Testing Uncovered Interest Rate Parity: The Case of Hungary

By Sophio Bendiashvili

Submitted to Central European University Department of Economics

In partial fulfillment of the requirements for the degree of Master of Arts

Supervisor: Professor Robert Lieli

Budapest, Hungary 2011

Abstract

I propose three methods to investigate the validity of the Uncovered Interest Rate Parity (UIP) condition in Hungary: (i) excess return investigation, (ii) the UIP regression equation, and (iii) bivariate Vector Error Correction Model (VECM). Using one, five and ten year government bond interest rates for Hungary (domestic), the European Central Bank (ECB), the Federal Reserve Bank of the US (US), and the Weighted Average (WA) of the ECB and US interest rates (foreign) depending on their contribution to Hungarian economy, I find out that the results are quite mixed and ambiguous, varying depending on the methods and the time period used for investigation. Generally, the conclusion is that the UIP condition in Hungary is more likely to hold for one year interest rates in relationship with the European Central Bank interest rates.

Key words: the uncovered interest rate parity, the UIP regression equation, bivariate VECM, Excess return.

Acknowledgment

I would like to express special thanks to my supervisor Professor: Robert Lieli, for his great support, advices and comments throughout the writing of this thesis.

I am very grateful to my friends Alen Dzanic, Károly Godány, and Kálmán G. Szabó for their help.

Table of Contents

Intro	oduc	tion1
1.	Lite	rature Review4
2.	Dat	a description8
3.	Un	covered Interest Rate Parity (UIP)10
4.	Emj	pirical Methodology12
5.	Emj	pirical Evidence14
5.	1	ADF and KPSS tests14
5.	2	Informal Check
5.	3	UIP Regression Equation
5.	4	Vector Error Correction Model
6.	Sun	nmary of the Results
Con	clus	ion
Refe	erenc	ces

Introduction

The relationship between exchange rate and interest rate has been an active topic in international economics already for decades; the condition that equalizes domestic (i_t) and foreign interest rate (i_t^*) spread with exchange rate yield is called, Uncovered Interest Rate Parity condition (UIP). In simpler term, it means that investors compare returns on assets based on their expectations of the depreciation rate. For example if investor invests in domestic currency, the rate of return on investments will be $(1+i_t)$, while in case of investing abroad the yield would be $(1+i_t^*)(s_{t+1}^e/s_t)$, where s_{t+1}^e is the future expected exchange rate and s_t is the spot exchange rate. Hence investors decide where to invest based on their expectations about the future exchange rate since they need to convert the foreign currency into the domestic currency. The UIP condition is motivated by ruling out arbitrage opportunity across countries, and assumes that investors are risk neutral, and have rational expectations about their investments.

Whether interest rate differential is an unbiased predictor of the exchange rate movements (when the slope coefficient for interest rate spread in the UIP equation (equation 5) equals to unity) has been a matter of investigation by many researchers. The overall picture of the UIP hypothesis is that in the short-run (less than 12 months) domestic and foreign interest rate differential is very poor estimator of the exchange rate movements. Bilson (1981) found negative slope coefficients and explained it, by the existence of foreign exchange risk premium. McCallum (1994) suggests that, there is heterogeneity in the slope coefficient depending on the exchange rate regime. It is widely found that the UIP hypothesis is rejected because of excess returns on investments, which is also explained by Lewis (1994) as the foreign exchange rate risk premium, and the market inefficiency. According to the literature the UIP condition is likely to hold at longer (more than one year) maturity interest rates. Chinn and Meredith (2005), Chinn (2006) found positive slope coefficient, close to unity especially for Netherlands and Switzerland versus the US.

For my investigation I use one, five and ten year government bond interest rates for Hungary (Hungary) versus the same maturity European Central Bank (ECB), Federal Reserve bank (Fed) and the weighted average (WA) of the foreign interest rates (foreign), according to their contribution to Hungarian economy.

Testing the uncovered interest rate parity condition in Hungary is especially interesting because of transition period to European Union, switching from crawling peg to the floating exchange rate regime and full capital liberalization on May, 2001. The aim of the paper is to estimate the validity of the UIP condition in Hungary, using different methods over the period of May, 2001-December, 2010.

. First, as a precondition for the following methods to make sense, I test the unit-root processes in the domestic interest rates (i_{t}), foreign interest rates (i_{t}^*), forward premium (i_{t} - i_{t}^*), exchange rates (s_t), and the exchange rates yields (Δs_t). Second, I use three different methods to investigate the uncovered interest rate parity condition: (i) Using $i_{t,k} - i^*_{t,k} - \Delta S_{t,t+k}$ differential, the first method visualizes on the graph the process of excess return, where $\Delta S_{t,t+k}$ is the log exchange rate yield, and $i_{t,k}$, $i^*_{t,k}$ are domestic and foreign interest rates respectively. (ii)The second method embodies the uncovered interest rate parity condition into the regression equation. The UIP equation investigates whether domestic and foreign interest rate differential is an unbiased estimator of the exchange rate yield, in other word, whether interest rate spread and the exchange rate yield are equalized. (iii) Third method is bivarite Vector Error Correction Model (VECM), which investigate the co-integrating relationships between domestic and foreign interest rates, implied by the UIP equation. For VECM and the

UIP regression equation the sample is divided into two periods, whole time period (May, 2001-December, 2010), and the period after the EU accession (May,2001-December, 2010) in order to investigate the difference in Hungarian interest rate market between the two periods.

Overall picture of the results looks quite mixed and ambiguous. The excess return investigation reports that the only evidence in favor of the uncovered interest rate parity is for one year interest rates between Hungary versus the European Central Bank and the weighted average interest rates. The UIP regression equation states no evidence to support the UIP condition in Hungary. However, VECM contradicts the UIP regression equation and states that the only evidence in favor of the UIP condition in Hungary is during the second half of the sample for one year interest rates for Hungary versus the ECB and the WA interest rates. Hence, the result differs depending on the methods, and the sample periods.

The paper is structured in the following way: Section 1 reviews literature, with several interesting developments about the uncovered interest rate parity during the last decades being discussed. Section 2 presents data description. Section 3 Reviews the uncovered interest rate parity, summarizes the UIP condition and states the regression equation. Section 4 presents empirical methodology, and describes separately each methodology used for investigation. Section 5 provides the results for each method. Section 6 discusses, summarizes and gives economic intuitions based on the obtained results. The paper ends with the conclusion.

1. Literature Review

The overall impression about the uncovered interest rate parity puzzle is that, the UIP condition is more likely to hold in the long-run than, in the short-run. The deviation from the UIP condition in the short-run is the result of exchange rate risk premium in the country, however, in the long-run the consistent results for the UIP condition are driven by the fact that, the exchange rates are determined by the economic fundamentals (Chinn and Meredith, 2005).

Bilson (1981) analyses uncovered interest rate parity condition by using one, three six and twelve months forward rates for nine currencies, (US, Canada, Swiss, UK, Belgium, France, Germany, Italy, Netherlands, and Japan) over the period of 1974-1980 years. The author finds that the Hypothesis (b=1) for UIP equation is strongly rejected. The slope coefficient is negative in all cases. The result implies that the spot exchange rate is a better estimator of future spot rates than forward rate, since the first differences of exchange rates are serially uncorrelated and behave like a random walk without drift. Longworth (1981) supports Bilson's finding about the failure of the UIP condition. The author examines US and Canadian 30-day rates, and finds that, almost each year's spot rate offered a better forecast for future spot rate, than did the current forward rate.

Froot and Thaler (1990) provide possible explanations about deviations from UIP condition (when $b\neq 1$). According to the authors, there are two possible interpretations when b<1. It is the result of time varying exchange rate risk premium, or expectation errors under the assumption of risk neutrality and that the exchange rate risks are fully diversifiable. Under time varying risk premium when $b\neq 1$ interest rate movements are driven by changes in exchange rate risk premium. For example when b<1, a one percentage increase in interest rate differential between countries leads to less than one percent expected depreciation in domestic

currency. Under Expectation errors risk premium is constant, so the change in interest rate differential fully reflects the expected change in the exchange rate.

Lewis (1994) presents a survey about excess return puzzle. The author estimates USD/DM and USD/ JPY rates over the 1975-1989 years, for short term financial instruments (less than 12 months). He rejects UIP hypothesis and claims that the excess returns are the result of foreign exchange risk premium, and market inefficiency.

McCallum (1994) argues that the deviation from UIP condition can be the result of monetary policy behavior. Using Dollar exchange rates against Yen, British Pound and DM for short-term interest rates, the author found out that the UIP condition is regime dependent. The UIP failure is the outcome of monetary policy regime to smooth interest rates and actions against high exchange rate volatility.

Flood and Rose (2002) study uncovered interest rate parity for 13 developed and 10 developing countries during the 1990s. Most of these countries overcame the currency crisis in 1990s: Finland, Italy, Sweden, and the United Kingdom from developed countries and Argentina, Brazil, the Czech Republic, Hong Kong SAR, Indonesia, Korea, Malaysia, Mexico, Russia, and Thailand from developing countries. They took high frequency data (daily) and used Germany as core currency for European countries, and the United States for the rest of the countries including Germany. The authors found that, the UIP condition works better after 1990s (the slope coefficient of UIP regression is close to unity), which implies that high interest rate currencies started to depreciate during the crisis. Also they discovered heterogeneity in slope coefficient, especially according to the exchange rate regime. For floating regime it is constantly better (close to one) than for fixed. The authors could not find any significant difference between developed and developing countries.

Bruggemann and Lutkepohl (2005) investigate short (3month financial instrument rates) and long-term (10year bond rate) relationship between exchange rate and interest rate of the US and the Euro area over the period of January, 198- December, 2004. The analysis is based on univariate unit root test and VECM. The results supports UIP condition for all four interest rates (US short and long term, Euro area short and long term rates). The authors found that the interest rates follow non-stationary process, while US and Euro area interest rates spread is stable over time. The authors also found strong evidence about European interest rate dependence on the US interest rate changes but not vice versa.

Chinn and Meredith (2005) investigate both short (up to 12month) and long (5year yields) term interest rates, and its relationship with exchange rate movements for the US, Canada, Germany and the UK over the period of 1980-2000. The authors find results for short-term interest rates, similar to most of the other authors. The average slope coefficient of UIP equation is about -0.8, which is consistent with Froot and Thaler's (1990) finding. On the other side long-term bonds give more promising results, compared to the commonly rejected UIP condition in the short-run. The slope coefficient of UIP equation has a correct sign and is close to unity. Especially for Canadian and German currencies, the slope coefficient is very close to one, (1.1 and 0.9 respectively). The authors specify that the failure of UIP in the short run is the outcome of exchange rate risk premiums. However in the long run excepted changes in the exchange rate are determined by economic "fundamentals", which makes the relationship between exchange rate and interest rates consistent with the uncovered interest rate parity condition.

Chinn (2006) investigates non-G7 developed countries (Denmark, Finland, Ireland, Spain, Norway, Netherlands, Sweden and Switzerland) over the period of 1996-2004 and the UIP equation is based on 5-year government bonds. The results of the regression implies that

the slope coefficients for Netherlands and Switzerland are statistically significant and close to unity while the hypotheses (b=1) for other countries are rejected.

Weber (2010) examined US, European relationship based on long-run interest rate equilibrium. The data contains monthly 10 year government bond rates over the period of January, 1990-June, 2006. The analysis is based on a backward recursive estimation of co-integration and trivariate VECM. The paper shows that since the middle of 1990s, the UIP condition does not hold any more, which is explained by central banks reactions on interest rate volatilities, intended to establish a common currency in the Euro area. Through trivariate VECM (interest rates and exchange rate) stationary long-term equilibrium is established, which is explained by the common stochastic trend for European interest rates and Eurodollar rates, which is again driven by central bank reactions.

2. Data description

Domestic interest rates are monthly averages of one, five, and ten year Hungarian government bonds rates. The same maturity foreign interest rates are measured in three different ways: (i) the European Central Bank (ECB) bond rates, (ii) the US Federal Government Security rates and (iii) the weighted average of ECB and US rates (WA) according to their contribution to Hungarian economy.¹ Exchange rates are end of the month rates, measured by one unit of EUR, USD and their WA value in Hungarian forint. All the data used in the paper, is publicly available from the National Bank of Hungary, the Federal Reserve Bank of the US and the European Central Bank.

The time horizon of the analysis is from May, 2001 till December 2010. The beginning date was chosen, in order to avoid a regime changes in the exchange rate. In particular, Hungary's monetary policy went from crawling peg to the floating exchange rate, which was preceded by the full capital liberalization (Arvai, 2005).

For the following calculations exchange rates are transformed to logarithm and then taken the first difference in order to create monthly returns, for interest rates no changes are applied. Table 1 presents descriptive statistics of the interest rates, it shows that the ECB bond rates have the least variations for all three maturities, and Hungarian bond rates are the most unstable. Table 2 introduces descriptive statistics for the exchange rates; it gives quite big standard deviations for all three exchange rates. The high variance in exchange rate implies that during the sample period, there was high volatility in exchange rate yields. The highest standard deviation, 9.59 has Ft/USD, which means that during the sample period the EUR is more stable in relationship with Ft compared to USD.

¹ Weighted average of US and ECB rates are calculated according to foreign direct investment by these countries to Hungary (EU-91%, US-9%)

Overall picture of descriptive statistics shows that the variances of the exchange rates are much higher than the variance of the different maturity interest rates. The finding might be explained by the volatility of the forward premium in Hungarian foreign exchange market, which creates obstacles for the uncovered interest rate parity to hold.

Table 1

Descriptive statistics

Government bond rates: Hungary versus European Central Bank, the United States and their weighted average.

TIME HOLIZON.	un Sample. 2001.0.	5-2010.12					
	Hungary	ECB	USA	WA			
1 year rates							
Mean	8.25	2.67	2.36	2.62			
Median	8.18	2.64	2.12	2.72			
Max.	12.7	4.6	5.22	4.39			
Min.	4.96	0.32	0.23	0.32			
Std.Dev.	1.81	1.2	1.59	1.17			
		5 year ra	ites				
Mean	7.86	3.42	3.44	3.43			
Median	7.48	3.5	3.43	3.5			
Max.	10.78	4.9	5.1	4.91			
Min.	5.46	1.62	1.18	1.61			
Std.Dev.	1.15	0.78	1.02	0.76			
10 year rates							
Mean	7.47	4.04	4.15	4.05			
Median	7.27	4.01	4.18	4.02			
Max.	10.45	5.3	5.39	5.32			
Min.	5.44	2.68	2.42	2.68			
Std.Dev.	0.94	0.58	0.68	0.56			

Time horizon: Full Sample: 2001.05-2010.12

Fable 2	
---------	--

Descriptive statistics Log, first differenced exchange rates: Hungary versus USD, EUR, and WA Time horizon: Full Sample: 2001.05-2010.12

	Ft/EUR	Ft/USD	Ft/WA
Mean	0.22	-0.78	0.06
Median	-0.29	-1.67	-1
Max.	30.15	41.79	37.14
Min.	-21.7	-23.1	-21.9
Std.Dev.	6.65	9.59	7.25

3. Uncovered Interest Rate Parity (UIP)

The Uncovered Interest Rate Parity (UIP) condition rules out the arbitrage opportunity by equalizing domestic (i_t) and foreign interest rate (i^*_t) spread with exchange rate yield. The simplest UIP equation under the assumption of the risk neutrality is as follows:

$$\Delta s^{e}_{t,t+k} = (i_{t,k} - i^{*}_{t,k}) \tag{1}$$

where $\Delta s_{t,k}^{e}$ defines expected percentage change in the exchange rate, and i_t , i_t^* are domestic (Hungary) and foreign (ECB, US, WA) interest rates respectively, t is spot period and k is the future period. The equation (1) assumes no-arbitrage opportunity between countries, which implies that the changes in exchange rate and interest rate spread are in equilibrium and there is no room left for earning extra money, by investing across countries.

If investors are risk averse, equation (1) does not hold any more. Hence the forward discount rate $(i_{t,k}-i_{t,k})$ can be different from the future spot rate $(\Delta s_{t,t+k}^{e})$, depending on the perceived risk of domestic versus foreign assets (Chinn, Meredith, 2005). The inequality between domestic and foreign interest rate differential and the expected exchange rate yield, leads the equation (1) taking the following form:

$$\Delta s^{e}_{t,t+k} = (i_{t,k} - i^{*}_{t,k}) + \eta_{t,t+k} \qquad (2)$$

where the term $\eta_{t,t+k}$ refer to the risk premium demanded from risk averse investors, in order to compensate for the risk of the given financial instrument. However expected exchange rate yields are not observable, hence equation (2) cannot be tested. Engel (1995) suggested to test the UIP condition together with the rational expectations, where investors efficiently use all the information available at time t, to predict the market movements at time t+k, and came up with the equation for the future spot rate:

$$\mathbf{S}_{t,t+k} = \mathbf{S}^{e}_{t,t+k} + \zeta_{t,t+k} \tag{3}$$

Where the term $s^{e}_{t,t+k}$ refers to the future expected exchange rate under the rational expectations, and $\zeta_{t,t+k}$ is a white noise process, uncorrelated with the interest rate differential and the spot exchange rate at time t.

Combining equations (2) and (3), gives the future realized change in exchange rate as

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

which can be transformed into the uncovered interest rate parity (UIP) equation, under the assumptions that $\eta_{t,t+k}$, $\zeta_{t, t+k}$ terms are orthogonal to the interest rate spread (Chinn, Meredith, 2005), and the risk premium is stable over time². The equation (5) represents the final UIP regression,

$$\Delta S_{t,t+k} = \alpha + \beta (i_{t,k} - i_{t,k}^*) + \varepsilon_{t,t+k} \quad (5)$$

where $\varepsilon_{t,t+k}$ is white noise process and the null hypothesis of the UIP is $\beta=1$. In case $\beta\neq1$ the null hypothesis fails, this implies that the interest rate differential is a biased estimator of the future spot exchange rate.

If $\Delta S_{t,t+k}$ follows the stationary process (I(0)) and the domestic and foreign interest rates behave like non-stationary I(1) processes, equation (5) implies that the domestic and foreign interest rates are co-integrated with the co-integration vector (1,-1).

 $^{^{2}}$ However Engel (1987) found significant evidence for time varying risk premium, but it is beyond the scope of this paper .

4. Empirical Methodology

I investigate the validity of the uncovered interest rates parity in Hungary over the period of May, 2001- December, 2010 in several ways:

(i) As a precondition for some of the following methods to make sense, Using Augmented Dickey Fuller (ADF) and KPSS tests I investigate unit-root processes for the different maturity domestic interest rates (i_t), foreign interest rates (i^{*}_t), forward premium (i_t-i^{*}_t), exchange rates (S_t) and exchange rate yields (Δ S_{t,t+k}), with the null hypothesis of non-stationarity and stationarity respectively. Usually financial data follows non-stationary process, which implies that the time-series contain trend or random walk. Hence in order not to get spurious results from the following methods it is necessary domestic interest rate, foreign interest rates, and the exchange rate to be integrated of order one I(1) and forward premium and the exchange rate yield follow stationary process I(0). Using two tests of the unit-root gives the paper advantage to double check the reliability of the results, since it is widely accepted by the econometricians that the power of ADF and KPSS tests is not high enough.

(ii), in order to visualize the process going on between Hungary and EU, as an informal check I show on the graph whether the exchange rate changes minus domestic and foreign interest rate differential ($\Delta S_{t,t+k} - i_{t,k} - i^*_{t,k}$) is stable over time. If in Hungary UIP condition holds, excess return on investment must be stochastic process.

(iii) The second way of checking the UIP condition is through the UIP regression equation (5), with the null hypothesis $\beta=1$. If the null hypothesis holds, domestic and foreign interest rate differential is an unbiased estimator of the exchange rate yield, hence the interest rate spread is equalized with the exchange rate yield, and the uncovered interest rate parity holds.

(iv) I use bivariate Vector Error Correction Model (VECM), which puts together short and long-run relationships of the domestic and foreign interest rates. VECM measures the correction of last period's deviation from equilibrium and co-integrating relationships prevents error term to become larger and larger in the long-run. The VECM equation, using one lag for simplicity, looks as follows:

$$\begin{pmatrix} \Delta \mathbf{i}_t \\ \Delta \mathbf{i}_t^* \end{pmatrix} = \beta_1 \begin{pmatrix} \Delta \mathbf{i}_{t-1} \\ \Delta \mathbf{i}_{t-1}^* \end{pmatrix} + \pi \begin{pmatrix} i_{t-1} \\ \mathbf{i}_{t-1}^* \end{pmatrix} + \varepsilon_t$$
(7)

where β_1 is 2x2 matrix and presents the short run effect, π is also 2x2 matrix, which equals zero in case of no-co-integration between interest rates, and $\pi = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \mathbf{x}(\mathbf{b}_{11} & \mathbf{b}_{12})$ if there is one co-integration vector, where *a* is adjustment speed after the last period's disequilibrium and ($\mathbf{b}_{11} & \mathbf{b}_{12}$) is the co-integration vector (Johansen, 1995).

5. Empirical Evidence

5.1 ADF and KPSS tests

First I present the results of unit-root tests described in section 3 part (i). Table 3,4 and 5 show the ADF and KPSS test results for all one, five, and ten year domestic(i_t) interest rates, foreign (i_t^*) interest rates, forward premium (i_t - i_t^*), exchange rates (S_t), and the exchange rate yield ($\Delta S_{t,t+k}$). Table 3 shows that both the ADF and KPSS tests report unit-root processes for all three maturity interest rates, thus I can use the results for father investigation.

Table 3					
ADF and KPSS tests	8				
Domestic and foreign	n interest rates				
Time horizon: 2001.0	05-2010.12;				
Lag length: 3					
	ADF statistic	LM-Stat			
1 Year					
Hungary	-2.45	0.56**			
	-1 47				
ECB	(0.54)	0.94***			
LIS A	-1.15	0.62**			
0011	(0.69)	0.02			
WA	-1.4	0.88***			
-	(0.58)	0.00			
5 year					
Hungary	-2.73	0.11**			
	(0.09)				
ECB	-1.88	1.09***			
	(0.33)				
USA	-1.95	0.48**			
	(0.3)				
WA	-2.08	0.53**			
10 year	(0.25)				
it year	-2 47				
Hungary	(0.12)	0.36*			
ECE	-2.22				
ECB	(0.19)	1.26***			
	-2.26	1 26***			
USA	(0.18)	1.30***			
W/ A	-2.21	1 27***			
WA	(0.2)	1.2/****			
*/**/*** denotes rejection of the hypothesis at 10%,5% and 1% respectively					
P-Values in parenthe	sis				

Table 4 stands for the domestic (H) and foreign (ECB; USA; WA) interest rate differentials (it- i^*_t), ADF and KPSS tests suggest the stationary process in Hungary versus the ECB and the WA (H-ECB; H-WA) cases for one year government bonds, while accepting unit-root processes for the rest of the cases. Depending on the results, it is not expected the UIP condition to hold for five and ten year interest rates, since by the definition of non-stationarity, the excess return is never predictable. However it is expected the UIP condition to hold for one year government bond interest rates in relationship with the ECB and the WA.

Table 4

ADF and KPSS tests							
Domestic (Hungary	Domestic (Hungary) and foreign (ECB, US, WA) interest rate differential						
Time horizon: 2001	Time horizon: 2001.05-2010.12;						
Lag length: 3							
	ADF statistic	LM-Stat					
1 Year	1 Year						
H-FCB	-2.64***	0.18					
11 202	(0.08)	0.10					
H-USA	-2.11	0.36*					
	(0.24)						
H-WA	-2.7*	0.19					
	(0.06)						
5 vear	-2.46	0.53**					
- ;	(0.12)						
H-ECB	-2.31	0.51**					
	(0.17)						
H-USA	-2.47	0.51**					
	(0.12)						
H-WA							
10 year							
H-ECB	-2.17	1.15***					
	(0.22)						
H-USA	-2.17	0.93***					
	(0.22)						
H-WA	-2.17	1.14***					
	(0.22)						
*/**/*** denotes rejection of the hypothesis at 10%,5% and 1% respectively							
P-Values in parenth	nesis						

Table 5 shows the unit- root tests for exchange rates, exchange rate yields and states that the KPSS test rejects stationary process for all three (Ft/EUR; Ft/USD; Ft/WA) exchange rates at one percent level, though ADF test rejects the unit-root processes for Ft/EUR and Ft/WA at ten and five percents levels respectively. Since both tests show that all three first differences (Δ Ft/EUR; Δ Ft/USD; Δ Ft/WA) follow stationary process, I can use the results for excess return investigation, the UIP regression equation and the bivariate vector error correction model, in order to investigate the validity of the UIP condition in Hungary.

Table 5						
ADF and KPSS tests	ADF and KPSS tests					
Exchange rates and E	Exchange rate differetials					
Time horizon: 2001.0	05-2010.12;					
Lag length: 3						
	ADF statistic	LM-Stat				
Ft/EUR	-2.67*	1.28***				
	2 42					
Ft/USD	(0.14)	1.55***				
Ft/WA	-3**	0.84***				
	(0.037)					
ΔFt/EUR	-6.24***	0.038				
	(0)					
∆Ft/USD	(0)	0.24				
	6.14***	0.04				
ΔFt/WA	(0)	0.04				
*/**/*** denotes rejection of the hypothesis at 10%; 5%; 1%						
P-Values in parenthe	P-Values in parenthesis					

5.2 Informal Check

The first way of testing the validity of the UIP condition is to check whether the excess return $(i_{t,k} - i_{t,k}^* \Delta S_{t,t+k})$ in Hungary is stable over time. Since the EU contribution to Hungarian economy is 90%, and it would be the best estimate to show the process, I take Hungary versus the European Central Bank interest rates and Ft/EUR exchange rate. The investigation shows whether the exchange rate yield minus domestic and foreign interest rate differential follows the stationary process for one, five and ten year interest rates. The hypothesis says that, if the excess return is stable over time, there is an implication for the UIP condition to hold. The idea behind is that, since the time-series is stationary process, it does not contain trend or random walk, hence it is predictable in sense that mean of the time-

series always returns around to its long-term equilibrium and the variance stays constant over

time.

Figure 1

 $i_{t,k}$ - $i^*_{t,k}$ - $\Delta S_{t,t+k}$: Hungary versus ECB interest rates and Ft/EUR exchange rate Time horizon: Full Sample: 2001.05-2010.12;



Figure 1 stands for the unit-root processes for one, five, and ten year maturity excess returns and shows that the only stationary process is presented for one year interest rates, while five and ten year cases follow the unit-root process. The results imply that the one year interest rate is a stochastic process without any specific trend, which is the condition for the UIP to hold. The same in not true for five and ten year interest rates, the figure shows nonstationary behavior of the time-seris during the sample period, which automatically excludes the possibility for the UIP to hold. Using ADF and KPSS test statistics, Table 6 supports the figure 1 by showing that, the only stochastic process is conducted for one year interest rates, however the test statistics strongly accept the unit-root processes for five and ten year interest rates.

ADF and KPSS tests							
$i_{t,k}$ - $i_{t,k}^*$ - $\Delta S_{t,t+k}$: Hungary versus ECB interest rates and Ft/EUR exchange rate for one, five and ten							
year government bonds.							
Time horizon: 2001.05	-2010.12;						
Lag length: 3							
	ADF statistic	KPSS statistic					
1 voor	-2.64*	0.17					
1 year	(0.08)	0.17					
5	-2.44	0 51**					
5 year	(0.13)	0.31***					
10	-2.11	1 15***					
10 year	10 year (0.24) 1.15***						
*** denotes rejection of	of the hypothesis at 1%;						
P-Values in parenthesis	5						

5.3 UIP Regression Equation

Table 6

The second way of testing the validity of the UIP condition in Hungary is by investigating the slope coefficient in the UIP regression equation (5) with the null hypothesis β =1. The standard error in the regression is calculated by the Newey-West method, which corrects for autocorrelation in the residual (ε_t). The autocorrelation is quite common feature for the financial data, since there is high probability for future interest and exchange rates to be correlated with the last period's rates. Bilson (1981) and Longworth (1981) found that the spot exchange rates it the better estimator of future realized rate, than the future expected rate is, since the exchange rates behave like random walk.

The Tables 7, 8, 9 show the results of the UIP regression equation for, one, five and ten year government bond rates respectively. The evidence from Hungary shows the slope coefficients for full sample are negative in most of the cases, or positive but insignificantly different from zero. In the case of Hungary versus USA, slope coefficient for ten year government bond rate performs closest to the null hypothesis (β =1) and equals to 0.42, however results are statistically not significant. Hence, for the whole sample period there is no evidence for the UIP to hold in Hungary.

During the second half of the sample, (after the EU accession) statistically significant results are in relationship with the EU and the WA, but higher than the null hypothesis (β =1). The implication about the slope coefficient higher than one can be the global financial crisis in 2007-2009, which made currency to depreciate (Figure 2) due to capital inflow slowdown in Hungary.

Figure 2

Exchange rates: Ft/EUR; Ft/ESD; Ft/WA Time horizon: May,2001- December, 2010



The conclusion that can be made from Tables 7, 8 and 9 is that, there is no statistically significant evidence that suggest the uncovered interest rate parity to hold during the May, 2001- December, 2010 for one, five, and ten year maturity government bond interest rates.

The results are in line with Lewis (1984), and state that the interest rate spread is a very poor

predictor of the exchange rate yields.

Testing Uncovered Intere	st Rate Parity							
Regression equation: ΔS_{t_i}	$_{t+k} = \mathfrak{a} + \beta (\dot{i}_{t,k} - i^*_{t,k}) +$	$\varepsilon_{t,t+k}$						
1 year government bond	rates: Hungary versus E	uropean Central Bank	and the United States					
Time horizon: Full Samp	le: 2001.05-2010.12; Su	ıb Sample: 2004.05-20	10.12					
	β	Std.error	t-stat					
Full Sample	Full Sample							
H-ECB	-0.344	0.33	-1.03					
H-USA	-0.21	0.35	-0.6					
H_WA	-0.4	0.36	-1.11					
Sub Sample								
H-ECB	2.83	0.85	3.33***					
H-USA	-0.16	0.81	-0.2					
H-WA	3.06	0.92	3.3***					
* denotes rejection of the	hypothesis at the 0.01 l	evel						
	J							
Table 8								
Testing Uncovered Intere	st Rate Parity							
Regression equation: $\Delta S_{t,i}$	$_{t+k} = \mathfrak{a} + \beta (i_{t,k} - i_{t,k}^*) +$	$\varepsilon_{t,t+k}$						
5 year government bond i	rates: Hungary versus E	uropean Central Bank	and the United States					
Time horizon: Full Samp	le: 2001.05-2010.12; Su	ıb Sample: 2004.05-20	10.12					
	β	Std.error	t-stat					
Full Sample								
H-ECB	-0.45	0.48	-0.93					
H-USA	0.01	0.52	0.03					
H_WA	-0.41	0.53	-0.78					
Sub Sample								
	5 70	1 1 2	5 1 / ***					
H-ECB	5.78	1.12	5.14					
H-ECB H-USA	0.53	1.12	0.48					
H-ECB H-USA H-WA	5.78 0.53 6.058	1.12 1.11 1.24	0.48 4.9***					
H-ECB H-USA H-WA *** denotes rejection of t	5.78 0.53 6.058 he hypothesis at the 0.0	1.12 1.11 1.24 1 level	0.48 4.9***					
H-ECB H-USA H-WA *** denotes rejection of t Table 9	5.78 0.53 6.058 he hypothesis at the 0.0	1.12 1.11 1.24 1 level	0.48 4.9***					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere	5.78 0.53 6.058 he hypothesis at the 0.0	1.12 1.11 1.24 1 level	0.48 4.9***					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: ΔS ₁	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $t_{t+k} = a + \beta (i_{t,k} - i_{t,k}^*) + \beta (i_{t,k} - i_{t,$	1.12 1.11 1.24 1 level ε _{t t+k}	0.48 4.9***					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: ΔS _t , 10 year government bond	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $_{t+k} = a + \beta (i_{t,k} - i^*_{t,k}) + 1$ rates: Hungary versus	1.12 1.11 1.24 1 level $\varepsilon_{t,t+k}$ European Central Bank	0.48 4.9***					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: ΔS _t , 10 year government bond Time horizon: Full Samp	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $_{t+k} = a + \beta (i_{t,k} - i^*_{t,k}) + \beta$ I rates: Hungary versus 1 le: 2001.05-2010.12; Su	1.12 1.11 1.24 1 level $\epsilon_{t,t+k}$ European Central Bank ib Sample: 2004.05-20	0.48 4.9***					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: $\Delta S_{t,t}$ 10 year government bond Time horizon: Full Samp	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $t_{t+k} = a + \beta (i_{t,k} - i^*_{t,k}) + l$ rates: Hungary versus 1 le: 2001.05-2010.12; Su β	1.12 1.11 1.24 1 level ε _{t,t+k} European Central Bank ıb Sample: 2004.05-20 Std.error	0.48 4.9*** 4.9*** t-stat					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: ΔS _t , 10 year government bond Time horizon: Full Samp Full Sample	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $t_{t+k} = a + \beta (i_{t,k} - i^*_{t,k}) + 1$ rates: Hungary versus 1 le: 2001.05-2010.12; Su β	1.12 1.11 1.24 1 level $\epsilon_{t,t+k}$ European Central Bank b Sample: 2004.05-20 Std.error	0.48 4.9*** x and the United States 10.12 t-stat					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: ΔS _t , 10 year government bond Time horizon: Full Samp Full Sample H-ECB	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $_{t+k} = a + \beta (i_{t,k} - i^*_{t,k}) + 1$ rates: Hungary versus 1 le: 2001.05-2010.12; Su β -0.03	1.12 1.11 1.24 1 level $\epsilon_{t,t+k}$ European Central Bank b Sample: 2004.05-20 Std.error 0.6	0.48 4.9*** 4.9*** t-stat -0.05					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: $\Delta S_{t,i}$ 10 year government bond Time horizon: Full Samp Full Sample H-ECB H-USA	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity t+k = $a + \beta (i_{t,k} - i^*_{t,k}) + \beta$ le: 2001.05-2010.12; Su β -0.03 0.42	1.12 1.11 1.24 1 level $\epsilon_{t,t+k}$ European Central Bank 1b Sample: 2004.05-20 Std.error 0.6 0.6 0.66	0.48 4.9*** 4.9*** t-stat -0.05 0.63					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: ΔS _t , 10 year government bond Time horizon: Full Samp Full Sample H-ECB H-USA H_WA	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $t_{t+k} = a + \beta (i_{t,k} - i^*_{t,k}) + t_{t}$ 1 rates: Hungary versus 1 le: 2001.05-2010.12; Su β -0.03 0.42 0.09	$1.12 \\ 1.11 \\ 1.24 \\ 1 level \\ \epsilon_{t,t+k} \\ European Central Bank \\ 1b Sample: 2004.05-20 \\ Std.error \\ 0.6 \\ 0.6$	0.48 4.9*** and the United States 10.12 t-stat -0.05 0.63 0.14					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: ΔS _t , 10 year government bond Time horizon: Full Samp Full Sample H-ECB H-USA H_WA Sub Sample	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $_{t+k} = a + \beta (i_{t,k} - i^*_{t,k}) + 1$ rates: Hungary versus 1 le: 2001.05-2010.12; Su β -0.03 0.42 0.09		0.48 4.9*** 4.9*** 10.12 t-stat -0.05 0.63 0.14					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: ΔS _t , 10 year government bond Time horizon: Full Samp Full Sample H-ECB H-USA H_WA Sub Sample H-ECB	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $_{t+k} = a + \beta (i_{t,k} - i^*_{t,k}) + 4$ 1 rates: Hungary versus 1 le: 2001.05-2010.12; Su β -0.03 0.42 0.09 9.64	$\frac{1.12}{1.11}$ 1.24 1 level $\epsilon_{t,t+k}$ European Central Bank b Sample: 2004.05-20 Std.error 0.6 0.66 0.66 0.66 1.4	0.48 4.9*** a and the United States 10.12 t-stat -0.05 0.63 0.14 6.8***					
H-ECB H-USA H-WA *** denotes rejection of t Table 9 Testing Uncovered Intere Regression equation: ΔS _t , 10 year government bond Time horizon: Full Sample H-ECB H-USA H_WA Sub Sample H-ECB H-USA	5.78 0.53 6.058 he hypothesis at the 0.0 est Rate Parity $_{t+k} = a + \beta (i_{t,k} - i^*_{t,k}) + \beta$ le: 2001.05-2010.12; Su β -0.03 0.42 0.09 9.64 1.77	$1.12 \\ 1.11 \\ 1.24 \\ 1 level \\ \epsilon_{t,t+k} \\ European Central Bank \\ 1b Sample: 2004.05-20 \\ Std.error \\ 0.6 \\ 0.66 \\ 0.66 \\ 1.4 \\ 1.4 \\ 1.43 \\ 0.6 \\ 0.66 \\$	0.48 4.9*** 4.9*** in the United States 10.12 t-stat -0.05 0.63 0.14 6.8*** 1.23					

*** denotes rejection of the hypothesis at the 0.01 level

5.4 Vector Error Correction Model

As it was described in section 3 part (iv), when $\Delta S_{t,t+k}$ is I(0) process and $i_{t,k}$, $i^*_{t,k}$ are I(1) processes, the equation (5) implies that there exists co-integrating relationship between domestic and foreign interest rates with the co-integration vector (1,-1). Therefore depending on the UIP regression equation, under (1, -1) co-integration vector between the domestic and foreign interest rates the UIP condition holds in Hungary.

Table 10, 11, 12 stands for one, five and ten year co-integrating relationships between domestic and foreign interest rates.³ The results are significantly improving after the EU accession, the economic interpretation behind can be that the perceived risk of Hungarian financial instruments decreased after the EU accession. Hence capital inflow more than doubled compared to the first sub sample, Figure 3 shows the yearly foreign direct investments (FDI) into Hungary, the figure reports that after the EU accession the FDI more than doubled, however the global financial crises had its own effect on it.

Foreign Direct Investments (FDI) to Hungary
Time horizon: 2001-2010 (Yearly Data)



³ The lags for the co-integration test are chosen according to the lags that minimized Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC).

Figure 3

The increasing foreign direct investment supported the decline in interest rates, which were more in line with the appreciated currency at that time for one year interest rates; even though the global financial crisis in 2007-2009 forced interest rate increase and the currency depreciation. Figure 4 shows the development of one, five and ten year Hungarian government bond interest rates, and shows that the interest rates are very sensitive to capital inflows, especially for one year interest rates.







This result contradicts the finding of Bruggemann and Lutkepohl (2005), Chinn and Meredith (2005) that, the UIP condition holds better in the long-run, because in the long-run interest rates and exchange rates are driven by the economic fundamentals. However, it is in line with the finding of Weber (2010) that, in the case of ten year government bonds the UIP condition does not hold, and interprets the results as an outcome of the Central Bank reactions on interest rate volatilities in favor of establishing the Euro currency.

Table 10

Bivariate Co-integration test

1 year government bonds: Hungary versus European Central Bank and the United States Time horizon: Full Sample: 2001.05-2010.12; Sub Sample: 2004.05-2010.12 Lag length: 3

	P-Val	ue	Co-integration Vector			
Full Sample						
	r=0	r=1	Hungary	ECB		
H-ECB	0.16	0.12	1	-0.78 (0.45)		
			Hungary	USA		
H-USA	0.53	0.3	1	-0.12 (0.44)		
			Hungary	WA		
H-WA	0.13	0.12	1	-0.8 (0.45)		
Sub Sample						
	r=0	r=1	Hungary	ECB		
H-ECB	0.006	0.11	1	-1.09 (0.29)		
			Hungary	USA		
H-USA	0.36	0.66	1	-0.57 (0.39)		
			Hungary	WA		
H-WA	0.01	0.1	1	-1.07 (0.31)		
Std. error in parenthesis						

Table 11

Bivariate Co-integration test

5 year government bonds: Hungary versus European Central Bank and the United States Time horizon: Full Sample: 2001.05-2010.12; Sub Sample: 2004.05-2010.12 Lag length: 3

P-Value			Co-integration Vector	
Full Sample				
	r=0	r=1	Hungary	ECB
H-ECB	0.16	0.05	1	-0.01 (0.53)
			Hungary	USA
H-USA	0.23	0.1	1	0.11 (0.4)
			Hungary	WA

H-WA	0.18	0.06	1	-0.1 (0.55)		
Sub Sample						
	r=0	r=1	Hungary	ECB		
H-ECB	0.11	0.06	1	-0.66 (0.57)		
			Hungary	USA		
H-USA	0.46	0.35	1	0.1 (0.4)		
			Hungary	WA		
H-WA	0.14	0.08	1	-0.58 (0.59)		
Std. error in parenthesis						

Table 12

Bivariate Co-integration test

10 year government bond rates: Hungary versus European Central Bank and the United States Time horizon: Full Sample: 2001.05-2010.12; Sub Sample: 2004.05-2010.12 Lag length: 3

	P-Value		Co-integration Vector	
Full Sample				
	r=0	r=1	Hungary	ECB
H-ECB	0.22	0.05	1	0.83 (0.74)
			Hungary	USA
H-USA	0.13	0.03	1	1.02 (0.48)
			Hungary	WA
H-WA	0.23	0.05	1	0.89 (0.77)
Sub Sample				
	r=0	r=1	Hungary	ECB
H-ECB	0.27	0.03	1	-2.15 (1.12)
			Hungary	USA
H-USA	0.38	0.08	1	0.97 (0.51)
			Hungary	WA
H-WA	0.31	0.03	1	-1.2 (1.07)

Std. error in parenthesis

6. Summary of the Results

As it is described in section 5, the results are quite mixed and ambiguous depending on the methods and the time period used for investigation. In this section I summarize the results for each method.

As it is described in section 5.1, as a precondition for the following methods to make sense I tested unit-root processes for domestic interest rates, foreign interest rates, forward premium, exchange rate, and exchange rate yield. The results show that all three interest rates are I(1) process, the one year forward premium, Hungary versus the ECB and the WA are I(0) process, and five and ten year forward premiums follow unit-root process. Therefore it is expected that the UIP condition only holds for one year government bond interest rates.

The exchange rate investigation follows the theory and reports that the all three exchange rates are I(1) processes, while exchange rate yields are I(0). The finding supports the following methods used for testing the UIP condition in Hungary.

The first method investigates the excess returns on Hungarian versus the European Central Bank interest rates for one, five and ten year government bonds. Both the figure and the unitroot tests show that the one year excess return follows a stationary process; hence there is an implication for the UIP condition. The result might be implied by the fact, that the trade volume of one year government bonds is about three times bigger (National Bank of Hungary) than that of five and ten year bonds. Hence the perceived risk of one year government bonds is much lower and the demand is much higher, which eliminates arbitrage opportunity for one year interest rates in the country.

The second method used for investigation, is by estimating the UIP regression equation (equation 5), in other words, testing "the Unbiasedness Hypothesis". "The Unbiasedness Hypothesis" implies that, if the results are consistent with the hypothesis $\beta=1$, domestic and

the foreign interest rate differential is an unbiased estimator of the exchange rate yield. The results are statistically significant only for sub sample (after the EU accession) in relationship with the ECB and the WA; however the slope coefficient is more than unity. The implication behind β >1 can be the global financial crisis in 2007-2009, which made the Hungarian Forint to depreciate as a result of decline in foreign direct investments in Hungary. However, testing the UIP regression equation in Hungary states that the forward premium (i_t - i_t^*) is a very poor predictor of the exchange rate yield (Δs_{t+k}^e), hence there is no evidence for the UIP condition for any interest rates in Hungary.

The third method described in sub section 5.5, estimates the UIP condition with the help of bivariate Vector Error Correction Model (VECM). Sample is divided into two parts, whole sample and after the EU accession. The co-integration vectors provided by the VECM contradict the UIP regression equation, and present that the UIP condition is more likely to hold during the second half of the sample in relationship with the European Central Bank and the Weighted Average interest rates.

The economic implication behind the result can be that the market efficiency is getting better off from the second half of the sample, which can be explained by the loosening control of capital movements in the country especially with the European Union. Apparently the EU accession decreased the perceived risk of Hungarian financial instruments; even though the accession was anticipated well ahead. Also economic situation in Hungary was affected by the global financial crisis during the sub sample, which forced Forint to depreciate and made the exchange rate yield more in line with the forward premium especially for one year interest rates.

The evidence in favor of the UIP condition in Hungary is quite ambiguous and differs depending on the method and the sample period used for investigation. Testing the excess returns for whole sample supports the UIP condition in relationship with the EU and the WA for one year interest rates. The UIP regression equation states no evidence for the UIP condition to hold and shows that the only significant slope coefficients are higher than unity explained by the financial crisis in 2007-2009. However the bivariate VECM contradicts the UIP regression equation, and presents the evidence in favor of the UIP condition, explained by the decreased perceived risk of Hungarian financial instruments and the effect of the global financial crisis during the sub sample.

Around ninety percent of foreign direct investments in Hungary, and mostly all kind of economic relationships are connected with the European Union, therefore currency and interest rate volatilities highly depend on the EU movements.

Since the Weighted Average consists ninety percent of EU interest and exchange rates and the ten percent of the US interest and exchange rates, the results for all the cases are in line with the ECB results.

The advantage of one year government bonds in terms of the UIP condition is that their trading volume is three times bigger than that of five and ten year bonds (The National Bank of Hungary). The high demand on government bonds eliminates the opportunity of getting higher excess returns, thus there stays no room for arbitrage.

Conclusion

Using different methods, I found ambiguous results in favor of the uncovered interest rate parity condition in Hungary. The results differ according to the methods and the sample period taken for the estimation. I use monthly data for one, five and ten year government bond rates of Hungary (domestic), the European Central Bank (ECB), the Federal Reserve Bank of the US and the Weighted Average (WA) of ECB and US (foreign), according to their contribution to Hungarian economy (FDI). As an exchange rate I use Hungarian Forint value of the EUR, the USD and the WA.

First, as a precondition I test unit-root processes in domestic interest rates, foreign interest rates, forward premium, exchange rate and the exchange rate yield. The results imply that the UIP condition is expected to hold only for one year government bonds in relationship with the ECB and the WA. I use three different methods for investigation: (i) First method shows on the figure the development of the excess returns ($\Delta S_{t,t+k} - (i_{t,k} - i^*_{t,k})$) during the sample period for different maturity government bonds. The Figure visualizes whether the exchange rates yield ($\Delta S_{t,t+k}$), and the forward premium ($i_{t-i}^*_{,t}$) differential follows stationary process. (ii) The second method estimates the UIP regression equation (equation 5), and with the help of the slope coefficient, investigates whether the exchange rate yield and the forward premium are equalized (β =1). For the UIP regression equation the data are divided into two parts: whole time period (May, 2001- December, 2010), and the period after the EU accession (May 2004-December, 2010). (iii) Third method runs the bivariate Vector Error Correction Model (VECM), and determines the co-integrating relationships between the different maturity domestic and foreign interest rates for two time periods: whole sample and the sub sample after the EU accession.

The implications for the UIP condition in Hungary are quite mixed, and contradictory in some cases. The excess return (i) supports the UIP condition for one year interest rates, in relationship with the ECB and the WA.

The UIP regression equation (ii) reports the only statistically significant slope coefficient for sub sample (after EU accession) in relationship with the EU and the WA. This can be interpreted by Forint depreciation as a result of the global financial crisis during 2007-2009. however the test does not show any evidence in favor of the UIP condition in Hungary.

The co-integration vectors (iii) imply the UIP condition during the sub sample (after the EU accession), for one year interest rates in relationship with the EU and the WA. The results are contradictory with finding of the UIP regression equation, but it can be interpreted as a result of the decrease in perceived risk of Hungarian financial instruments after the EU accession. The evidence was also encouraged by the currency depreciation in Hungary during and after the global financial crisis.

As it is shown in the paper, the uncovered interest rate parity is more likely to hold for one year interest rates, but because the results are quite ambiguous, the UIP condition in Hungary remains puzzle. Therefore there is still room left for further investigation.

References

- Arvai, Zsofia, 2005, "Capital Account Liberalization, Capital Flow Patterns, and Policy Responses in the EU's New Member States," IMF Working Paper No. 05/213.
- Asteriou, D. and S. G. Hall (2007). "Applied econometrics: A modern approach". New York: Palgrave Macmillan
- Bilson,J. (1981), "The Speculative Efficiency Hypothesis, "Journal of Business, Vol.54 pp. 433-54
- Brenner, R. J., and Kroner, K. F. (1995), "Arbitrage, Cointegration, and Testing the Unbiasedness Hypothesis in Financial Markets," Journal of Financial and Quantitative Analysis, 30, 23-42.
- Brüggemann, R., Lütkepohl, H., 2005. "Uncovered interest rate parity and the expectations hypothesis of the term structure: empirical results for the U.S. and Europe". SFB 649 Economic Risk Discussion Paper 2005-035.
- Chinn, M.D., Meredith, G., 2005. "Testing uncovered interest parity at short and long horizons during the Post-Breton Woods era". NBER Working Paper No. 11077.
- Chinn, Menzie D. (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.
- Engel, R., 1996, The forward discount anomaly and the risk premium: A survey of recent evidence, National Bureau of economic research.
- Engle, R. F, D. M. Lilien, and R. P. Robins (1987): "Estimating Time Varying Risk Premia in the Term Structure: The ARCH-M Model," Econometrica, 55, 391-408.
- European Central Bank Bond rates (1, 5 and 10 years) over the period of 1999Jan-2010Dec <u>http://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=143.FM.M.U2.EUR.4F.BB.R</u> <u>U2_10Y.YLDA&periodSortOrder=ASC</u>
- Fama, Eugene F. "Forward and Spot Exchange Rates," J. Monet. Econ., Nov. 1984, 14(3), pp. 319-38.
- FDI in Hungary during 2001-2010: www.mnb.hu
- Flood, Robert B., and Andrew K. Rose (2002) "Uncovered interest parity in crisis", International Monetary Fund Staff Papers 49, 252-66
- Frankel, J.A., Poonawala, J., 2006. "The forward market in emerging currencies less biased than in major currencies". NBER Working Paper No.12496
- Froot, K. A., and R. H. Thaler, 1990, "Anomalies: Foreign Exchange," Journal of Economic Perspectives, 4, 179-192.

- Hungarian Government bond rates (1, 5 and 10 years), Exchange rates and foreign direct investments over the period of 1999Jan-2010Dechttp://english.mnb.hu/Statisztika/data-and-information/mnben_statisztikai_idosorok
- Johansen, S. (1988a): "Statistical Analysis of Co-integration Vectors," Journal of Economic Dynamics and Control, 12, 231-255.
- Lewis, Karen. "Puzzles in International Financial Markets," in Gene Grossman and Ken-Neth Rogoff, eds. 1995.
- Longworth, David, "Testing the Efficiency of the Canadian-U.S. Exchange Market Under the Assumption of No Risk Premium," Journal of Finance, Vol. 36 (March 1981), pp. 43-49
- McCallum, B.T., 1994a. "A reconsideration of the uncovered interest parity relationship". Journal of Monetary Economics 33, 105–132.
- US Federal Government Securities rates (1, 5 and 10 years) over the perios of 1999Jan-2010Dechttp://www.federalreserve.gov/econresdata/releases/statisticsdata.htm
- Weber, E., "What happened to the transatlantic capital market relations"? Econ. Model. (2010), doi:10.1016/j. econmod.2010.10.017