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# REAL EXCHANGE RATES AND STOCK PRICES: INSIGHTS INTO THE COMPETITIVENESS OF ROMANIAN ECONOMY

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**Abstract:**

*The paper investigates the dynamic links between stock prices and exchange rates in Romania, after 1997, considering the changes in the exchange rate regime occurred after 1997. The research employs advanced econometric methods – cointegration and Granger causality tests, in order to capture the bi-directional influences between stock prices and exchange rates, applied to monthly data over the 1999-2007 period. We use two types of exchange rates: nominal effective exchange rates and real effective exchange rates, aiming at revealing the competitiveness effects embedded in the real exchange rate evolution. In terms of stock prices, we use the BET and BET-C indices of the Bucharest Stock Exchange. We conclude that there is a long-term equilibrium relationship between the stock market performance and the nominal and real effective exchange rates, while the information is generally transmitted from the stock prices to exchange rates with a one-month lag in the case of cointegrated variables. Also, the exchange rates are the leading variables for the stock prices and the stock market adjusts quite dramatically to changes in the exchange rates in one month time in the case of cointegrated variables.*

**Keywords:** *exchange rates, stock exchange, cointegration, Granger causality, competitiveness*

## 1. Theoretical considerations

The linkages between stock prices and exchange rates can be analysed on two grounds, generally referred to as the microeconomic and macroeconomic level. From the microeconomic level point of view, the exchange rate may influence the value of domestic and multinational companies, the concept that captures this influence being referred to in the literature as exposure to exchange rate risk. Fluctuations in exchange rates can sometimes have a significant effect on firm value, as they influence the terms of competition, the input and output prices, and the value of firm's assets and liabilities denominated in foreign currencies. Although firms with foreign operations are more affected as compared to "pure" domestic firms, virtually no company can be considered as being isolated from the effects of exchange rates

changes. Consequently, all firms' prices may react sooner or later to changes in the exchange rates. Two main mechanisms that generate exposure to exchange rate risk can be identified: a conversion effect – given the lower amount in home currency that will be obtained after converting the same amount in a foreign currency at a lower exchange rate; a competitive effect – given the change in the firm's competitive position that follows an asymmetric sensitivity of its revenues and expenses to exchange rate changes.

The existing empirical evidence on companies' exposure to exchange rate risk is almost entirely concentrated on the case of companies originating from developed countries, but the results of previous research are quite mixed in identifying significant exposures at individual and even industrial level. Moreover, most of these studies tackle the impact of nominal exchange rate changes on stock prices, following the rationale that inflation rates are so small, that any change in the nominal exchange rate level will directly generate changes in the real exchange rate level. This might be true for developed countries, that traditionally display low inflation rates, but for the emerging countries, where inflation rates were higher, the link between nominal and real exchange rates is not as direct as for the developed countries' case.

From the macroeconomic level perspective, stock prices that reflect real economic activity may affect exchange rates through the increase in the demand for real money and, subsequently, the value of domestic currency. The relation between exchange rates and stock prices at the macroeconomic level may be sensitive to the exchange rate regime in force. Economic theory suggests that currency appreciation under a floating exchange rate regime reduces the competitiveness of countries' exports and, consequently, is expected to have a negative effect on the domestic stock market. Conversely, for a country relying on imports, an appreciation of the domestic currency lowers input costs and may generate a positive effect on the stock market.

More recently, a considerable amount of research has been dedicated to the study of the dynamic interactions between stock prices and exchange rates. This type of research somehow discards the previous microeconomic versus macroeconomic approach of the links between exchange rates and stock prices and uses advanced econometric models such as bivariate and multivariate cointegration, Granger causality tests and GARCH models to study the dynamic and bi-directional relation between exchange rates and stock prices. Kim (2003) investigates the existence of long-run equilibrium relationships among the aggregate stock price, industrial production, real exchange rate, interest rate and inflation rate in the United States, applying Johansen's cointegration methodology: he finds that for the 1974-1998 period the S&P 500 index is positively related to the industrial production but negatively related to the rest of the variables. Dong et. al (2005) examine six emerging Asian countries over 1989 and 2003 and found no cointegration between their exchange rates and stock prices, but they detected bi-directional causality in Indonesia, Korea, Malaysia and Thailand. Except for Thailand, the stock returns show significantly negative relation with the contemporaneous change in the exchange rates, which implies that currency depreciations generally accompany falls in stock prices. Ibrahim (2000) studies the

interactions between the foreign exchange market and the stock market in Malaysia and his results indicate that despite the lack of a long-run relationship between the exchange rate measures and stock prices in bivariate cointegration models, there is evidence of such long-run relations in multivariate models that include money supply and foreign reserves. Another interesting research was developed by Murinde and Poshakwale (2004) that investigate price interactions between the foreign exchange market and the stock market in a number of three European emerging financial markets – Hungary, Poland and Czech Republic – before and after the adoption of the euro. Using daily observations on both stock prices and exchange rates, they find that for the pre-euro period stock prices in these countries uni-directionally Granger cause exchange rates only in Hungary, while bi-directional causality relations exist in Poland and Czech Republic. After the euro adoption, exchange rates uni-directionally Granger-cause stock prices in all three countries. The authors interpret these results as being consistent with the dynamic nature of the transition process, suggesting that causality is much easier to detect as the markets become more integrated with the EU.

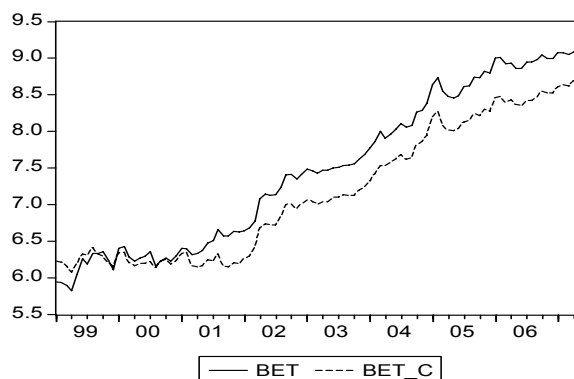
Both nominal and real exchange rates have been used so far in the study of interactions between the foreign exchange market and the stock market, but from the competitiveness point of view the two types of exchange rates do not offer the same output. Nominal exchange rates are either bilateral exchange rates of the domestic currencies against the currencies of the country's main trading partners (typically, these currencies are the US dollar or the euro), or nominal effective exchange rates. The nominal effective exchange rate of a country (NEER) or, equivalently, the "trade-weighted currency index" of the country aims to track changes in the value of the country's currency against the currencies of its main trading partners. The real effective exchange rate (or, equivalently, the "relative price and cost indicators") aims to assess a country's competitiveness in terms of prices and costs against its main competitors in international goods and services markets. The existing literature employs a wide range of prices to calculate real effective exchange rates, such as: consumer price index (CPI), GDP deflator, industrial production prices index (PPI), nominal unit labour costs for the total economy or for the manufacturing industries, and the ratio between the prices of tradable and non-tradable goods. As an indicator of international competitiveness, the real effective rate is best to be used over a long-run horizon. Still, despite its widespread use, this indicator has some disadvantages. Specifically, the concept of international competitiveness is difficult to be measured at the economy level, as the indicator does not take fully into account the competition at firm level that includes factors such as product quality, innovation and reputation. Nevertheless, the use of real exchange rates may be explained by the fact that firms' international performances are highly influenced by macroeconomic evolutions, particularly in emerging countries. The methodologies used for the computation of the effective exchange rates differ between the International Monetary Fund, European Central Bank and OECD. In our research we have used the rates calculated according to the European Central Bank methodology. Specifically, the NEER is calculated as a weighted geometric average of the bilateral exchange rates against the currencies of

trade partner countries and reported as an index; a rise in the index indicates a strengthening of the currency. The REER corresponds to the NEER deflated by nominal unit labour costs for the total economy and consumer prices (CPI/HICP); a rise in the index signifies a loss of competitiveness.

## 2. Data and research methodology

The research we undertook employs two main sets of data over the January 1999 – June 2007 period, on a monthly basis: on one hand, data on the nominal effective and real effective exchange rates of the Romanian currency (RON), and, on the other hand, data on the Romanian stock exchange performance. Both effective exchange rates were calculated against the euro-13 area countries, the EU-27 member countries and the main 41 trading partners – overall, six such exchange rates were used: NEER\_EU13, NEER\_EU27, NEER\_41, REER\_EU13, REER\_EU27, and REER\_41. To track the performance of the Romanian stock exchange we used the end of month values of the two indices reported by the Bucharest Stock Exchange, denominated in leu: BET and BET-C. The data concerning the exchange rates were retrieved from the database of the Directorate General for Economic and Financial Affairs of the European Commission, while the monthly values of the two indices were collected from the Bucharest Stock Exchange website. Figure 1 to 3 show the evolutions of exchange rates and stock prices over the considered period.

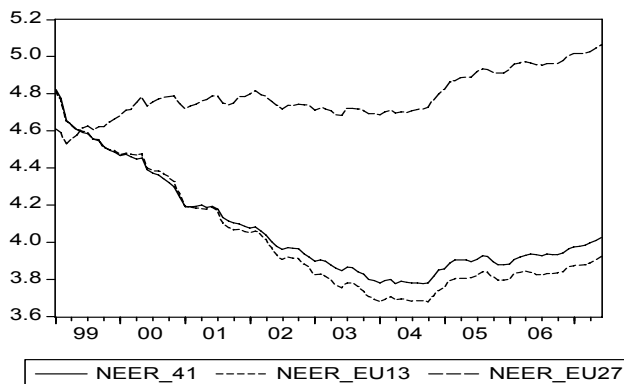
Figure 1. BET and BET-C indices of the Bucharest Stock Exchange, January 1999- June 2007 (values as natural logarithms)



The increase in the overall performance of companies listed on the Bucharest Stock Exchange was obvious during 1999-2007 and particularly after May 2002. Both BET, the first index developed by BSE and considered the reference index for the market, which is calculated as a free float weighted capitalization index of the most liquid 10 companies listed on the BSE regulated market, as well as BET-C, the composite index calculated as a market capitalization index that reflects the price movement of all the companies listed on BSE regulated market, first and second

category, excepting the SIFs, increased, with two noticeable picks, one in February 2005 and the other one in February 2006. Their evolution suggests, at the same time, that the market performance is mainly driven by the most liquid 10 stocks, which is quite typical for an emerging market, where the stock markets are concentrated around the most important listed companies. As Figures 2 and 3 allow us to observe, while the nominal effective rates indicate a strengthening of the leu after the end of 2004, the real exchange rates tell us a different story, as all indices show a decrease of competitiveness against Romania's trading partners. The real appreciation of the currency was due to a number of specific factors, such as: the increase of capital inflows as result of privatisation transactions, particularly in the utilities sector (energy, oil, gas), the significant number of Romanian citizens employed outside the country that contributes to the financing of Romania's current account deficit, and the use of euro as the major foreign currency on the foreign exchange market after March 2003.

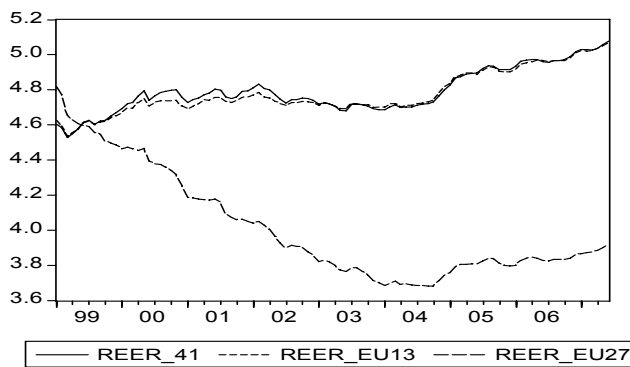
Figure 2. Nominal effective exchange rates of Romanian leu against January 1999- June 2007 (values as natural logarithms)



Our research objective was directed towards the detection of significant interactions between the stock exchange and the exchange rates, at the nominal and real level. We developed our analysis by using two types of analysis: a cointegration test and a Granger causality test. The concept of cointegration was first developed by Engle and Granger (1987), which discuss the case of variables that are integrated of order one and are included in a regression. We know that  $I(1)$  variables should be differenced before they are used in linear regressions in order to make them  $I(0)$ , otherwise the regression is spurious. Engle and Granger advanced the idea that sometimes the regression of two  $I(1)$  variable might not be spurious, but meaningful, in case the two variables are cointegrated. Generally, if  $y_t$  and  $x_t$  are two  $I(1)$  processes, then, in most of the cases,  $y_t - \beta x_t$  is also a  $I(1)$  process for any number  $\beta$ . Nevertheless, it is possible that for some  $\beta \neq 0$ ,  $y_t - \beta x_t$  is not an  $I(1)$ , but an  $I(0)$  process, with constant mean, constant variance and autocorrelation that depends only on the time distance between any two variables in the series, and it is asymptotically uncorrelated. If such  $\beta$  exists, the series  $y_t$  and  $x_t$  are said to be cointegrated and  $\beta$  is

called the cointegrating parameter. As a result, a regression of  $y_t$  on  $x_t$  would be meaningful, not spurious. Economically speaking, cointegration of two variables indicates a long-term or equilibrium relationship between them, given by their stationary linear combination (called the cointegrating equation). We test for the existence of cointegration between the stock market indices and the exchange rates using the Johansen (1988) and Johansen and Juselius (1990). This procedure is based on the maximum likelihood estimation in a VAR model, and calculates two statistics – the trace statistic and the maximum Eigenvalue – in order to test for the presence of  $r$  cointegrating vectors. The trace statistic tests the null hypothesis that there are at most  $r$  cointegrating vectors against the hypothesis of  $r$  or more cointegrating vectors. The maximum Eigenvalue statistics tests for  $r$  cointegrating vectors against the hypothesis of  $r+1$  cointegrating vectors for a number of  $r$  variables includes in the testing procedure.

Figure 3. Real effective exchange rates of Romanian leu against EU-27 countries, January 1999-June 2007 (values as natural logarithms)



The Granger causality test (Granger, 1969) was developed as a more efficient approach as compared to the basic correlation tool, which does not imply causation between correlated variables in any significant sense of the word. The Granger test addresses the issue of whether the current value of a variable  $y - y_t$  - can be explained by past values of the same variable –  $y_{t-k}$  – and then whether adding lagged values of another variable  $x - x_{t-k}$  – improves the explanation of  $y_t$ . As such, the variable  $y$  is said to be Granger-caused by  $x$  if the coefficients on the lagged values of  $x$  are found to be statistically significant. The statement “ $x$  Granger causes  $y$ ” does not necessarily imply that  $y$  should be seen as the effect or results of  $x$ , as the Granger test measures only precedence and information content on variable  $y$ , and does not indicate causality in the common sense of the word. The only significant piece of information the Granger test reveals is whether the  $x$  variable helps in a better prediction of the  $y$  variable. In our research we performed bivariate Granger causality tests on stock exchange logarithmic returns and first logarithmic differences in exchange rates, using the standard methodology proposed by Granger (1969, 1986) and Engle and Granger

(1987). In order to test for Granger causality among the stock market index  $x_t$  and exchange rate  $y_t$  we estimated the following equations

$$\Delta \ln y_t = c + \sum_{i=1}^k \delta_i \Delta \ln y_{t-i} + \sum_{i=1}^k \beta_i \Delta \ln x_{t-i} + \varepsilon_t \quad \text{and}$$

$$\Delta \ln x_t = g + \sum_{i=1}^k \phi_i \Delta \ln x_{t-i} + \sum_{i=1}^k \gamma_i \Delta \ln y_{t-i} + \omega_t$$

and performed an F test for joint insignificance of the coefficients  $\beta_i$  and  $\gamma_i$ ,  $i=1 \dots k$ . The null hypothesis was that  $x_t$  does not Granger cause  $y_t$  or  $y_t$  does not Granger cause  $x_t$ . Therefore, when the null hypothesis is rejected this indicates a presence of Granger causality. For each pair of stock market index and exchange rate we performed two Granger causality tests in order to identify unilateral causation ( $x_t$  causes  $y_t$  or  $y_t$  causes  $x_t$ ), bilateral causation ( $x_t$  causes  $y_t$  and causes  $x_t$ ) or no causation.

The application of the Granger test raises a number of issues that are critical for the significance of the test's results. The first issue is related to the number of lags used in the OLS regressions, since the test's results are highly sensitive on this number (Gujarati, 2003; Hamilton, 1994; Wooldridge, 2006). Various approaches towards the finding of the critical lag are proposed that are more or less of the "trial and error" type. The method we used relied on the estimation of an autoregressive model for each variable and using various lag length selection criteria to determine how many lags should appear in the Granger equation. The second issue is linked to the specification of the Granger causality tests. As shown by MacDonald and Kearney (1987), Miller and Russek (1990) and Lyons and Murinde (1994), the Granger causality tests are well specified if they are applied in a standard vector autoregressive form to first differenced data only for non-cointegrated variables. Statistically, the presence of cointegration excludes non-causality between the variables under consideration. Therefore, if two variables are found to be cointegrated, then there must be causality in the Granger sense between them, either uni-directionally or bi-directionally. In such a case, the Granger test can be correctly specified by including in the equation referring to two cointegrated variables an error correction (EC) term, representing the residuals from the cointegrating regression. The general form of the equation we used is

$$\Delta \ln y_t = c + \sum_{i=1}^k \delta_i \Delta \ln y_{t-i} + \sum_{i=1}^k \beta_i \Delta \ln x_{t-i} + \lambda_i EC_{t-1}^{y/x} + \varepsilon_t$$

where  $y_t$  and  $x_t$  are two cointegrated variables, while  $EC_{t-1}^{y/x}$  indicates the residuals from the cointegrating regressions where  $y_t$  was the dependent variable and  $x_t$  the independent variable. In such a test, the EC term indicates the adjustment of the dependent variable to the lagged deviations from the long-run equilibrium path. If the coefficient attached to the EC term is statistically significant, it means that the dependent variable adjusts towards its long-run level. For this test we also used the various information criteria to indicate the number of lags to be introduced in the regression and we used the same number of lags for both variables.

### 3. Results

Before specifying any cointegration or Granger causality test, we test for unit root in the indices and exchange rates levels, as well as in first differences. The Augmented Dickey-Fuller (ADF) test indicated that the exchange rates and stock market indices' levels were non-stationary at the 1% statistical significance level, while their first differences were stationary at the 1% significance level. Therefore, we proceed with the development of the cointegration test for the levels of variables and afterwards with the Granger causality test for their first differences.

As Table 1 shows, both the trace and the eigen-value statistics indicate cointegration between BET and two of the nominal effective rates (NEER\_41 and NEER\_EU13), as well as between BET and the real effective exchange rate against the EU-27 partners (REER\_EU27) for the entire period. The other stock exchange index, BET-C, is found to be cointegrated with the nominal effective rate against Romania's main 41 trading partners (NEER\_41) and with the bilateral RONEUR exchange rate. No cointegration is detected between this index and one of the real exchange rates.

Table 1. Cointegrating relations between stock market indices and exchange rates (4 lags)

	<i>Trace</i>	<i>Eigen</i>
BET – NEER_41	29.31**	22.28**
BET – NEER_EU13	29.46**	22.46**
BET – REER_EU27	30.15**	23.15**
BET_C – NEER_41	31.60**	23.47**

Note: \* indicates significance at 1% level, \*\* at 5% level and \*\*\* at 10% level

The results of the Granger tests performed on non-cointegrated variables are shown in Table 2. We report only the Granger causality relations identified as statistically significant.

Table 2. Bivariate causality results on non-cointegrated variables

<i>Null hypothesis</i>	<i>F-statistic</i>
BET_C dnc NEER_EU13	2.9270*** [1]
BET_C dnc NEER_EU27	3.1249*** [1]

Note: \*, \*\* and \*\*\* indicate significance at 1%, 5% and 10%, respectively. The numbers in squared brackets indicate the number of lags of the causal variable used in the Granger test.

The results of the Granger tests indicate that Romanian stock market performance is reflected with a one-month lag on the Romanian currency value, but



only in nominal terms. This might indicate that the foreign exchange market reacts to the developments in the Romanian economy and the firm's performances embed in their stock prices. On the other hand, the lack of an information transmission from the stock prices to the real exchange rates or vice versa might show that the changes in the competitiveness of the Romanian economy are not captured by the performances of the companies in the stock market.

We turn next to the results of modified Granger causality tests on cointegrated variables, that include an error correction terms indicated the adjustment of the dependent variable to the lagged deviations from the long-run equilibrium path. If the coefficient of the EC term is statistically significant, it means that the dependent variable adjusts towards its long-run level in the next month. We report the findings in form of F-statistic and error correction coefficient in Table 3.

Table 3. Modified bivariate Granger causality tests results

<i>Null hypothesis</i>	<i>F-statistic</i>	<i>Error correction coefficient (t-statistic)</i>
NEER_41 dnc BET	1.9204*** [2]	-1.7119*** (0.0902)
BET dnc NEER_41	1.8967 [1] 0.5900 [7]	1.7142*** (0.0897) 1.5627 (0.1121)
NEER_EU13 dnc BET	2.0158*** [2]	-1.8679*** (0.0649)
BET dnc NEER_EU13	1.8593 [1] 0.5689 [6] 0.5585 [7]	1.6109 (0.1104) 1.4193 (0.1596) 1.4012 (0.1651)
REER_EU27 dnc BET	2.0376*** [2]	-1.6985*** (0.0927)
BET dnc REER_EU27	1.2295 [1]	1.4682 (0.1453)
NEER_41 dnc BET_C	1.3446 [2]	1.8004*** (0.0750)
BET_C dnc NEER_41	1.9235 [1] 0.6832 [7]	1.6904*** (0.0942) 1.8088*** (0.0743)

Note: \*, \*\* and \*\*\* indicate significance at 1%, 5% and 10%, respectively. The numbers in squared brackets indicate the number of lags of the causal variable used in the Granger test. The numbers in round brackets indicate the p-value for the t-statistic.

In the Granger sense, the results do not confirm the previous findings that stock prices are the leading variables for the exchange rates. On the contrary, the modified tests indicate that exchange rates are leading variables for the stock prices. Two of the nominal effective exchange rates (NEER\_41 and NEER\_EU13) as well as one of real effective exchange rate (REER\_EU27) have explanatory power for the current values of the BET, but only at a 10% significance level, which also indicates a weak relationship between the variables. The coefficients of the error correction terms, which represent an additional channel of causality, validate the previous findings of cointegration between the variables. We find that the stock market adjusts to correct for disequilibrium, but quite dramatically, as coefficients that are statistically significant have values below -1 or above 1. These results might be a sign of an over-reaction of

the stock market to shocks in the exchange rates, which goes beyond the correction of the stock market to the long-run equilibrium with exchange rates.

#### **4. Conclusion**

This research study employs standard bivariate cointegration tests, using the Johansen-Juselius methodology, as well as standard and modified Granger causality tests to explore the interactions between exchange rates and stock market prices applied to Romania, one of the emerging economies in Central and Eastern Europe and a new member of European Union since January 2007. In the analysis, two types of exchange rates of the Romanian currency are used: effective nominal rates and real effective rates. The two indices of the Bucharest stock exchange were capturing the evolution of stock prices. The analysis involved the January 1999 – June 2007 period.

When standard Granger causality test were performed on non-cointegrated variables, we identified unilateral causality relations from the stock prices to exchange. The results of modified Granger tests indicate that exchange rates are the leading variables for the stock prices and that the stock market adjusts quite dramatically to changes in the exchange rates in one month time. The magnitude of adjustment might indicate even an over-reaction of the stock market to developments on the foreign exchange market, which points toward a central role played by the exchange rate in the Romanian economy, on one hand, and in the decision of players in the stock market, on the other hand.

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