# EXCHANGE RATES AND VOLATILITY IN CENTRAL AND EASTERN EUROPE: A TEST FOR UNCOVERED INTEREST PARITY[307]

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*At times of heightened global capital market volatility, high-yielding currencies tend to depreciate, while low-yielding currencies tend to serve as "safe heaven". We present the results of a test for Uncovered Interest Parity for selected European currencies, in defined moments of capital market high-volatility. We conclude about patterns of sensitivities of currencies to changes in global market volatility.*

*Key words: Exchange rates, Volatility, Central and Eastern Europe, Uncovered interest parity, Financial crisis*

## 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 has essential implications for international corporate finance decisions and for international investments. First, the assumption that interest parity builds upon is financial markets' integration, so that empirical tests on interest parity may be also seen as tests of international financial markets integration. Second, when deviations from interest parity occur, which opens the room for arbitrage in money and foreign exchange markets, monetary authorities may intervene in order to defend interest rates and exchange rates against potential speculative pressures. Third, corporations and international investors may fundament their decisions in different manners in a framework described by interest rate parity as compared to one where interest parity does not hold. Fourth, the widespread, large and persistent violations of interest parity indicate that speculation in money and foreign exchange markets may be profitable for the astute traders.

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,

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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 $t$, $s_t$[308], 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*:

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

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 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:

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

As Isard (2006) notes, this is equivalent to combining CIP with the assumption that exchange rates are driven, at the margin, by risk-neutral market participants who are ready to take uncovered spot or forward positions whenever the forward rate deviates from the expected future spot rate.
Rearranging the terms of equation (1) above, we obtain

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

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

308 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.

$$\frac{E_t(s_{t+1})-s_t}{s_t}=\frac{1+r}{1+r^*}-1\text{, or for small values of } r^*\text{, } \frac{E_t(s_{t+1})-s_t}{s_t}\approx r-r^* \qquad (4)$$

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.

**Empirical evidence on interest rate parity**

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.

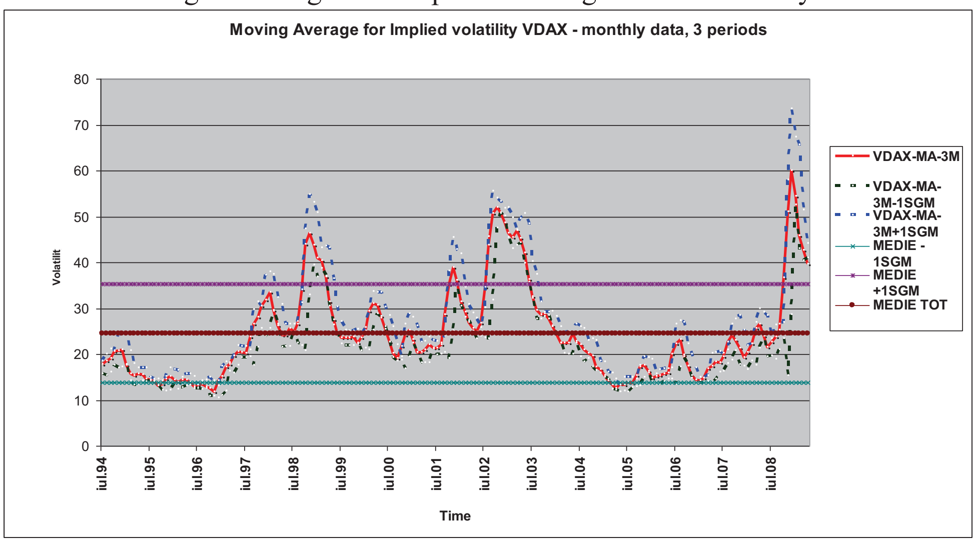
The influence of volatility on the UIP validity has been also tested using a regime switching model that allows for exchange rate switches between volatility regimes over time. The use of regime switching models to exchange rate data has been proposed by Engel and Hamilton (1990), Bekaert and Hodrick (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.

**Research methodology and results**

Our research involves a comparative analysis between low-yielding currencies (we take into consideration the euro, the Japanese yen, the British lira and the Swiss franc) and several high-yielding currencies from Central and Eastern Europe (the Turkish Lira, the new Romanian RON, the Russian Ruble, the Polish Zlot and the Czech Crown) in the moments of high volatility for the capital market, as shown below. We consider as proxy, for European Capital Market Volatility, the VDAX indicator[309].

Looking back at the 1994 – 2009 period[310], Figure 1 shows several significant episodes of high market volatility, as indicated by swings in the VDAX indicator.

Figure 1 - Significant episodes of high market volatility




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 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 1 below shows all the remaining six episodes we identified.

309 VDAX is expresses the implied volatility of the Deutsche Borse 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.

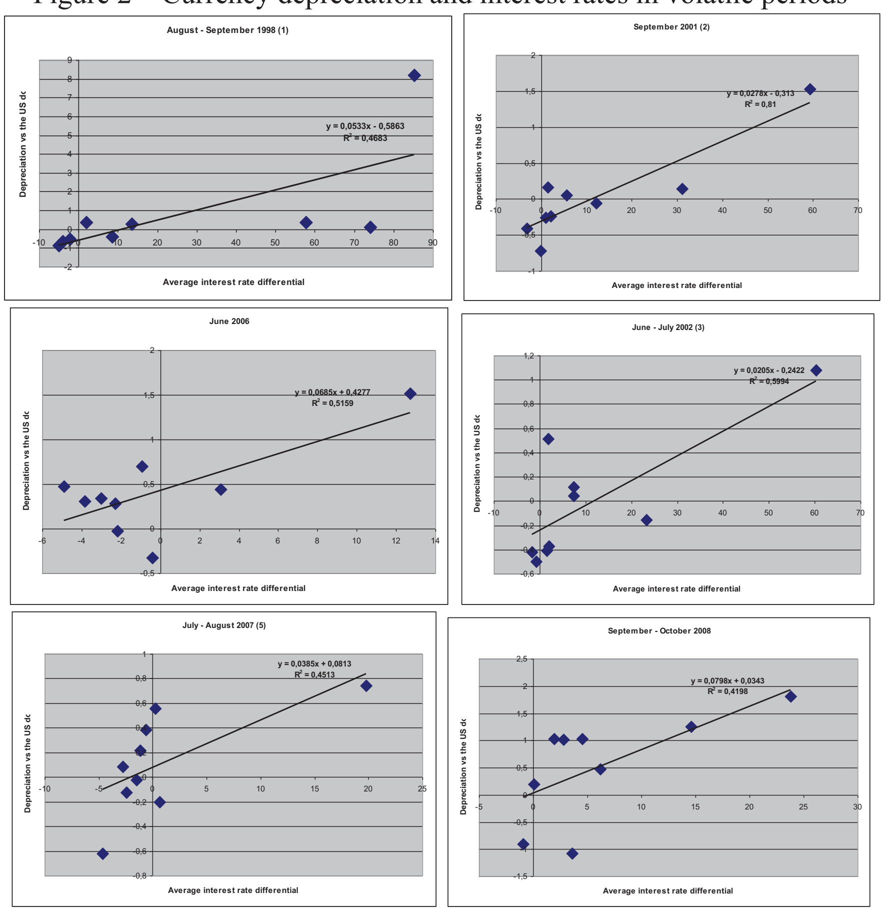
310 From 13 April 1994 to 13 April 2009

**Table 1. Episodes of high volatility, 1994-2009**

| *Episode* | *Beginning day* | *Ending day* | *Maximum value of VDAX* | *Minimum value of VDAX* | *Percentage range* |
|---|---|---|---|---|---|
| 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 each episode of high volatility for European Capital Market in terms of VDAX we considered the average daily interest rate differential (the term for comparison is the US dollar interest rate) and the depreciation of each selected currency versus the US dollar (log changes on a daily basis, annualised).

Figure 2 – Currency depreciation and interest rates in volatile periods



## Conclusions

For each of the six moments of high-volatility for the capital market, we found an overall positive relationship between the average daily interest rate differential and the depreciation of each selected currency versus the US dollar. This means that in moments of increased capital market volatility, the higher the interest rate differential, the higher would be the depreciation.

Our findings are consistent with the empirical results existent in the literature (ex: Cairns, 2007). Thus, we found that in also Central-Eastern European economies the UIP holds better in moments of increased capital market volatility.

We will abort further research by analysing the connection between interest rate differential and currencies depreciation by the mean of regime switching models.

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