rate return compensates for the return provided by the interest rate differential. According to the theory, if the foreign interest rate is lower than the domestic interest rate, the foreign currency should appreciate on average against the domestic currency; conversely, if the foreign interest rate is higher than the domestic interest rate, the foreign currency should depreciate, on average, against the domestic currency.

As pointed out in Section 1.2., previous tests on UIP fail to identify a relationship between the change in the exchange rates and interest rate differentials as indicated by theory. Specifically, a low volatility environment might support the counterintuitive relationship of the depreciation of lower-interest currencies. To test this presupposition, we add another term to the regression in (4), which captures the influence of volatility on the relationship between exchange rates and interest rate differentials. The new regression takes the form:

$$(s_{t+1} - s_t) \cdot 52 = \alpha + (\beta_0 + \beta_v \cdot v_t) \cdot (r_t - r_t^*) + \varepsilon_{t+1} \qquad (7)$$

where v_t is the annualized historical volatility calculated using daily exchange rate returns for approximately 20 business days up to the end of the month. The uncovered interest parity theory stands if we cannot reject the null hypothesis of $a = \beta_v = 0$ and $\beta_0 = 1$ in (7). The parameter $(\beta_0 + \beta_v)$ reflects the extent to which currency returns are related to interest rate differentials depending on the exchange rate volatility. Thus, a positive β_v would indicate that a lower volatility leads to a lower value of $\beta_0 + \beta_v$, which means a higher deviation from what is implied by the UIP theory.

We find that all estimated slope coefficients from equation (4) are statistically different that one at the five-percent level, which indicates that for all currency pairs and for the entire period the uncovered interest theory is not validated. The same is true for β coefficients from equation (7), which reinforces our findings. Table 1 reports the results from the regression equations (5) and (7).

There few points to be noted. First, of all β coefficients only four are statistically different from zero (for Romanian leu, Turkish lira, Russian ruble and British pound), but all of them are positive, although their values are very close to zero. This indicates that despite the fact that UIP does not hold, the direction in the exchange rate change indicated by the interest rate differential follows the UIP framework. Overall, the relationship implied by UIP between interest rate differentials and exchange rates changes is weak and the inclusion of foreign exchange market volatility does not significantly alter this result. We observe that when volatility is taken into account, its coefficients are statistically significant at least at the 10% level in five currencies' case (Polish zloty, Romanian leu, Russian ruble, Japanese yen and British pound). Since β_v coefficients are all positive, this indicates a higher deviation from what is implied by UIP. Nevertheless, the volatility addition to equation (4) leads to statistically different than zero interest rate differential coefficients in the case of Polish zloty and Japanese yen. Interesting, though, both these coefficients are negative, implying that the exchange rates for these two currencies changes in the opposite direction compared to the one indicated by the interest rate differentials. For three of the high-yielding currencies (Romanian leu, Turkish lira and Russian ruble) the inclusion of volatility does not amend the positive relationship between exchange rate changes and interest rate differential.

Table 1. Results of UIP Test Regressions

	UIP test without volatility - equation (4)		UIP test with volatility - equation (6)		
	□	□	□	□ □	□ v
Poland	-0.058	0.010	-0.127 **	-0.025 ***	0.472 ***
	- (0.90)	(1.394)	- (2.01)	- (2.895)	(6.53)
Czech Republic	-0.053	0.016	-0.056	0.020	- 0.019
	- (1.31)	(1.977)	- (1.36)	(1.618)	- (0.46)
Romania	0.007	0.004 ***	0.026	0.002 *	0.014 **
	(0.14)	(3.653)	(0.56)	(1.719)	(2.49)
Turkey	-0.145	0.009 ***	-0.174 *	0.005 *	0.036
	-	(3.009)	-	(1.873)	(0.13)

	(0.95)			(4.53)				
Russia	-0.165	0.038	*	-0.072	0.020	***	0.023	***
	-			-				
	(1.76)	(7.505)		(0.87)	(3.310)		(5.15)	
Japan	-0.053	-0.012		-0.062	-0.081	***	0.655	***
	-	-		-	-			
	(0.70)	(0.624)		(0.83)	(3.128)		(3.89)	
Switzerland	-0.065	-0.022		-0.065	-0.051		0.315	
	-	-		-	-			
	(1.17)	(1.098)		(1.15)	(1.520)		(1.08)	
UK	-0.020	0.023	*	-0.004	-0.148	***	1.811	***
	-			-	-			
	(0.51)	(1.054)		(0.10)	(4.465)		(6.76)	

Note: This table reports the results from the regression equations (5) and (7). T-statistics are reported in parantheses. The values with ***, ** and * are different than zero at the one, five and ten-percent significance level. The sample is December 30th, 2006 to April 6th, 2009 for the CZK, JPY, PLZ, RUR and CHF; May 26th, 1996 to April 6th, 2009 for RON; December 30th, 1996 to January 2nd, 2006 for NTL; January 6th, 1997 to April 6th, 2009 for GBP.

4. HIGH VOLATILITY EPISODES AND UNCOVERED INTEREST PARITY

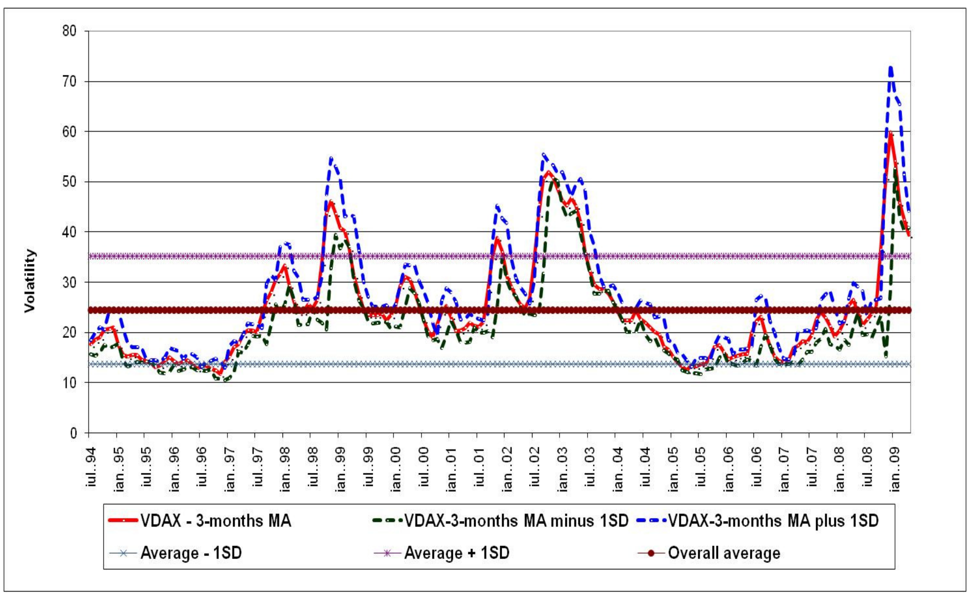
When considering the impact of market volatility on the relationship between the change in exchange rates and interest rate differential it is important to investigate the influence of higher than normal volatility episodes on the UIP validity. Looking back at the 1994 – 2009 period[1], Figure 1 shows several significant episodes of high market volatility, as indicated by swings in the VDAX indicator.

Of all these episodes of high volatility we selected a number of 9 periods, following a threshold in 3-months (60 days) moving average of

[1] From April 13th, 1994 to April 13th, 2009.

VDAX values (we used monthly data). In case the daily increases in VDAX were equal to at least two standard deviations up from the moving average and were occurring in at least eight days out of any consecutive 20 days (or 1 month, approximately), we considered it as the debut of an episode of high volatility. The end of the high volatility episode (or its peak) was defined in such a way as the daily declines in VDAX are above one standard deviation of the moving average. Of these episodes we considered only the ones that have the percentage range (the difference between the highest value and the lowest value of VDAX) above the distance between the standard deviation and the average of VDAX over the entire period (44%). Table 2 below shows the remaining six episodes we identified and the range in the VDAX value for each.

Figure 1 - Significant episodes of high market volatility



Note: The figure shows the moving average (MA) for VDAX on a 3-months basis, outlining the thresholds for ±1 standard deviation (SD) from the average.

Table 2. Episodes of high volatility, 1994-2009

Episode	*Beginning day*	*Ending day*	*Maximum value of VDAX*	*Minimum value of VDAX*	*Percentage range in VDAX*
1	August 13, 1998	September 21, 1998	54.23	29.92	81.25%
2	August 30, 2001	September 25, 2001	54.59	26.30	107.57%
3	June 4, 2002	July 25, 2002	58.76	28.61	105.38%
4	June 12, 2006	June 13, 2006	27.42	17.26	58.86%
5	July 10, 2007	August 16, 2007	31.42	20.42	53.87%
6	September 12, 2008	October 28, 2008	83.23	25.34	228.45%

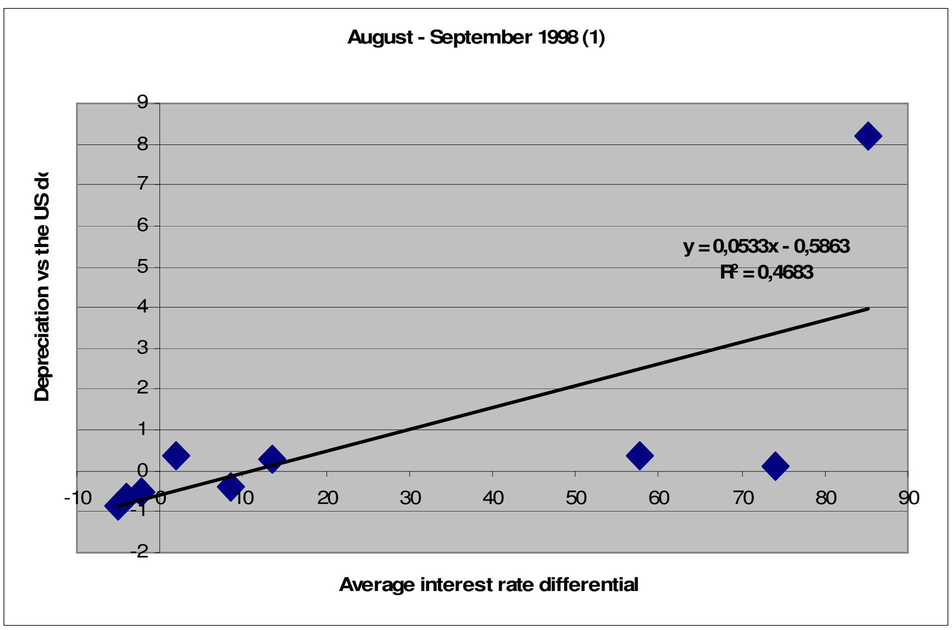
For the six episodes of high volatility in terms of VDAX we considered the average daily interest rate differential of the currencies against the US dollar interest rate and the change in the currencies' exchange rates against the US dollar. We test the uncovered interest rate parity validity for the eight currencies using regressions of the form:

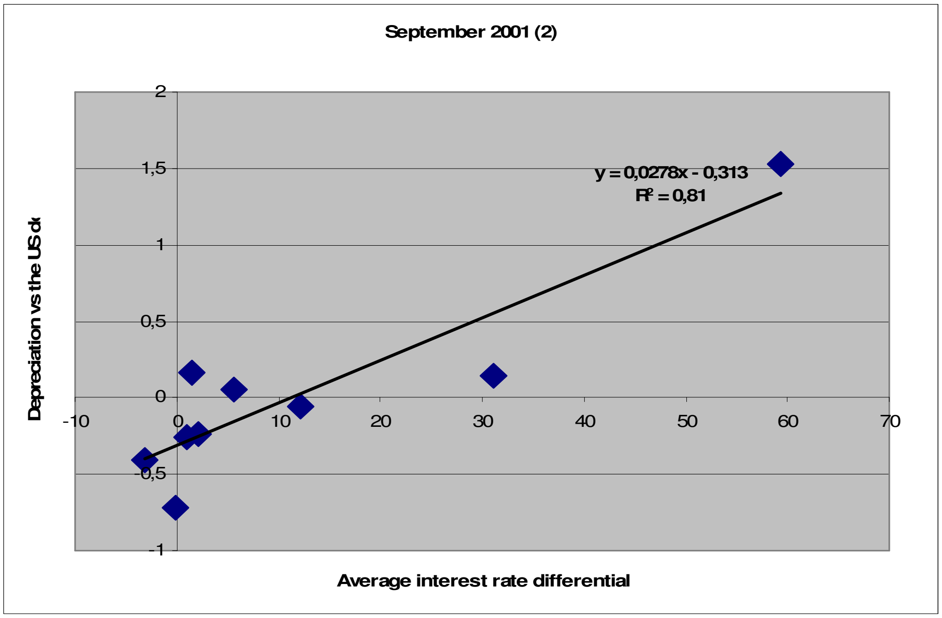
$$(s_{t+1} - s_t) = \alpha + \phi \cdot (r_t - r_t^*) + \varepsilon_{t+1} \qquad (8)$$

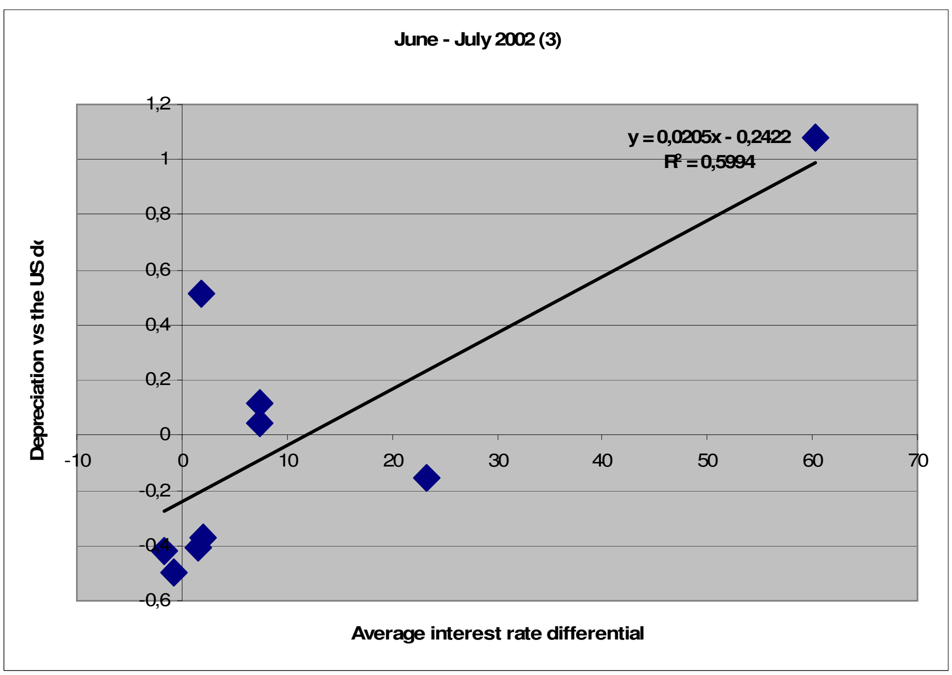
where *s* denotes the exchange rate of the selected currency against the US dollar, *r* is the domestic interest rate and *r** is the US interest rate. We run the regressions for a null hypothesis of α = 0 and β = 1. This part of our analysis also includes the euro, besides the eight currencies mentioned above. The daily changes in exchange rates are logarithmic and annualised.

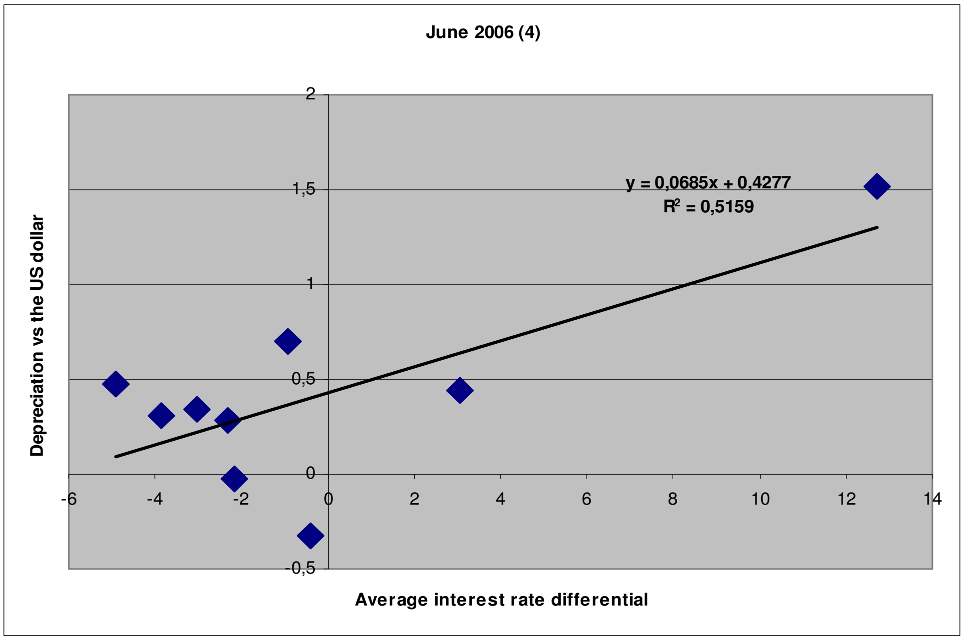
Figure 2 plots the annualised average depreciation of the US dollar against the eight currencies plus the euro versus the annualised average interest rate differentials for the six high-volatility episodes identified in Table 2, while Table 3 presents the results of regressions specified in (8).

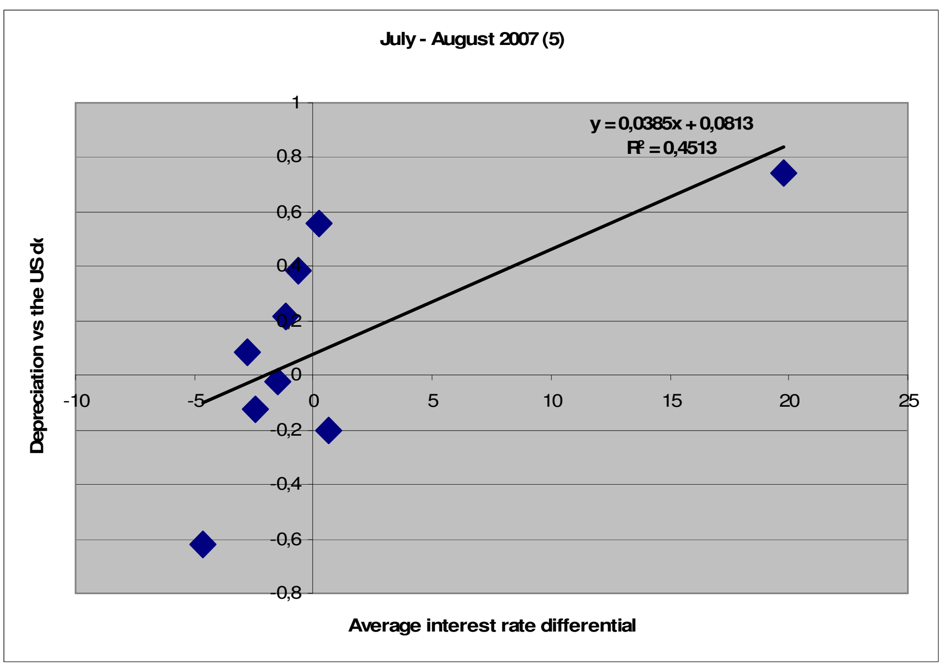
**Figure 2 – US dollar depreciation and interest rate differentials in volatile peri-
ods**

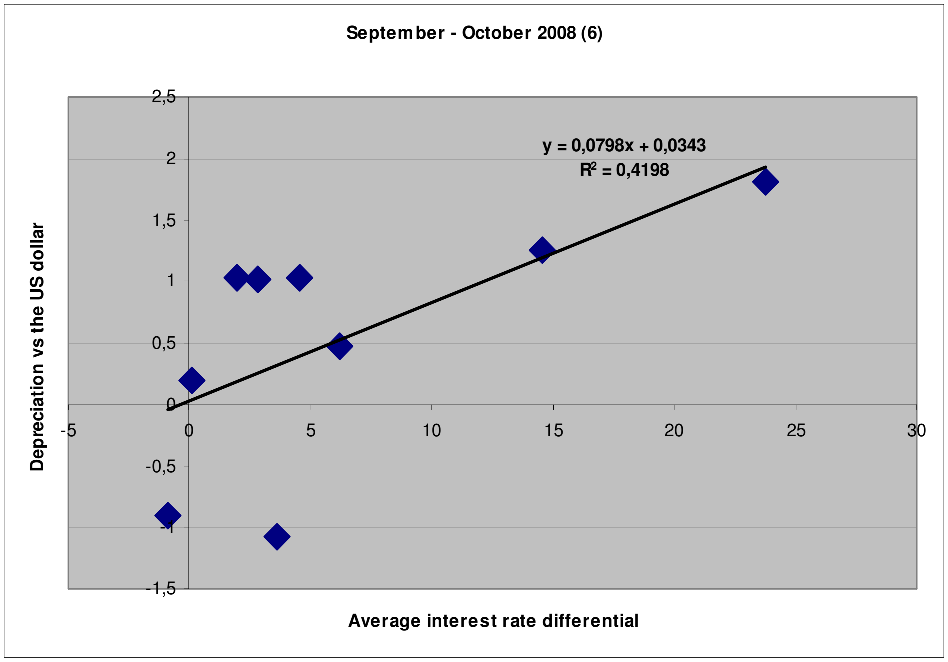



September 2001 (2)
y = 0,0278x - 0,313
R² = 0,81
Depreciation vs the US dc
Average interest rate differential
2
1,5
1
0,5
0
-0,5
-1
-10
0
10
20
30
40
50
60
70


June - July 2002 (3)
y = 0,0205x - 0,2422
R² = 0,5994
Depreciation vs the US dc
Average interest rate differential
1,2
1
0,8
0,6
0,4
0,2
0
-0,2
-0,4
-0,6
-10
0
10
20
30
40
50
60
70


June 2006 (4)
y = 0,0685x + 0,4277
R² = 0,5159
Depreciation vs the US dollar
Average interest rate differential


July - August 2007 (5)
y = 0,0385x + 0,0813
R² = 0,4513
Depreciation vs the US dc
Average interest rate differential



Note: Numbers (1) to (6) refer to high-volatility episodes identified in Table 2.

For all high-volatility moments we find that UIP does not hold, as all ϕ coefficients are statistically different than one. Still, for each of the six episodes of high-volatility in the capital market, we found an overall positive relationship between the average daily interest rate differential and the changes in exchange rates against the US dollar. This means that in moments of increased capital market volatility, the higher the interest rate differential, the higher the change in exchange rates: more specifically, when volatility in capital markets is high, low-yielding currencies tend to appreciate and high-yielding currencies tend to depreciate against the US dollar. Our findings are consistent with the empirical results existent in the literature.

Table 3. Results of regressions for high-volatility episodes

High-volatility episodes	ϕ		R^2	Adj R^2
1	0,0533	**	0,4683	0,3923
	(2,4830)			
2	0,0278	***	0,8100	0,7829
	(5,4631)			
3	0,0205	**	0,5994	0,5422
	(3,2366)			
4	0,0685	**	0,5159	0,3730
	(2,7313)			
5	0,0385	**	0,4513	0,3730
	(2,3996)			
6	0,0798	*	0,4198	0,3369
	(2,2503)			

Note: This table reports the results from the regression equation (8). T-statistics are reported in parantheses. The values with ***, ** and * are different than zero at the one, five and ten-percent significance level. High-volatility episodes numbers are taken from Table 2.

4. CONCLUDING REMARKS

Our paper addresses the relationship between exchange rates changes and interest rate differentials in the uncovered interest parity framework, by taking into account the implications of capital market and foreign exchange market volatility on the UIP validation. We use eight currencies in our analysis, of which five are Central and Eastern European - Polish zloty, Czech koruna, Romanian leu, Turkish Lira , and Russian rubble – and three are developed markets currencies - Japanese yen, Swiss franc and British pound -, and the euro. Our testing of uncovered interest parity follows a two-step procedure: first, we use OLS regressions to summarize the empirical facts about interest rate differentials and changes in exchange rates; second, we explore the influence of capital market and foreign exchange market volatility on the validation of uncovered interest parity.

We find that the uncovered interest theory is not validated over the entire period, but the direction in the exchange rate change indicated by the interest rate differential follows the UIP framework. Overall, the relationship implied by UIP between interest rate differentials and exchange rates changes is weak and taking into account foreign exchange market volatility does not significantly alter this result. When capital market volatility is considered, UIP is again not validated, but for each of the six episodes of high-volatility in the capital market that we identified we found an overall positive relationship between the average daily interest rate differential and the changes in exchange rates against the US dollar. This means that in moments of increased capital market volatility, the higher the interest rate differential, the higher the change in exchange rates: more specifically, when volatility in capital markets is high, low-yielding currencies tend to appreciate and high-yielding currencies tend to depreciate against the US dollar.

Our results have a number of implications for international corporate finance decisions and for international investments. First, the finding that uncovered interest parity does not hold in normal and turbulent times, may be interpreted as an indication of financial markets segmentation, which opens the window for international profit opportunities, either from arbitrage or from speculation. Second, the pronounced real appreciation of the currencies of countries of Central and Eastern Europe against the dollar and the euro will continue to attract significant capital inflows that can be so large that they could overwhelm macroeconomic decision makers' efforts to control inflation and contain external current account deficits. This is actually one of the reasons for Central and Eastern European countries to give up a monetary policy rule centred on exchange rate stability in favour of inflation-targeting regimes. Third, uncovered interest parity may be used as a forecasting tool of the direction of exchange rate change, which is a piece of good news for corporate finance decision makers.

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