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Analysis of the Dynamic Relation between the Currency Rates and the Interest Rates from Romania and Euro Area before and during the Financial Crisis

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Abstract: This paper examines the changes induced by the actual financial crisis in the dynamic relation between the currency rates and the differentials of the interest rates from Romania and euro area. In the framework of the Uncovered Interest Rate Parity hypothesis we apply the Vector Autoregressive methodology for daily values of the currency rates and the interest rates during the crisis. We compare the results obtained with a similar analysis for a period of time before the crisis began and we find significant differences.

Keywords: Uncovered Interest Rates Parity, Vector Autoregressive Model, Financial Crisis, Romanian Foreign Exchange Market
JEL Classification: G01, G14, G19

1. Introduction

The relation between the exchange rates and the interest rates differentials is among the topics of the international finance. It was approached in many theoretical models, most known of them being the uncovered interest rates parity (UIRP), which stipulates that interest rates differentials between two countries could be considered as an estimator for the expected change in the exchange rate.

The basic equation of UIRP is:

$$(1 + i_t^h) / (1 + i_t^f) = E_t (S_{t+T}) / S_t \quad (1)$$

where:

- i_t^h is the return at time t on a domestic asset which arrived to maturity at the moment t + T;
- i_t^f is the return on a comparable foreign asset;
- S is the nominal exchange rate expressed as the price, in the domestic currency, of a unit of the foreign currency;
- $E_t (S_{t+T})$ is the expected value of the exchange rate at time t+T, based on the information available at time t.

On the assumption of rational expectations we may consider that on average:

$$E_t (S_{t+T}) = S_{t+T} \quad (2)$$

Taking natural logarithms we obtain:

$$\ln (S_{t+T}) - \ln (St) \approx \ln i_t^h - \ln i_t^f \quad (3)$$

The fundamental equation of UIRP can be expressed as:

$$\ln (S_{T+t}) - \ln (S_t) = \alpha + \beta [\ln (i_t^h) - \ln (i_t^f)] + \varepsilon_t \quad (4)$$

Meredith and Chinn (1998) formulated the unbiasedness hypothesis of UIRP imposing the conditions $\alpha = 0$ and $\beta = 1$.

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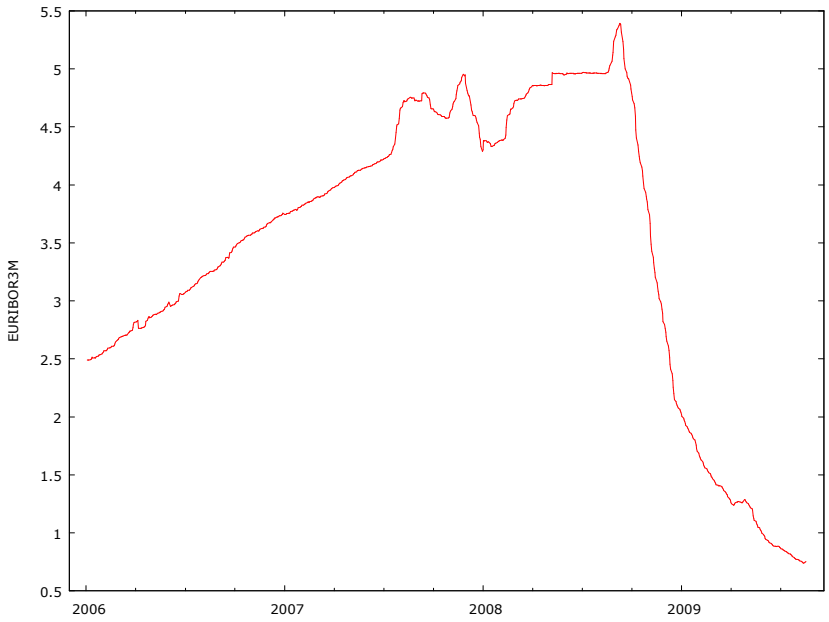
According to UIRP, the national currency of a country with high interest rates tends to depreciate. However, empirical studies revealed numerous situations in which UIRP wasn't validated. Froot and Thaler (1990) surveyed 75 studies on UIRP and they found the unbiasedness hypothesis of UIRP was confirmed only in few cases. Empirical researches identified some particularities of UIRP. Meredith and Chinn (1998) found that in general UIRP was validated on long term but invalidated on short term. McCallum (1994) explained such a situation by the role of short term interest rates as monetary policy instruments. When an economy is affected by a negative shock the national currency depreciates. The monetary authorities react to this shock by raising the interest rates. After the shock is dissipated the national currency appreciates and the monetary authorities lower the interest rates. In the specialised literature there were revealed some particularities of the relation between the exchange rates and the interest rates in the emerging markets or during the financial crisis. Francis et al (2002) found the emerging market liberalization provoked mixed effects on the uncovered interest rate parity for the countries from Latin America and Asia. Flood and Rose (2001) proved that for countries in crisis, when the volatility of the exchange rates and the interest rates increase and the monetary authorities have to deal with speculative pressure, UIRP may work differently.

In this paper we approach the relation between the currency rates and the interest rates from Romania and from the Euro Area before and after the financial crisis. In the last years these variables were significantly affected by the global crisis. The nominal exchange rates RON / EUR which reflect the price of a unit of euro in the Romanian national currency decreased from 2006 to the first half of 2007. During the second half of 2007 they experienced a significant depreciation followed by a relative stabilization in the first half of 2008. In the second half, in the global crisis context a sharp depreciation occurred and it was followed by a more calm evolution during the first three quarters of 2009 (Figure 1).

Figure 1. Evolution of nominal exchange rate RON/EUR
from January 2006 to September 2009

The interest rates in the Euro Area experienced an almost regular growth at the beginning of 2006 to the end of 2007. After a fluctuant evolution, in the first three quarters of 2008 the European Central Bank cut the interest rates in order to stimulate the economic activity, affected by the global crisis (Figure 2).

Figure 2. Evolution of EURIBOR 3M
from January 2006 to September 2009



In Romania from the beginning of 2006 to the end of 2007 the interest rates were relatively stable and much higher than in the Euro Area. During the first half of 2008 the National Bank of Romania (NBR) slowly increased the interest rates. In the third quarter of 2008, in the context of the global crisis, speculative attacks were directed against the national currency. NBR reacted by increasing for a short period of time the interbank interest rates to almost 50 percent per annum. After that, in order to stimulate the economy, the interest rates were reduced (Figure 3).

In our analysis we use sub-samples of data from two periods of time: before and after the global crisis affected the exchange rates and the interest rates. We test the unbiasedness hypothesis of UIRP using simple regressions. Then we analyze, in a Vector Autoregressive (VAR) framework, the interactions between the interest rates differentials and the exchange rates.

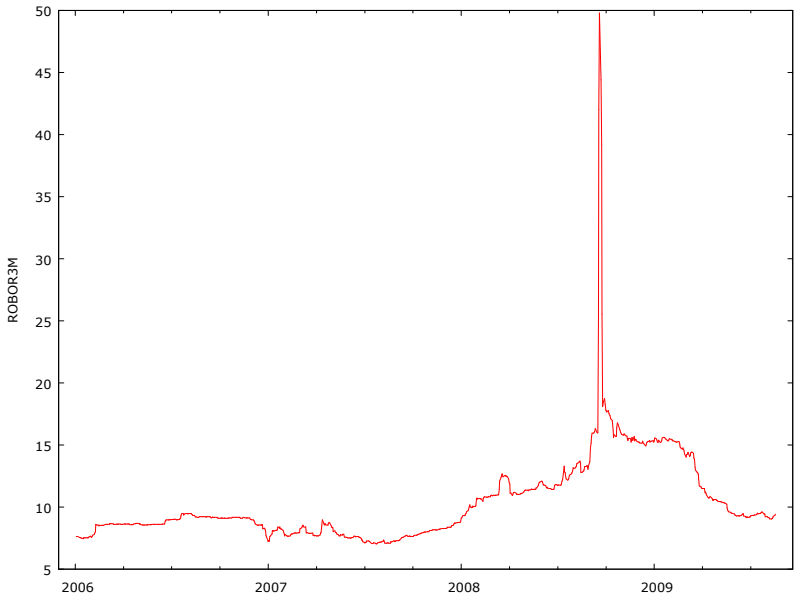
The rest of the paper is organized as follows. In the second part we describe the data and the methodology used in our investigation. In the third part we present the empirical results and in the fourth part we conclude.

2. Data and Methodology

In our investigation we employ daily values of the exchange rate RON / EUR and the interbank offered rates from the Euro Area and from Romania. We use two variables:

- neer, as natural logarithm of the nominal exchange rate RON / EUR;
- dif, as differences between the natural logarithms of ROBOR 3M and natural logarithms of EURIBOR 3 M;
- d_neer, as first differences of neer;
- d_dif, as first differences of dif.

Figure 3. Evolution of ROBOR 3M
from January 2006 to September 2009



The data are from January 2006 to September 2009. We divide this sample in two sub-samples:

- first sub-sample, from the 3rd of January 2006 to the 23rd of July 2008, corresponding to a relative tranquil period;
- second, from the 24th of July 2008 to the 30th of September 2009, when the impact of the global crisis on the exchange rates and on the interest rates was significant.

In the Table 1 there are presented the descriptive statistics of the two variables for both sub-samples. We may notice that there are significant differences between the two periods of time.

The stationarity of the time series used in our investigation will be analysed by the Augmented Dickey – Fuller Test and by the test proposed by Saikkonen and Lutkepohl (2002) and Lanne et al (2001), which allow us to take into account the eventual structural breaks. The deterministic terms of the equations will be established based on the graphical representation of time series, while the number of the lagged differences will be chosen based on Akaike Information Criteria.

The unbiasedness hypothesis of UIRP will be tested by simple regressions. We shall study the cointegration between the two variables using Johansen Test and a test proposed by Saikkonen and Lutkepohl (2000). Then we shall analyze the interactions between the interest rates differentials and the exchange rates in a VAR framework in which the number of lagged differences will be

chosen based on the Schwartz Bayesian Criteria. Finally we shall test the Granger causality between the two variables.

Table 1. Descriptive statistics of neer and dif for the two sub-samples

	neer		dif	
Indicator	**Sub-sample 1**	**Sub-sample 2**	**Sub-sample 1**	**Sub-sample 2**
Mean	1.24616	1.39792	0.827150	1.88476
Median	1.25623	1.43561	0.838918	2.12955
Minimum	1.13501	1.25857	0.399489	0.896964
Maximum	1.32694	1.46156	1.20204	2.52759
Std. Dev.	0.0435187	0.0649417	0.219542	0.514667
C.V.	0.0349223	0.0464558	0.265419	0.273068
Skewness	-0.526704	-0.908079	-0.175695	-0.704678
Ex. kurtosis	-0.303264	-0.747136	-1.07854	-0.970115
Jarque - Bera test for normality	32.8447	46.2797	35.1703	35.1289
p-value for Jarque - Bera test	0.0001	0.0001	0.0001	0.0001

3. Empirical Results

3.1. Analysis of the first sub – sample

Based on the graphical representation of the four variables we chose the constant and the trend as deterministic terms for neer and dif and only the constant for their first differences. The results of Augmented Dickey – Fuller Tests are presented in the Table 2. They indicate that both variables are not stationary in level but stationary in their first differences.

Table 2. Augmented Dickey-Fuller Test for the observations from the first sub-sample

Variable	**Deterministic terms**	**Lagged differences**	**Test statistics**
neer	Constant and trend	3	-1.6734
d_neer	Constant and no trend	2	-15.7165***
dif	Constant and trend	2	-0.5540
d_ dif	Constant and no trend	1	-13.2585***

Note: The number of the lagged differences was chosen based on Akaike Information Criteria.

Table 3 presents the results of the unit root tests with structural breaks. Again the both variables proved not to be stationary in level but stationary in their first differences.

We test the unbiasedness hypothesis of UIRP by a simple regression between d_neer and d_dif. The results indicate the rejection of this hypothesis.

Table 3. Unit root tests with structural breaks for the observations from the first sub-sample

Variable	Deterministic terms	Shift Function	Break Date	Lagged differences	Test statistics
neer	Constant and trend	Impulse dummy	503	3	-1.1877
		Shift dummy	526	3	-1.0668
d_neer	Constant and no trend	Impulse dummy	503	2	-15.5430***
		Shift dummy	502	2	-3.5980***
dif	Constant and trend	Impulse dummy	332	2	-1.1327
		Shift dummy	332	2	-1.0282
d_ dif	Constant and no trend	Impulse dummy	332	1	-13.0031***
		Shift dummy	324	1	-13.4044***

Note: The number of the lagged differences was chosen based on the Akaike Information Criteria.

In the Table 4 there are presented the results of Johansen tests that indicate the lack of cointegration between neer and dif.

Table 4. Johansen cointegration tests for the first sub sample (Case 3: Unrestricted constant)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.038899	31.320	0.0001	25.988	0.0003
1	0.0081071	5.3318	0.0209	5.3318	0.0209

The results of the Saikkonen and Lutkepohl tests, presented in the Table 5, indicate again the lack of cointegration between neer and dif.

Table 5. Saikkonen and Lutkepohl cointegration tests for the first sub sample (intercept included)

Rank	LR	p-value
0	18.92	0.0028
1	0.65	0.4745

Since dif and neer are integrated at order 1 but not cointegrated we study their interactions of their first differences in a VAR framework. The results, presented in the Table 6, indicate a low interaction between the two variables.

Table 6. VAR system for the first sub-sample

Equation 1: d_neer

Variable	Coefficient	Std. Error	t-ratio	p-value
const	-8.01895e-05	0.000176544	-0.4542	0.64982
d_neer_1	0.147616	0.0580516	2.5428	0.01123**
d_neer_2	-0.0496225	0.0501503	-0.9895	0.32280
d_dif_1	-0.0303478	0.0162896	-1.8630	0.06291*
d_dif_2	-0.000568234	0.0154784	-0.0367	0.97073

F(4, 649) = 2.522382; P-value(F) = 0.039970

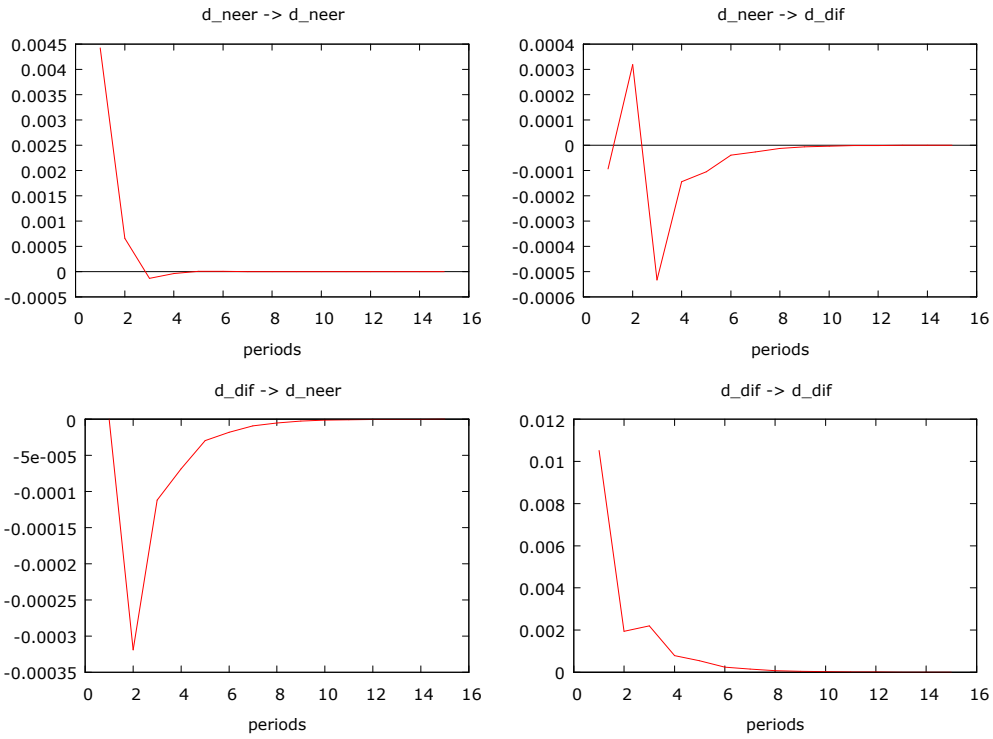
Equation 2: d_dif

Variable	Coefficient	Std. Error	t-ratio	p-value
const	-0.000217414	0.000424883	-0.5117	0.60903
d_neer_1	0.076577	0.0841299	0.9102	0.36304
d_neer_2	-0.142957	0.103215	-1.3850	0.16651
d_dif_1	0.184186	0.075134	2.4514	0.01449**
d_dif_2	0.177109	0.0603779	2.9333	0.00347***

F(4, 649) =3.531997; p-value(F) = 0.007302

The impulse – response analysis indicate that a shock from d_dif leads to a fall of d_neer for a short period of time, but finally it is back to the initial level. Instead, a shock of d_neer provokes a raise of d_dif which, after a fluctuant evolution, arrives to the initial level (Fig. 4).

Figure 4. VAR impulse-response analysis for the first sub-sample



The Granger causality tests indicate no causality between d_neer and d_dif (Table 7).

Table 7. Tests of Granger causality between the variables for the first sub-sample

Null hypothesis	F-statistic	P-value	Causal inference
H_0: "d_neer" do not Granger - cause "d_dif"	0.2548	0.2548	"d_neer" do not Granger-cause "d_dif"
Null hypothesis	**F-statistic**	**P-value**	**Causal inference**
H_0: "d_dif" do not Granger-cause "d_neer"	2.0006	0.1357	"d_dif" do not Granger-cause "d_neer"

3.2. Analysis for the second sub-sample

The graphical representation of the four variables suggests that we may use the constant and the trend as deterministic terms for neer and dif and only constant for their first differences. The results of Augmented Dickey – Fuller Tests, presented in the Table 8, indicate that both variables are not stationary in level but stationary in their first differences.

Table 8. Augmented Dickey-Fuller Test for the observations from the second sub-sample

Variable	Deterministic terms	Lagged differences	Test statistics
neer	Constant and trend	14	-1.4043
d_neer	Constant and no trend	13	-4.8567***
dif	Constant and trend	12	-1.9369
d_ dif	Constant and no trend	11	-6.0376***

Note: The number of the lagged differences was chosen based on Akaike Information Criteria.

In the Table 9 there are presented the results of the unit root tests with structural breaks. Again we found neer and dif as non stationary while their first differences are stationary.

Table 9. Unit root tests with structural breaks for the observations from the second sub-sample

Variable	Deterministic terms	Shift Function	Break Date	Lagged differences	Test statistics
neer	Constant and trend	Impulse dummy	48	8	-2.0441
		Shift dummy	49	8	-2.0695
d_neer	Constant and no trend	Impulse dummy	80	9	-5.5298***
		Shift dummy	44	9	-3.0325***
dif	Constant and trend	Impulse dummy	57	7	-2.1142
		Shift dummy	80	7	-1.8860
d_ dif	Constant and no trend	Impulse dummy	49	12	-6.1406***
		Shift dummy	52	11	-2.6276*

Note: The number of the lagged differences was chosen based on the Akaike Information Criteria.

The results of the Johansen cointegration tests, presented in the Table 10, suggest that dif and neer are not cointegrated.

Table 10. Johansen cointegration tests for the second sub sample (Case 3: Unrestricted constant)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.088261	30.198	0.0001	26.519	0.0002
1	0.012737	3.6791	0.0551	3.6791	0.0551

In the Table 11 there are presented the results of the Saikkonen and Lutkepohl cointegration tests which confirm the lack of cointegration between dif and neer.

Table 11. Saikkonen and Lutkepohl cointegration tests for the second sub-sample (intercept included)

Rank	LR	p-value
0	6.61	0.3707
1	0.17	0.7380

The two equations of the VAR model for the second sub-sample are presented in the Table 12. They suggest an interaction much significant than for the first sub sample.

Table 12. VAR system for the second sub-sample

Equation 1: d_neer

Variable	Coefficient	Std. Error	t-ratio	p-value
const	0.000694996	0.000339933	2.0445	0.04184**
d_neer_1	0.224282	0.0963506	2.3278	0.02064**
d_neer_2	-0.124962	0.0763382	-1.6370	0.10276
d_dif_1	-0.0145743	0.0090842	-1.6044	0.10976
d_dif_2	-0.0134358	0.0111667	-1.2032	0.22991

F(4, 280) = 4.444529; P-value(F) = 0.001692

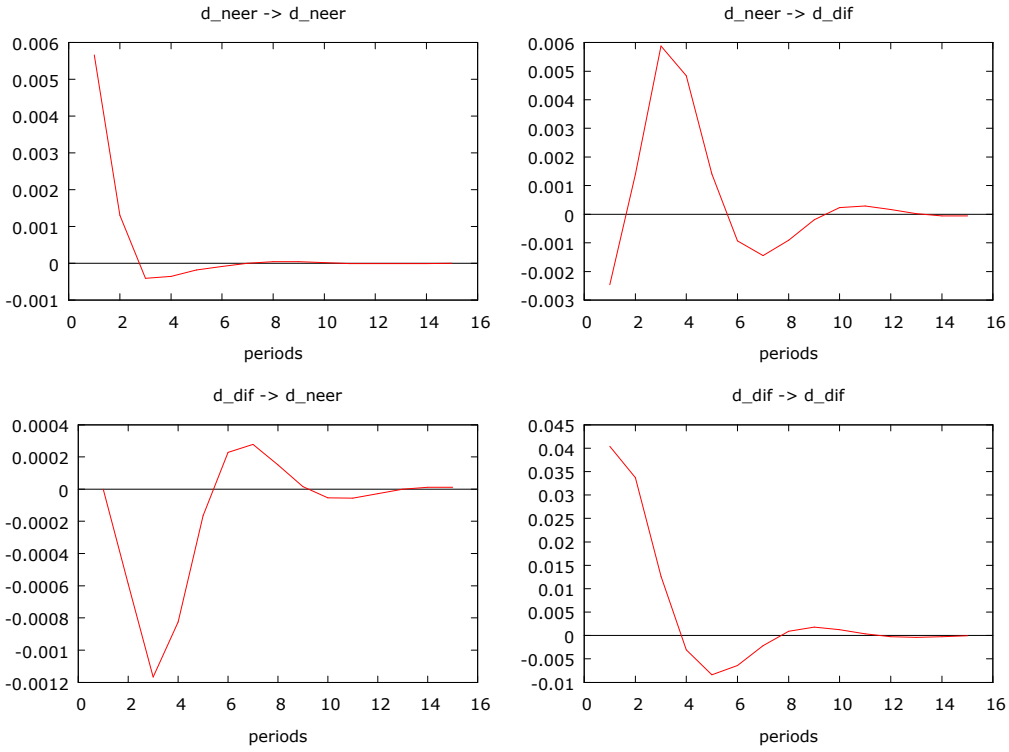
Equation 2: d_dif2

Variable	Coefficient	Std. Error	t-ratio	p-value
const	0.00252239	0.00298876	0.8440	0.39941
d_neer_1	0.608058	0.509638	1.1931	0.23383
d_neer_2	0.53222	0.531244	1.0018	0.31729
d_dif_1	0.833495	0.123193	6.7658	0.00001***
d_dif_2	-0.372968	0.131799	-2.8298	0.00499***

F(4, 280)= 12.10619; P-value(F) = 0.00001

The impulse – response analysis indicates that a unit shock of d_dif provokes a fall of d_neer which, after a fluctuant evolution, is back to the initial level. A unit shock of d_ner leads to a fall of d_dif, followed by a fluctuant evolution, until the stabilization to the initial level (Figure 5).

Figure 5. VAR impulse-response analysis for the second sub-sample



The Granger causality tests for the second sub-sample indicate a unidirectional relation: d_dif Granger causes d_neer but d_neer does not Granger cause d_dif (Table 13).

Table 13. Tests of Granger causality between the variables for the second sub-sample

Null hypothesis	**F-statistic**	**P-value**	**Causal inference**
H_0: "d_neer" do not Granger-cause "d_dif"	2.2272	0.1088	"d_neer" do not Granger-cause "d_dif"
H_0: "d_dif" do not Granger-cause "d_neer"	8.7425	0.0002	"d_dif" Granger-cause "d_neer"

4. Conclusions

In this paper we analysed the impact of the financial crisis on the relation between the exchange rates and the interest rates differential. We used daily data of RON / EUR exchange rates and three months interest rates from Romania and the Euro area.

We found no evidence in favor of UIRP. By contrary, the VAR analysis indicated that a raise of the interest rates differential led to an appreciation of the national currency.

From the VAR impulse – response analysis it resulted the financial crisis affected significantly the relation between the interest rates differentials and the exchange rates. This conclusion was confirmed by the Granger causality tests. For the first sub-sample we found no causality among the variables but for the second sub – sample it resulted the interest rates differential Granger caused the exchange rates.

The lack of causality for the first sub – sample may be explained by the significant control of NBR of the exchange rates and the interest rates in this period of time. Instead, in the financial crisis context, NBR preferred to relax the control of the exchange rates to make easier the defense of the national currency in the case of speculators attacks.

References

Amisano, G. - Giannini, C. 1997: *Topics in Structural VAR Econometrics*, 2nd edn, Springer, Berlin

Bekaert, G. - Harvey, C. R. 2000: Foreign Speculators in Emerging Equity Markets. *Journal of Finance,* 55, 565-613.

Bekaert, G. – Wei, M. – Xing, Y. 2002: Uncovered Interest Rate Parity and the Term Structure. *NBER Working Paper* No. 8795.

D'Amato, M. – Pistoresi, B. 2001: Interest Rate Spreads between Italy and Germany, 1995-1997. *Applied Financial Economics* 11 (December): 603-12.

Dornbusch, R. 1976: Expectations and Exchange Rate Dynamics. *Journal of Political Economy.* Vol. 84, No. 6, December, pp. 1161-1176.

Flood, R. P. – Rose, A. K. 2001: *Uncovered Interest Parity in Crisis: The Interest Rate Defence in the 1990s*. Working Paper No. 01/207, International Monetary Fund, Washington.

Francis, B. – Hasan, I. – Hunter, D. 2002: Emerging Market Liberalization and the Impact on Uncovered Interest Rate Parity. *Federal Reserve Bank of Atlanta.* Working Paper 2002-16 August

Froot, K. A. – Ito, T. 1989: On the Consistency of Short-Run and Long-Run Exchange Rate Expectations. *Journal of International Money and Finance*, Vol. 8, No. 4, pp. 487-510.

Froot, K. A. 1990: Short Rates and Expected Asset Returns. Working Paper No. 3247. *National Bureau of Economic Research*, Cambridge, Massachusetts.

Froot, K. A. – Thaler, R.H. 1990: Foreign Exchange. *Journal of Economic Perspectives*, Vol. 4, No. 3, Summer, pp. 179-192.

Guy, M. - Chinn M. 1998: Long Horizon Uncovered Interest Parity, Working Paper No. 6797. *National Bureau of Economic Research*, Cambridge, Massachusetts.

Isard, P. 1995: *Exchange Rate Economics*. Cambridge University Press, Cambridge.

Lanne, M. - Lütkepohl, H. - Saikkonen, P. 2001: *Test procedures for unit roots in time series with level shifts at unknown time.* Discussion paper, Humboldt - Universität Berlin.

Loopeseko, B.E. 1984: Relationships Among Exchange Rates, Intervention, and Interest Rates. *Journal of International Money and Finance*, 3, pp. 257-277.

MacDonald, R. – Taylor, M.P. 1992: *Exchange Rate Economics: A Survey*. IMF Staff Papers, Vol. 39, No. 1, March, pp. 1-57.

McCallum, B. T. 1994: A Reconsideration of the Uncovered Interest Parity Relationship. *Journal of Monetary Economics*, Vol. 33, No. 1, February, pp. 105-132.

Saikkonen, P. - Lütkepohl, H. 2000: Trend adjustment prior to testing for the cointegrating rank of a vector autoregressive process. *Journal of Time Series Analysis*, 21: 435-456.

Saikkonen, P. - Lütkepohl, H. 2002: *Testing for a unit root in a time series with a level shift at unknown time.* Econometric Theory, 18:313-348.

Takagi, Shinji 1991: *Exchange Rate Expectations: A Survey of Survey Studies.* IMF Staff Papers. 38(1) March: 156-183.

Wu, J. – L. 1999: A Re-Examination of the Exchange Rate-Interest Differential Relationship: Evidence from Germany and Japan. *Journal of Money and Finance*, Vol. 18, No. 2, April, p. 319-336.