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### ASYMMETRIC RELATIONSHIP BETWEEN OIL PRICE AND EXCHANGE RATE: THE CASE OF ROMANIA

*Petrol Fiyatları ve Döviz Kuru Arasındaki Nedenselliğin Araştırılması, Romanya Örneği*

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#### ABSTRACT

The fragile structure of the global economy in the last decades makes it necessary for policy makers to have consistent predictions on the future values of the commodities and assets and also exchange rates. The fact that it is still the biggest source of energy, oil, has a crucial importance for the real economy and even financial markets. In this study, the relation of the real oil price and the real exchange rate in Romania will be investigated for the period of 2004:4 to 2014:10 using monthly data. Results in the tests suggest that Romania should consider the real oil price and real exchange rate causality due to the fact that there is a significant causality between the variables.

**Keywords:** Oil Prices, Exchange Rate, Romania, Asymmetric Causality

**JEL Classification:** F31, F41, C32

#### ÖZ

Global ekonomi sözlüğünde kırılganlık terimi sıkça karşılaşılan bir terim olagelmıştır. Bu da politika yapıcılar için önemli bir husustur. Enerji üretim için çok önemli bir girdi konumundadır ve bu girdi hala büyük ölçüde petrolden karşılanmaktadır. Bu çalışmada petrol fiyatları ve döviz kuru ilişkisi Romanya için irdelenmiştir. Bu çalışmanın veri aralığı 2004:4 ve 2014:10 tarih aralığındadır. Araştırmanın sonucu Romanya için petrol fiyatları ve döviz kuru arasında anlamlı bir ilişki olduğunu göstermektedir.

**Anahtar Kelimeler:** Petrol Fiyatları, Döviz Kuru, Romanya, Asimetrik Nedensellik

**Jel Sınıflandırması:** F31, F41, C32

#### Introduction

It is obvious that fluctuations in the real exchange rates cause planning problems for governments, for industry even for individuals. It is a crucial need to predict real exchange rate in advance and the exchanged commodity between countries has a significant role in determining the exchange rates. In that parallel, Domenico et al (2015) suggests that, conditional on knowing the future value of commodity prices, one can forecast exchange rates well. Thus, if one had a good model to forecast oil prices, one could exploit it to forecast future exchange rates. No doubt that crude oil is one of the biggest components in commodity trade in the world. Moreover, the price of oil is too volatile to be ignored, in June 2008 the price of crude oil was over 140\$, and at the end of the year 40\$ (Turhan et al, 2014). In general, crude oil market is thought as an example to oligopoly market, but in the near future, Brahmasrene et al.(2014) defined USA oil market as monopolistically competitive market structure, that definition tells us that, pricing for crude oil has changed and is more unpredictable.

The rest of paper is organized as follows. The econometric methodology is outlined in next section. In the second section, econometric methodology that is the causality will be questioned using the Toda-Yamamoto (1995) linear Granger type causality test, Hacker and Hatemi-J (2005,

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2006) bootstrap process-based Toda-Yamamoto (1995) linear Granger causality, Hatemi J (2012)-Roca (2014) asymmetric causality test and Balcilar et al. (2010) bootstrap rolling window causality test. In the section three, empirical results are presented. We summarize and conclude empirical findings in the last section.

### **1. Theoretical Framework and Literature Review**

The relationship between crude oil prices and the exchange rate parity is a dynamic matter in the literature. There are certain papers that deal with that topic. The main distinction between those researches is the econometric tests applied. It is also an issue that whether the countries are using floating or fixed exchange rates, or may be semi-flexible. In this research, we investigate whether the changes in US Dollar explains the oil prices in Romania economy. Furthermore, it will be also investigated if oil price explains the changes in US Dollar / Lei parity in Romania. According to *Art.2 of Law 312/2004*, one of the main tasks of the National Bank of Romania is to define and implement the monetary policy and the exchange rate policy. The exchange rate regime of the led currently in place is that of a managed float, in line with using inflation targets as a nominal anchor for monetary policy and allowing for a flexible policy response to unpredicted shocks likely to affect the economy. It is not surprising that depreciation in USD will have more effect in LEU compared to Euro due to the fact that EU Central Bank has more efficient instruments, with that aspect Romania differs from EU countries. In Romania case, it should be also considered that the longer a currency is under a floating exchange rate regime, the more likely will show indications of asymmetric adjustment (Ahmad and Hernandez, 2013).

About the oil reserves in Romania, according to the Energy Information Administration (EIA, <http://www.eia.doe.gov/>), Romania has nine crude oil refineries with a total capacity of almost ½ million barrels per day (bbl/d), which is among the largest refining capacities in Eastern Europe. Although Romania's refineries operate below capacity, refinery output could in the close history exceed domestic consumption allowing the country to export the surplus petroleum products. The mentioned fact that, Romania is not only an oil consumer, but also a producer and even one of the biggest producers in EU. In that moment Evidence from Lizardo and Mollick (2010) should be also considered. According to that study, an increase in the real price of oil causes a more significant depreciation of the US dollar relative to the currency of oil exporting countries. On the other hand, the real exchange rate of oil importing countries depreciated relative to the US dollar in similar scenario.

Theoretically, it is also an issue that how the oil import or export will make effect on balance of payments (Zhang, 2013). The relation of the two variables is determined in the early studies of Golub (1983). It's argued that a country that is oil exporting (oil importing) may experience exchange rate appreciation (depreciation) when oil prices rise and depreciation (appreciation) when oil prices fall (Aziz and Bakar, 2011). According to Blomberg and Harris (1995) when USD depreciates, foreigner's purchasing power of oil will increase. Then the shift in the oil demand will end with the price increase in return. Ji and Fan (2012), bridges a link the literature with the crises. During the crises environment, due to loose monetary policy of the US government the relationship among USD and oil prices is less significant. On the other hand Arab Spring and the unrest in the oil exporting Middle-East countries and the ongoing threats to political instability in the region contributes to run up in oil prices which will slow down the global economic growth. (Aloui et al, 2013)

Empirical results indicate that the term that the analysis is implemented is very important. It is rare to see that detail in the literature, the hypothesis checked for most of the studies investigate just the causality between oil prices and the exchange rate. A good example that explores different causality directions for different terms suggest there is causality from exchange rates to crude oil prices in the short run while there is a causality from crude oil prices to the exchange rates in the long run (Brahmasrene et al.,2014) According to Raurava (2004) an increase in the oil price is associated with the real depreciation of the ruble in the long run. Krugman (1980) where he showed

that the initial effects of an increase in oil prices on real exchange rates differ from their long-run effects. In the former it is an appreciation and in the latter it is depreciation.

Benassy-Quere et al. (2007) show that a 10% increase in the oil price results with a 4.3% appreciation of the dollar in the long run. A depreciation of domestic currencies has a greater impact on oil prices than an equivalent appreciation (Jammaiza et al, 2015). Another study that shows causality from oil price to local currency is explained by Chen and Chen (2007). Their study suggests that the rise in oil prices depreciates the domestic currency against the dollar. Ghosh (2011), in his study examines that a positive shock in the oil price in return causes to the depreciation of Indian currency against US dollar. Huang and Guo(2007) suggests that real oil price fluctuations imply a minor appreciation in the real exchange rate for China. Narayan et al. (2008) supports the literature with the study that investigate Fijian dollar movements with the oil price increase. The result is that a rise in oil prices casues an appreciation of the Fijian dollar. According to Yousefi and Wirjanto (2004), most OPEC countries will adjust their prices on the value of the dollar to maintain market share and secure the purchasing power of oil revenue. A 10% depreciation in the dollar will result in a price increase (in dollars) between 1.9% and 8.5%, and this hypothesis is supported by Akram (2009) that presents prof of a depreciation in Us dollar leading to higher oil prices on the other hand fluctuations in usd significantly results with oil price fluctuations. Askari and Krichene (2010) also suggests a depreciation of the US dollar would lead to higher oil prices.

In the literature, the direction of the causality is not absolute, there are different studies suggest different causality directions. Dinga and Vo (2012) summarizes the studies suggesting the causality from oil prices to exchange rates are Benassy-Querea et al. (2007), Chen and Chen (2007), Ayadi (2005), Chaudhuri and Daniel (1998) and Krugman (1984) and on the other side some others suggest the causality runs in the opposite direction; Zhang, Fan, Tsai, and Wei (2008), Krichene (2005), and Yousefi and Wirjanto (2004).

Even though studies generally state that exchange rates and oil prices are co-integrated (where the possible causality may run in both directions as mentioned); the studies again should be separated into two groups concluding that an increase in the oil price is associated with either a US dollar appreciation (Benassy-Quereet al., 2007); or depreciation (Zhang et al., 2008) against other currencies. Jain and Ghosh (2013) takes attention in a different perspective, in their study they focus on the financial instruments that governments and individuals payed attention. Since the financial crises precious metals and oil seems to be alternative investment for investors. That might sound as a dilemma, cause, oil price fluctuation is the reason for problems in real economical activities but on the other hand, people invest that asset in the financial markets.

## **2. Methodology**

### **2.1. Toda-Yamamoto (1995) Linear Granger Type Causality Test**

Toda-Yamamoto (1995) applies VAR model due to number of the delay and also take into account the degree of integration of the series with  $\chi^2$  distribution of the Wald test. Toda-Yamamoto causality analysis of the values  $\beta$  of the variables so that the level of the series by creating a standard VAR model eliminates the problems of determining the rank of cointegration (Hector Zapata and Alicia Rambaldi, 1997:289-292, Jarita Duasa, 2007:85-87). The relationship between real exchange rate (REER) and real oil price (ROP) VAR (p) process can be expressed as ;

$$REER = \phi_1 + \sum_{i=1}^{p+d_{max}} \alpha_{1i} REER_{it} + \sum_{i=1}^{p+d_{max}} \beta_{1i} ROP_{it} + \varepsilon_{1t} \quad (1)$$

$$ROP = \phi_2 + \sum_{i=1}^{p+d_{max}} \alpha_{2i} ROP_{it} + \sum_{i=1}^{p+d_{max}} \beta_{2i} REER_{it} + \varepsilon_{2t} \quad (2)$$

where  $d_{\max}$  is the maximum degree of integration of the variables in the model,  $p$  is the optimal lag length obtained from the VAR model and  $\varepsilon_t$  is the term refers to the error correction based on the assumption of white noise. The null hypothesis is tested as  $\beta_{1i} = 0$  for  $i \leq k$  in equation 3. If the alternative hypothesis is accepted, it means that causal relationship running from real oil price to real exchange rate. The null hypothesis is tested as  $\beta_{2i} = 0$  and  $i \leq k$  in equation 4 again and if the alternative hypothesis accepted, it means that there is a causality between variables running from real exchange rate to real oil price.

**2.2. Hacker and Hatemi-J (2005, 2006) Bootstrap Process-Based Toda-Yamamoto (1995) Linear Granger Causality**

Toda-Yamamoto (1995) causality test, applying a number of sampling is less, and if you have autoregressive conditional heteroscedasticity (ARCH) effect in error terms, based on the results of causality is wrong to make comments. Therefore, Hacker and Hatemi-J (2006) and also Hatemi-J (2005) developed a new methodology by using Brad Efron (1979) bootstrap process based on the causality test. The vector autoregressive model of order  $p$  VAR( $p$ ) can be expressed as where  $y_t$  is the number of variables in the VAR model,  $v$  is an vector of intercepts and  $A_r$  is matrix of parameters for lag  $r$  ( $r=1, \dots, p$ ) ;

$$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + \varepsilon_t \tag{3}$$

If the variables are cointegration equation 3 and 4 in the VAR ( $p + d_{\max}$ ) model with a simple expression;

$$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + A_{p+d_{\max}} y_{t-p-d_{\max}} + \varepsilon_t \tag{4}$$

(Abdulnasser Hatemi-J and Eduardo Roca, 2007:830, Hacker and Hatemi-J, 2006:1490).<sup>2</sup> The estimated VAR( $p+d_{\max}$ ) model in Equation 4 can be written compactly as:  $Y = (y_1, \dots, y_T)$ ,

$$\hat{D} = (\hat{v}, \hat{A}_1, \dots, \hat{A}_p, \dots, \hat{A}_{p+d_{\max}}), \hat{\delta} = (\hat{\varepsilon}_1, \dots, \hat{\varepsilon}_T) \text{ and } Z_t = \begin{bmatrix} 1 \\ y_t \\ y_{t-1} \\ \vdots \\ y_{t-p-d+1} \end{bmatrix};$$

can be written as,

$$Y = \hat{D}Z + \hat{\delta} \tag{5}$$

Null hypothesis that the there is no Granger causality (causality non Granger) Toda-Yamamoto (1995) developed by the modified Wald test (Modified WALD);

$$MWALD = (C\hat{\beta})'[C((Z'Z)^{-1} \otimes S_U)C']^{-1}(C\hat{\beta}) \square \chi_p^2 \tag{6}$$

<sup>2</sup> For choice of optimal lag order Hatemi-J (2003) are developed new information criteria. For the details of Hatemi-J criterion can be read the study of Hacker and Hatemi-J (2006).

where  $\otimes$  is the Kronecker product, and  $C$  is a  $pxn(1+(p+d_{\max}))$  selector matrix,  $S_U$  is variance-covariance matrix of residuals and  $\hat{\beta} = \text{vec}(D)$  is  $\text{vec}$  signifies the column-stacking operator. The error terms are normally and the MWALD test statistic is asymptotically  $\chi^2$  distributed (Hatemi-J and Roca, 2007:831, Hacker and Hatemi-J, 2006:1491, Abdunasser Hatemi-J and Bryan Morgan, 2009:441). Abdunasser Hatemi-J (2005) Monte Carlo experiments testing the error terms in the normal zero smudge MWALD (nonnormality) and ARCH effect is rejected because of the null hypothesis leads to excessive. This is why Hatemi-J (2005), Efron (1979) developed by the leveraged bootstrap developed simulations. We generate the distribution for the MWALD test statistics by running the bootstrap simulation 10.000 times and calculating the MWALD test statistics for each run. We then find bootstrap critical values pertaining to 1%, 5% and 10% significance levels. Afterwards, we calculate the MWALD statistics using original data. We reject the null hypothesis of no causality in the Granger sense at the  $\alpha$  level of significance, if the actual MWALD is greater than. The Monte Carlo simulations are conducted using programme procedure written by Hacker and Hatemi-J (2005, 2006)

### 2.3.Balcilar vd. (2010) Bootstrap Rolling Window Causality Test

Balcilar vd. (2010) in their analysis runned a LR (likelihood ratio) causality test using bootstrap method depending on error term. LR Granger causality test depending on bootsrap has two variables VAR(p) in the model,  $t=1,2,\dots,T$ ;

$$y_t = \Phi_0 + \Phi_1 y_{t-1} + \dots + \Phi_p y_{t-p} + \varepsilon_t \tag{7}$$

In the equity above,  $\varepsilon_t = (\varepsilon_1, \varepsilon_2) \square iid(0, \sigma^2)$  is a covariance matrix  $\Sigma$  that is not odd. Optimal lag criteria is defined by akaike information criteria (AIC). While  $y_t = [y_{1t}, y_{2t}]_{2 \times 1}$  considered as matrix, VAR(p) model will be shown as;

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \phi_{10} \\ \phi_{20} \end{bmatrix} + \begin{bmatrix} \phi_{11}(L) & \phi_{12}(L) \\ \phi_{21}(L) & \phi_{22}(L) \end{bmatrix} \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{8}$$

When  $\phi_{ij}(L) = \sum_{k=1}^p \phi_{ij,k} L^k$ ,  $i,j=1,2$   $k$  lag operator,  $L^k x_t = x_{t-k}$ . Null hypothesis of the test is; where  $\phi_{12,i} = 0$ ,  $y_{2t}$  is not Granger cause of  $y_{1t}$ , or oppositely, where  $\phi_{21,i} = 0$ ,  $y_{1t}$  is not Granger cause of  $y_{2t}$ . In order to avoid possible structural unit roots and to get over the problems that are related to the size of the sample, Balcilar vd. (2010) uses the bootstrap test that is modified by Koutris vd. (2008) and Shukur ve Mantalos (2000) Rolling Window Granger Causality test. Due to the hypothesis;

$Y := (y_1, y_2, \dots, y_T)$	Matrix Type: $2 \times T$
$B := (\Phi_0, \Phi_1, \dots, \Phi_T)$	Matrix Type: $(2 \times (2p+1))$
$Z_T := (1, y_t, y_{t-1}, \dots, y_{t-p+1})$	Matrix Type: $((2p+1) \times 1)$
$Z := (Z_0, Z_1, \dots, Z_{T-1})$	Matrix Type: $((2p+1) \times T)$
$\eta := (\varepsilon_1, \varepsilon_2, \dots, \varepsilon_T)$	Matrix Type: $(2 \times T)$

Considered to be matrixes and  $\Phi_0$  constant term, when  $t=1,2,\dots,T$ ; VAR(p) model  $Y = BZ + \eta$  and the least square is shown as:  $\hat{B} = YZ'(Z'Z)^{-1}$ . From that equation, unrestricted model error term  $\eta_U$  and restricted model error term  $\eta_R$  used, then  $S_U = \eta'_U \eta_U$  and  $S_R = \eta'_R \eta_R$  derived. Test statistics is defined as below in the equation:

$$LR = (T - k) \ln \left( \frac{\det S_R}{\det S_U} \right) \tag{9}$$

T sample size,  $k=2x(2p+1)+p$  error correction term, p VAR model lag length, distributes as  $\chi^2$ . After the calculation of the test statistics, under the assumption  $i=1,2,\dots,T$  Ordinary Least Squares (OLS) and error terms  $(\eta_R - \bar{\eta}_R)$  used and  $Y^* = BZ^* + \eta^*$  regression obtained. Null Hypothesis suggests  $N_b$  times LR\* (Likelihood Ratio) is calculated ( $LR^* \geq LR$ ). Finally, the size of the rolling window is considered as;  $t = \tau - l + 1, \tau - l, \dots, l$ ,  $\tau = l, l + 1, \dots, T$  and it is implemented to also rolling sub samples addition to the all sample.

### 3. Empirical Results

For this study, monthly data is collected on real oil prices and the real exchange rate of Romania. The data covers the period from 2004:01 to 2016:06. The natural logarithm of the variables real exchange rate (REER) and real oil price (ROP) are considered in the empirical tests. For the variables to eliminate the seasonality risk, the method is based on Tramo-Seats method.

Table 1: Descriptive Statistics

	Sample	Mean	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis	Jarque-Bera
REER	150	4.694	5.033	4.464	0.185	0.308	1.397	18.430 (0.00)
ROP	150	4.587	5.329	3.529	0.358	-0.758	3.447	15.647 (0.00)

**Not:** In parenthesis shows probability value. Descriptive statistics are for log series.

According to the descriptive statistics, standard deviation is higher for oil price that mostly depends on the global crises and the fluctuations in the oil market. If the asymmetry in the probability distribution of the variables is considered, Skewness<sup>3</sup> value shows that ROP to the left skewed and REER to the right skewed. Kurtosis measure that is a measure of the data is peaked or flat compared to a normal distribution. According to Kurtosis results<sup>4</sup>, REER data is more flat, ROP is more peaked compared to a normal distribution. On the other hand, Jarque-Bera (JB) test that offers normal distribution in the null hypothesis shows that all of the variables is distributed normal.

<sup>3</sup> For Skewness Test Results  $S = \alpha_3 = \begin{cases} <0 & \text{left skewed} \\ =0 & \text{symetric} \\ >0 & \text{right skewed} \end{cases}$

<sup>4</sup> For Kurtosis Test Results  $K = \alpha_4 = \begin{cases} <3 & \text{flat} \\ =3 & \text{normal} \\ >3 & \text{peaked} \end{cases}$

**Table 2:** ADF (1981) and PP (1988) Linear Unit Root Test Results

Models	Variables	Level		First Differences	
		ADF	PP	ADF	PP
Constant	REER	-0.938 (1) [0.773]	-0.879 (5) [0.793]	-7.943 (0) [0.00]***	-7.698 (3) [0.00]***
	ROP	-1.863 (1) [0.348]	-1.697 (5) [0.430]	-8.392 (0) [0.00]***	-8.436 (2) [0.00]***
Constant and Trend	REER	-1.749 (1) [0.724]	-1.613 (5) [0.783]	-7.921 (0) [0.00]***	-7.947 (3) [0.00]***
	ROP	-2.444 (1) [0.355]	-2.155 (4) [0.510]	-8.512 (0) [0.00]***	-8.547 (4) [0.00]***

**Notes:** The figures in parenthesis denote the lag length selected by the Schwarz criterion. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5% and 10% level of significance, respectively. Values within the brackets shows the probability ratios. For the ADF test: The results of Dickey Fuller test in the case of zero lag length and lag length chosen due to SIC criteria. For the ADF test, the Mac Kinnon(1996) critical values for with constant -3.485, -2.885 at the 1 %, and 5 % levels. The critical values for with constant and trend -4.035, -3.447 at the 1 % and 5 % levels, respectively. For the PP test: Values in the parenthesis show bandwidths obtained according to Newey-West using Bartlett Kernel criteria. For the PP test Mac Kinnon (1996) critical values for with constant -3.483, -2.884 at the 1 % and 5 % levels. The critical values for with constant and trend -4.033, -3.446 at the 1 % and 5 % levels, respectively.

$y_t$  series, in order to be stationary (tau) value should be bigger than MacKinnon (1996) critical value ( $|\tau_h| > \tau_t$ ). Moreover if the probability value is less then; %1 (0.01), %5 (0.05) and %10 (0.1) confidence interval values the null hypothesis that offers unit root in the variables is rejected. REER and ROP series is stationary for both ADF and PP tests in first difference.

**Table 3:** Toda-Yamamoto (TY, 1995) and Hacker-Hatemi J (2005, 2006) Bootstrap Granger Causality Test Results

Hypothesis	$k + d_{\max}$	MWALD	%1 Bootstrap CV	%5 Bootstrap CV	%10 Bootstrap CV
REER $\nrightarrow$ ROP	4	1.195 (0.754)	11.992	8.012	6.389
ROP $\nrightarrow$ REER	4	7.942 (0.047)**	11.828	8.030	6.466*

**Note:**  $\nrightarrow$  represent the null hypothesis that there is no causality. \*\* and \*\*\* is in order supports causality in %90. %95 and %99 confidence interval.  $k + d_{\max}$  Value is the lag length according to AIC plus the stationary levels of the variables. The values in the parenthesis show the probability ratios asymptotically.

The result in this test offer support to the literature claims the causality from oil price to exchange rate. Two different tests runned is summarized in the table above. Two test results support each other, and offer causality from oil price to real exchange rate. Moreover, causality from real exchange rate to oil price is rejected. As mentioned before, Romania is accepted also as an oil exporter country, it is necessary to remember the hypothesis, it's argued that a country that is oil exporting (oil importing) may experience exchange rate appreciation (depreciation) when oil prices rise, and depreciation (appreciation) when oil prices fall (Aziz and Bakar, 2011). The results of TY (1995) and Hacker-Hatemi J (2005,2006) tests clearly parallel. In Romania, in the period that is examined in the test, there is a significant causality from Real Oil Price to Real Exchange Rate. One can argue that, because of the peak and bottom prices in oil prices in this period and also the world crises in the selected period it is more than normal too see that result. It will not be surprising to see the same results any country in the world in that period. Each country no matter importing or exporting might have the same result, that is, oil prices is a cause on the exchange rates. That result is satisfactory because it is checked with to different methodology, but they are not enough to clear the way that variables changing (increase or decrease). Another test (Hatemi J (2012)-Roca (2014)) will be implemented in order to investigate whether this hypothesis is valid for Romania or not.

**Table 4:** Hatemi J (2012)-Roca (2014) Asymmetric Causality Test Results

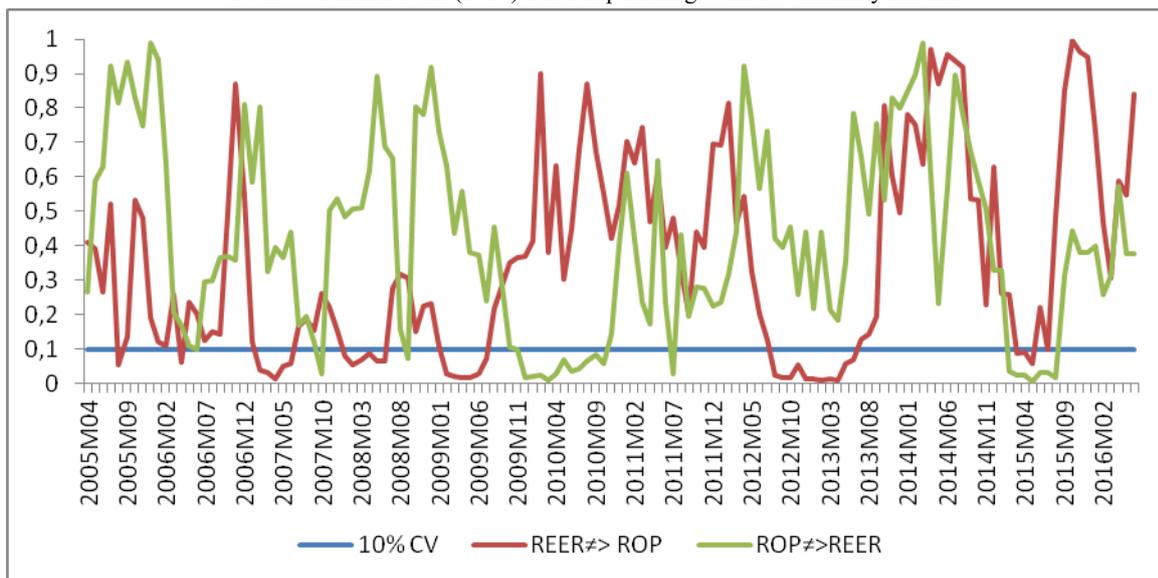
Causality	MWALD	1% Bootstrap Critical Value	5% Bootstrap Critical Value	10% Bootstrap Critical Value
(REER) <sup>+</sup> ⇒(ROP) <sup>+</sup>	0.011 (0.917)	7.829	3.928	2.830
(REER) <sup>+</sup> ⇒(ROP) <sup>-</sup>	1.158 (0.560)	10.476	6.465	4.806
(REER) <sup>-</sup> ⇒(ROP) <sup>-</sup>	0.143 (0.931)	11.471	6.693	5.115
(REER) <sup>-</sup> ⇒(ROP) <sup>+</sup>	1.317 (0.518)	10.056	7.381	5.153
(ROP) <sup>+</sup> ⇒(REER) <sup>+</sup>	2.771 (0.096)*	6.852	4.082	2.293*
(ROP) <sup>+</sup> ⇒(REER) <sup>-</sup>	3.718 (0.156)	10.167	6.411	5.110
(ROP) <sup>-</sup> ⇒(REER) <sup>-</sup>	12.889 (0.00)***	12.245***	6.365**	5.125*
(ROP) <sup>-</sup> ⇒(REER) <sup>+</sup>	2.479 (0.290)	9.914	6.306	4.852

**Not:** ⇒ sign shows that there is no causality. The values in the parenthesis show the probability ratios asymptotically. \*\*, \* and \*\*\* is in order supports causality in %90, %95 and %99 confidences interval. Bootstrap number is 10.000.

Although many empirical macro-economic research has investigated —using a range of econometric techniques, such as co-integration theory, the Granger causality test, the vector autoregressive model and the vector error correction model—the influence of oil price–exchange rate interaction on macroeconomic and currency policies, little is known about the +, - shocks interaction. This comparatively new empirical test in the literature has an answer for the possible causality relation is in which direction, positive or negative. That question is more meaningful for countries that have a big portion of oil trade in their balance of payment accounts. The literature suggests different reactions for oil importer and exporter countries in terms of a positive or negative oil price shock. It is also important, if there is an oil trade, if the country is an exporter or importer. In Romania case, Hatemi J (2012)-Roca (2014) asymmetric causality test results offers a negative ROP shock will result a negative shock in REER. Even though Romania is not an oil exporting country as it was quarter decades, the Romanian economy is still responding to global oil shocks as an oil exporter country.

For many, it was expected to see also REER causality on ROP, due the test results that relation is not supported. The main reason for that might be the exchange rate regime that Central Bank follows. Of course a bigger reason is; Romania itself is too small in terms of oil trade to set the world prices with the exchange rate movements.

**Table 5:** Balçılar et al. (2010) Bootstrap Rolling Window Causality Results



The aim to run this test is to see whether the causality changes in different periods. There is an important period that will be focused; the crises. According to the test results, in the %90 confidence interval, the sign under the line shows the causality. While the red line offers causality from REER to ROP, the green line offers causality from ROP to REER. The results gained from Toda-Yamamoto (TY, 1995) and Hacker-Hatemi J (2005,2006) could not explain any causality from REER to ROP, but Balçilar et al. (2010) causality test offers a significant causality from REER to ROP especially before and after the crises. During the period starting from 2015:M3 till 2015:M5 the causality is bi-directional.

On the other hand, the causality that was significant due to Toda-Yamamoto (TY, 1995) and Hacker-Hatemi J (2005,2006) is significant just before crises. One can argue that, the while real oil prices going upwards to the peak in 2008, was a significant cause of the REER in Romania. After the peak, real oil prices turned backwards and even to the deep, REER is a significant determinant of the ROP in Romania. Apart from that explanation, the fact that Hatemi J (2012)-Roca (2014) asymmetric causality test results offers a negative ROP shock will result a negative shock in REER is valid especially during crises.

May be, a more important result for Romanian economy, is the movements after crises. The economic uncertainty in the world and in EU, makes the REER and ROP relation more significant. We can suggest that that causality relation occurs when the markets behave out of normal. That makes policy makers to focus on oil prices more than regular especially when there is economic uncertainty. In Romania, most of the exported oil is refined oil and in the last years, Romania imports crude oil and exports after refining the oil. The price instability becomes a bigger problem with that fact.

### **Conclusions and Policy Implications**

Apart from the fact that if the country is oil importing or exporting, monitoring oil prices especially in the high volatile regime is very important since that information can guide governments on how to implement effective policies to stabilize their exchange rates, and also controlling inflation and even balancing the budget (Balçilar, 2015). Depreciation in USD will cause an increase the purchasing power of oil-importing countries (except the USA) and negatively affects oil-exporting countries. If we consider the contrast, an overvalued USD leads adversely affect oil-importing countries and probably cause a demand shock that ultimately affects oil-exporting countries (Reboredo and Castro, 2013). The situation may change for countries that are using energy more than any other average country (Nakaijamaa and Hamorib, 2012)

Also in the literature it is suggested that, with the global economic growth, the oil prices might go further. In that case, especially the growth trend in emerging markets can push the oil prices up and it is clear that price shock in oil will be a great asset for oil exporting countries in terms of a current account surplus. The tests applied in this study in general supports that thesis for Romania. That's why Romania could seek in the next years more advantages of such export. It's another results that our analysis support parallel to the literature is the direction of the causality from oil prices to the exchange rate. Even tough Romania is not a leading oil exporter; it is still accepted as an oil producer. Our empirical results proves that there is a causality from real oil price to real exchange rate according to Toda Yamamoto (1995) and Hacker-Hatemi J (2005,2006) test results. Hatemi J (2012)-Roca (2014) asymmetric causality test supports the hypothesis that, if the oil price decrease, the real exchange rate for the oil exporter countries depreciates.

Even though, Romania is not a country like Russia that the economy mostly depends on the oil. If it was so, Romania economy will be more fragile in terms of oil price shocks; it is easy to remember the devaluation of Ruble in 2014 according to the sharp decrease in the real oil prices in the world. Moreover, while Central Bank that aiming the price stability the pressure of the oil price is more likely to make small problems for Romanian economy. It is also interesting that results offer causality only in the negative shocks on ROP, any positive shock on ROP does not seem to

have any affect in REER. Balcılar et al. (2010) bootstrap rolling window causality test results summarized the causality and the periods that the causality is significant. In the big crises 2008-2009, the test offers a different result. During that period, there is a significant causality from real exchange rate to oil prices. As many governments did in that period, loose monetary policy of the government to avoid any possible recession seems to be caused as causality from REER to ROP. Still the effects of the crises is observed in EU, that's why many fluctuations in the real economy and financial markets leads and causes the instability in the oil market and exchange rates. Those two variables cause each other especially in those periods.

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