# RELATIONSHIP BETWEEN FOREIGN EXCHANGE RATE AND STOCK PRICE OF COMMERCIAL BANKS IN ROMANIAN FINANCIAL MARKET

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**Abstract**

In the context of globalization and the financial crisis that the world traversed over the period 2007-2009, the Romanian capital market suffered extreme shocks (stock indices recording a decline of up to 90% while the national currency depreciated sharply against EUR and USD), which led to a significant increase in volatility in the national financial market. Considering that the financial sector was the trigger of the crisis and one of the most affected sector, we chose to analyze whether we can talk about the foreign exchange rate impact on price of the bank shares traded on the Bucharest Stock Exchange and vice versa (during March 2008 - June 2017), using correlation and VAR Granger Causality test. Frequency of data is daily. We also studied the evolution of the correlation between the banking sector (represented by the shares of the banking companies traded on the Bucharest Stock Exchange) and the foreign exchange market during and after the financial crisis. Next, we analyzed volatility changes in this sector in the post-crisis period compared to the one recorded during the financial crisis. We have included the three Romanian banks: BRD-Groupe Societe Generale, Banca Transilvania, Patria Bank and two foreign banks traded on BSE: Erste Bank AG and Deutsche Bank and RON/EUR and RON/USD exchange rates.The results of the study showed that we can speak of a unidirectional causality running from the RON / EUR exchange rate to the prices of the Romanian banks included in the study (except for Patria Bank) and of a bidirectional causality for foreign banks Erste Bank and Deutsche Bank. During the crisis (as could be expected), we noticed an increase in volatility and market correlation and a slight decline once the effects of the crisis began to dissipate.

**Keywords:** causality, stock market, foreign exchange rate, VAR Granger Causality model, volatility.

**JEL Classification** C15, C58, G01

## Introduction

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The debut of the financial crisis was associated with the bankruptcy of Lehman Brothers (September 15, 2008), the fourth largest US investment bank. This bankruptcy has prompted a shock wave in the financial markets, which has resulted in sharp declines in capital markets and high turbulence in foreign exchange markets.

There has been a growing dependence between the financial markets as a result of the uncertainty that dominated the world during the financial crisis. Increased dependence on international stock markets has been documented in numerous studies (such as Paltalidis 2011, Samarakon 2011, Dufrenot, Mignon and Peguin-Feisolle 2011). Other studies (Coudret, Couharde and Mignon, 2011) surprised the same trend in foreign exchange markets. Researchers who analyzed the relationship between capital markets and foreign exchange markets during the different crises have shown that due to uncertainty, stock market volatility has also prompted strong movements in other markets, such as foreign exchange, for example. As a result, the relationship between stock and exchange rate returns is a subject of study for the scientific world, investors and economic and political decision-makers everywhere.

More precisely, if on a capital market there are rising yields compared to those obtained in other markets, is the national currency expected to appreciate or depreciate against foreign currencies? In general, it is accepted that a high yield registered by a local market relative to other foreign markets is associated with a depreciation of the national currency.

Also, an investor holding foreign shares is exposed both to the risk of the investment on the stock exchange and to fluctuations in the exchange rate.

Over time, attention has been focused more on the link between the interest rate differential and the exchange rate between different countries (subject for which there is a vast literature) and less on the link between the yields obtained on capital markets and foreign exchange rates.

Most of the previous studies focus on investigating the link between stock prices and the exchange rate in mature economies, in some euro area economies without including Romania in these studies and without focusing on the Romanian banking sector.

In an attempt to supplement this omission in the literature, our research focused on the correlation (and volatility) between the yields of the banking sector traders traded on BVB (BRD-Groupe Societe Generale, Banca Transilvania, Patria Bank and two of the foreign banks Erste Bank and Deutsche Bank) and exchange rate returns both during the financial crisis (March 2008 - February 2009) and in the period after the end of the crisis (March 2009 - June 2017).

The commercial banks included in the study (Banca Transilvania and BRD-Groupe Societe Generale) occupy positions 2 and 3 in the ranking of Romanian banking companies according to their market share and have an important role both on the credit market and on the Romanian capital market.

In the period before the financial crisis, they were in the attention of both resident and non-resident investors, so trading prices have grown sharply. With the outbreak of the financial crisis, the Romanian stock exchange fell sharply, with stock indices depreciating by up to 90%. It is obvious that even the shares of the banking companies were not shunned by these decreases. Although in recent years banks have reported rising business and consequently

higher profits, the stock prices of these shares have not correlated with the reported financial results, their level remaining well below the pre-crisis financial horizon.

In general, previous studies have focused on the influence of foreign financial markets on the evolution of Romanian stock market indices, which also include these banking companies.

We propose to test whether and to what extent the exchange rate is one of the factors that influence the price of the banking shares traded on the Bucharest Stock Exchange and if the evolution of the stock prices of these shares have an impact on the exchange rate evolution.

For the first time, we collected the data included in the study, we calculated the statistical correlation indicators for the initial data, tested the stationarity of the data using the ADF test, stationary the data by applying the first difference, then applied the Granger causality test (Granger, 1999) to check the short-term relationship between the data included in the study (the five commercial banks and the exchange rate, RON/EUR and RON/ USD).

In order to accurately determine the relationship between the RON / EUR exchange rate and the bank's share price we used the VAR Granger Causality Method. In the study, we analyzed the evolution of correlation and volatility over two-time periods: March 2008 - February 2009 (financial crisis period) and March 2009 - June 2017 (post-crisis period).

The paper is organized in four main areas: Literature review (which includes earlier studies on this series), Data and methodology (including descriptions of applied data and methodology), results and interpretations and study findings.

## 1. Review of the scientific literature

The relationship between the exchange rate and the share price can be approached through two theoretical models, namely: the traditional approach based on the capital flows model (Dornbusch & Fischer, 1980) which states that the stock market is influenced by exchange rates, in while portfolios approach, share-based model (Branson, 1983 and Frankel, 1983) argue that the stock market is the one that influences exchange rates.

In the case of the traditional approach, it starts from the idea that a more competitive exchange rate will positively influence the real economy and this will be reflected in the appreciation of the stock prices traded on the stock exchange. On the other hand, domestic importing companies will see an increase in production costs, which will cause a decrease in sales and consequently in their earnings, which will result in lowering the trading prices of these firms. We can conclude that the impact of the exchange rate on the stock price may be positive or negative.

n the latter case, an increase in the national capital market will attract foreign investment, which will determine the appreciation of the local currency exchange rate as compared to foreign currencies (Kollias, Mylonidis and Paleologu, 2012).

Theoretically, the exchange rate indirectly influences the stock price by the impact it has on investors on the stock exchange. Investors who invest in foreign markets take into account

both the price of the shares they invested in and the exchange rate of the currency in which they make that investment. In the case of a RON / EUR exchange rate, an investor holding shares in EUR, if the EUR appreciates (meaning that the RON is depreciated) will obtain a higher return than those who have invested in shares whose price is expressed in RON. As such, investors will choose to invest in shares whose price is expired in EUR, and so the purchasing pressure will determine the appreciation of the price of those shares. The previous example shows how fluctuations in the exchange rate can cause fluctuations in stock prices traded on the stock exchange.

Studies on exchange rate linkage and share prices have had different results.

Aggarwal (1981) concluded that there was a positive correlation between stock prices and a strong dollar, between 1974-1978, using monthly frequency data.

Soenen and Hennigar (1988) argued that the sign of stock price correlation and exchange rate is influenced by the data sample used.

Bahmani, Oskooee and Sohrabian (1992) analyzed the relationship between the exchange rate and the stock price for the period 1973-1988 (monthly data) in the USA. the conclusion of the study was that the two variables are not cointegrated, but in the short term there is a bidirectional relationship. Mougoue, in 1999, studied this connection (long and short term) in the case of the United States and the United Kingdom. The conclusion of the study was that there was a covariance between the exchange rate and the stock price, the depreciation of the currency led to a fall in stock prices.

Zhao (2010) analyzed this relationship for China and the study identified a bidirectional relationship between Renminbi (RMB) and the stock exchange index of the Shanghai Stock Exchange, indicating that the stock market's past conditionality has an impact on the future volatility of the course foreign exchange and vice versa.

The relationship between the stock price and the exchange rate was mentioned in several studies such as: (Tabak, 2006), (Kurihara, 2006) and (Sekmen, 2011).

Kutty G. (2010) examined the relationship between stock price and exchange rate in Mexico. The study revealed that stock prices influence the short-term exchange rate and that there is no long-term relationship between these variables.

Kanas (2010) found that there were positive effects of stock market returns in changing exchange rates for G7 countries except Germany. In addition, the recent study by Chkili, Aloui and Nguyen (2012) used CCC-FIAPARCH to capture long-term asymmetry and co-integration from the daily data (January 1999 to December 2010) for England, France and Germany. A strong correlation between share price and exchange rate has been identified, performing better than the GARCH model used for the same data. Caporale, Hunter, Ali (2010) attempted to overcome the nature of the link between the two variables for 2007-2010 for the US, UK, Canada, the euro area and Switzerland. The result showed that there is a bidirectional link in the euro area and Switzerland, a unidirectional link (from the stock market to the exchange rate) for the US and the UK and the lack of a link in the case of Canada.

Boubaker & Jaghoubbi (2014) conducted a study for 17 countries across the EU during 2007-2011. The study found that the decline in (local) stock markets is associated with depreciation (appreciation) of the EUR / USD exchange rate.

Ngan (2016) studied the relationship between the price of 9 Vietnamese banks and the VND / USD exchange rate and the result revealed a one-way link, namely that only the exchange rate influences the course of the listed stock on the Vietnamese stock exchanges without being able to define what kind of relationship is involved, covariance or contra-variant. There have also been studies (Izan, 1999) that have shown that in the long run there is no relationship between the stock market and the foreign exchange market. Lee's (2001) study for the G-7 countries had the same result.

Other theories (Hau and Rey, 2006) argue that currency and stock market returns are negatively correlated with the rebalancing of portfolios. The survey comprised 40 stock indices studied over a 30-year period. They concluded that stock market returns may explain the behavior of exchange rates to a small extent, recommending that this relationship be investigated at the level of each country, unable to say whether it exists or varies over time for some countries, sometimes in response to various shocks.

## 2. Research methodology

In order to investigate the correlation between the shares price and the exchange rate, we used the daily reference prices of the five banks traded on the Bucharest Stock Exchange, three of them Romanian banks, namely: BRD- Societate Generale, Banca Transilvania and Patria Bank (formerly Commercial Bank Carpatica) and two foreign banks: Erste Bank (traded at the Vienna Stock Exchange) and Deutsche Bank (traded on German stock exchanges). I also used the RON / EUR and RON / USD exchange rates. The motivation to include RON / USD in the study is that until 2004 the US dollar was the foreign currency representative in Romania and because a large number of interbank transactions are doing in this currency.

The prices of Romanian bank shares and Erste Bank were taken from BVB web site (www.bvb.ro), while for Deutsche Bank data we used Yahoo Finance (www.finance.yahoo.com). Quotations for currency pairs EUR / RON, EUR / USD were taken from the BNR web site (www.bnr.ro).

For the period included in the calculation, March 2008-June 2017, there were 7 series of data, containing the daily prices of 5 banking companies and 2 exchange rates. To find the relationship between the exchange rate (RON / EUR and RON / USD) and the price of the 5 banks traded on the BVB, we used the VAR Granger Causality test. We studied the correlation between the 7 data series included in the study and also the volatility of these time series during the analyzed period, but also on two subperiods of time: the crisis period (March 2008 - February 2009) and post crisis (March 2009 - June 2017).

In order to achieve the first requirement of the VAR Granger Causality test, it was necessary to check whether the time series are stationary.

The data stationarity test was performed using the Augmented Dickey-Fuller ADF test. The ADF test was proposed in 1979 by David Dickey and Wayne Fuller and was perfected by Dickey in 1981. The test became a popular tool for testing stationarity in numerous studies, ex (Wickremasinghe, 2004) that used the ADF to test the exchange rate stationarity.

We applied this test for each of the 7 data sets studied, namely BRD, PBK, TLV, EBS, DBK, RON / EUR and RON / USD. The non-stationary time series were converted into daily returns by applying the first difference. On the stationary data (exchange rates and the 5 banks) we applied the Granger test. Cointegration as a concept was introduced by Engle and Granger (1987), indicating a long-term link between two variables. The creators of this concept have demonstrated that the result of the regression of two variables is not wrong (false) if the two variables are cointegrated.

In our case, if we note FXi, exchange rate of a currency pair i and PBi the commercial bank's price, the Granger causality test checks if the actual value of FXi can be explained by its past values and if the explanatory power can increase by adding the values past of another variable, in our case PBi. If the coefficient of the variable PBi is statistically significant, we say that the variable $PB_i$ Granger cause FXi.

The model for Granger causality is the following:

$$FXi = \alpha 0 + \Sigma \alpha kFXi\text{-}k + \Sigma \beta iPBi\text{-}k + \mu \qquad (1)$$

$$PBi = \omega 0 + \Sigma \omega kPBi\text{-}k + \Sigma \varphi iFX\ i\text{-}k + \nu \qquad (2)$$

where:

$\alpha, \beta$ - are the coefficients of FX,

$\omega, \varphi$ - are the coefficients of PB,

$\mu, \nu$ - are the residues having the mean of zero and $\sigma^2 < \infty$.

The null hypothesis is FXi does not Granger cause PBi. The null hypothesis is rejected if all coefficients $\varphi$ (k> 0) are jointly significantly different from zero by using F-test.

The null hypothesis is PBi does not Granger cause FXi. This is rejected if all coefficients $\beta$ (k> 0) are jointly significantly different from zero by using F-test.

If both $\beta$ (k> 0) and $\varphi$ (k> 0) are jointly significantly different from zero, then we have bi-directional causality between FXi and $PB_i$.

The data included in the study are the five banking companies (Table no. 1) and the RON/EUR and RON/USD rates.

**Tabel no. 1- List of commercial banks**

|   | Symbol | Commercial Banks | Stock Exchange |
|---|--------|------------------|----------------|
| 1 | **BRD** | BRD – Groupe Societe Generale | BVB |
| 2 | **TLV** | Banca Transilvania | BVB |
| 3 | **PBK** | Patria Bank (former Banca Comerciala Carpatica) | BVB |
| 4 | **EBS** | Erste Bank | VSE |
| 5 | **DBK** | Deutsche Bank | FWB |

*Source of data*: Bucharest Stock Exchange and Yahoo Finance.

The chosen period for this study is March 2008 - June 2017. 2008 was the year when the crisis was more visible, the situation worsening after the fall of Lehman Brother on September 15, 2008.

In Annex 1 we have the graphs of the evolution of the prices for the five banking companies and those of the two exchange rates. From the analysis of the individual graphs of the seven variables we can see that as BRD and TLV prices rise (in post crisis period), the national currency depreciates both in relation to the single European currency and the US dollar.

In the case of PBK and DBK we have a different evolution than the other three banks, a downward trend, following the negative news that emerged in recent years for these banks. The news was reflected in the financial results, the two banks registering multi-annual losses.

It is worth mentioning the increased volatility of Erste Bank, the Austrian bank whose most important asset is the Romanian Commercial Bank (BCR). Restructuring BCR was a big challenge for Erste Bank, especially as it was in crisis conditions.

## 3. Results and discussion

For the five banks traded on the BSE and the RON / USD and RON / EUR rates we cannot assume the normal daily distribution of the daily returns for any of 7 time series (Table no. 2).

We can also see that the highest volatility and the largest declines were recorded by foreign banks (EBS and DBK), followed by Romanian bank TLV.

It should be noted that in the case of stock indices (which have been the subject of numerous studies) the situation was reversed especially during the crisis, with Romanian indices depreciating by up to 90% while the international stock indices registered a decrease of 50-60 %.

**Table no.2 - Daily data statistics (March 2008-June 2017)**

|  | RONEUR | RONUSD | BRD | TLV | PBK | EBS | DBK |
|---|---|---|---|---|---|---|---|
| Mean | -1.99E-05 | -7.32E-05 | 11.04927 | 0.000848 | 0.094483 | -0.006094 | -0.020425 |
| Maximum | 0.006557 | 0.016467 | 26.90000 | 0.838000 | 0.449000 | 19.60000 | 5.608101 |
| Minimum | -0.007672 | -0.015428 | **3.730000** | **-0.735000** | **0.035000** | **-16.50000** | **-4.648800** |
| Std. Dev. | 0.000846 | 0.002592 | **3.467436** | **0.041185** | **0.062021** | **2.789477** | **0.800022** |
| Skewness | -0.356422 | -0.500996 | 1.413064 | 0.367701 | 2.474753 | -0.070486 | 0.039545 |
| Kurtosis | 15.97212 | 8.447927 | 5.277534 | 134.5670 | 9.825137 | 8.643602 | 8.403534 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Jarque-Bera | 15464.83 | 2811.412 | 1207.083 | 1586066. | 6512.715 | 2920.099 | 2675.857 |
| Probability | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |

*Source of data:* Bucharest Stock Exchange and Yahoo Finance. Calculations by the author

As he could see from table no. 3 the highest correlation with RON / EUR is registered for EBS, DBK followed by TLV and BRD, in all 4 cases the relationship is positive.

In the case of Patra Bank, the relationship is negative. For RON / USD the situation is a bit different, EBS, TLV and DBK (the highest positive correlations), followed by PBK and BRD (negative correlation).

**Table no. 3 - Correlations (daily sample)**

| | RONEUR | RONUSD | BRD | TLV | PBK | EBS | DBK |
|---|---|---|---|---|---|---|---|
| **RONEUR** | 1.000000 | 0.564960 | 0.005377 | 0.016018 | -0.021343 | 0.068141 | 0.023263 |
| **RONUSD** | 0.564960 | 1.000000 | -0.032770 | 0.038018 | -0.018468 | 0.048700 | 0.035176 |
| **BRD** | 0.005377 | -0.032770 | 1.000000 | -0.043836 | 0.687693 | -0.056302 | -0.076435 |
| **TLV1** | 0.016018 | 0.038018 | -0.043836 | 1.000000 | -0.016574 | -0.016783 | -0.011743 |
| **PBK** | -0.021343 | -0.018468 | 0.687693 | -0.016574 | 1.000000 | -0.020017 | -0.047529 |
| **EBS** | 0.068141 | 0.048700 | -0.056302 | -0.016783 | -0.020017 | 1.000000 | 0.051326 |
| **DBK** | 0.023263 | 0.035176 | -0.076435 | -0.011743 | -0.047529 | 0.051326 | 1.000000 |

*Source of data:* Bucharest Stock Exchange and Yahoo Finance. Calculations by the author

To see if the correlations between exchange rates and stock prices of the 5 banks included in the study are not coincidental, we used the Granger Causality test.

The first requirement for the Granger Causality test is that the time series are stationary.

Thus, we went to testing the stationarity of 7 time series using the Dickey-Fuller test, and the results are presented below (Table no. 4).

**Table no. 4 - Results of ADF test**

| | Variable | T_crit. 5% | T_stat level | T_stat 1st difference | Conclusion |
|---|---|---|---|---|---|
| 1 | **RONEUR** | -2.87 | -31.00771 | -46.40656 | Stationary at lag 1 |
| 2. | **RONUSD** | -2.87 | -2.005765 | -46.40656 | Stationary at lag 1 |
| 3 | **BRD** | -2.87 | -2.906948 | - | Stationary at level |
| 4 | **TLV** | -2.87 | -1.438598 | -46.44214 | Stationary at lag 1 |
| 5 | **PBK** | -2.87 | -4.802162 | - | Stationary at level |
| 6 | **EBS** | -2.87 | -2.244058 | -46.28500 | Stationary at lag 1 |
| 7 | **DBK** | -2.87 | -2.761391 | -36.29261 | Stationary at lag 1 |

*Source of data: Bucharest Stock Exchange and Yahoo Finance. Calculations by the author*

Applying the ADF test, we noticed that 5 of the 7 series were not stationary. BRD and PBK were stationaries at the initial level

The non-stationary time series (except BRD and PBK) were converted into daily returns by applying the first difference, thus becoming stationary at lag 1.

The variables thus stationary allowed the regression model to run. We tested the relationship between the RON / EUR exchange rate (and then RON / USD) and the 5 banks included in the study applying the Granger Causality test (Table no.5).

**Table no. 5 Result of Granger test for Impact of RON/EUR on Bank Shares**

|  |  | P- value Lag 1 | P- value Lag 2 |  |
|---|---|---|---|---|
|  | **BRD** | **0.00014** | **0.00011** | Impact at lag1 and 2 |
|  | **TLV** | **0.00654** | **0.00133** | Impact at lag1 and 2 |
| Impact of RON/EUR on | **PBK** | 0.77324 | 0.84595 | No impact |
|  | **EBS** | **0.00331** | **0.01107** | Impact at lag1 and 2 |
|  | **DBK** | **0.00059** | **0.00036** | Impact at lag1 and 2 |

*Source of data: Bucharest Stock Exchange and Yahoo Finance. Calculations by the author*

**Table no. 6 Result of Granger test for Impact of banl share on RON/EUR**

|  |  | P- value Lag 1 | P- value Lag 2 |  |
|---|---|---|---|---|
|  | **BRD** | 0.94424 | 0.72059 | No impact |
|  | **TLV** | 0.12696 | 0.19594 | No impact |
| Impact of | **PBK on** RONEUR | 0.30740 | 0.47364 | No impact |
|  | **EBS** | **0.02860** | 0.13439 | Impact at lag1 |
|  | **DBK** | **1.3E-07** | **2.6E-08** | Impact at lag1 and 2 |

*Source of data: Bucharest Stock Exchange and Yahoo Finance. Calculations by the author*

The RON / EUR exchange rate has an impact on the market price of the Romanian banking shares (BRD and TLV) and on the prices of the two foreign banks (EBS and DBK) and has no impact on the PBK price (Table no.5).

The price of any of the Romanian banks has no impact on the RON / EUR exchange rate, while foreign exchange stock prices have an impact on the exchange rate at lag 1 for EBS and both lags in the case of DBK (Table 6 ).

In conclusion, we can speak of a unidirectional causal relationship between the RON/EUR and the price of Romanian banks, meaning the exchange rate has an impact on bank stock prices BRD and TLV (while on PBK has no impact).

It should be noted that the prices of any of the Romanian banks do not influence the RON / EUR exchange rate, which can be deduced from the low value of the stock exchange transactions compared to the value of the trade in the European currency (EUR) by Romania with the main European countries (Germany, France, etc.).

In the case of foreign banks traded on the Bucharest Stock Exchange, it could speak of a bidirectional relationship, the RON / EUR exchange rate influencing the price of the shares EBS and DBK and vice versa

It is necessary to specify that the foreign banks included in the study are traded in EUR in the countries where they are listed (EBS in Austria, respectively BRK in Germany) and in RON at BVB (meaning the trading price on the stock exchanges in the country of origin multiplied by the exchange rate EUR / RON).

The results of testing the relationship between the RON / USD exchange rate and the prices of the banks included in the study are presented below (Table no. 7 and 8). It can be seen in this case that there is a different situation, namely that the prices of the banking shares (except PBK) have an impact on the RON / USD exchange rate. Also, the RON / USD exchange rate has an impact on the market price of TLV and DBK at both lags.

**Table no. 7 Result of Granger test for Impact of RON/EUR on Bank Shares**

|  |  | P- value Lag 1 | P- value Lag 2 |  |
| --- | --- | --- | --- | --- |
|  | **BRD** | 0.23178 | 0.44883 | No impact |
|  | **TLV** | **0.01225** | 0.05018 | Impact at lag1 |
| Impact of **RONUSD** on | **PBK** | 0.05290 | 0.16555 | No impact |
|  | **EBS** | 0.29717 | 0.17839 | No impact |
|  | **DBK** | **0.00361** | **0.00084** | Impact at lag1 and 2 |

*Source of data: Bucharest Stock Exchange and Yahoo Finance. Calculations by the author*

**Table no. 8 Result of Granger test for Impact of bank shares on RON/USD**

|  | P- value Lag 1 | P- value Lag 2 |  |
| --- | --- | --- | --- |
| **BRD** | **0.09219\*** | **0.04537** | Impact at lag1 and 2 |
| **TLV** | **0.00129** | **0.00538** | Impact at lag1 and 2 |
| Impact of **PBK on RONUSD** | 0.39078 | 0.60932 | No impact |
| **EBS** | **0.00235** | **0.00998** | Impact at lag1 and 2 |
| **DBK** | **3.9E-06** | **3.2E-06** | Impact at lag1 and 2 |

*Source of data: Bucharest Stock Exchange and Yahoo Finance. Calculations by the author*

As with RON / EUR, the PBK price is not influenced and does not affect the RON / USD exchange rate. In order to accurately determine the relationship between the RON / EUR exchange rate (and RON / USD) and the stock price we used the VAR Granger Causality model. The results are presented in the following tables.

**Table no. 9 Result of VAR estimate for model relation between RON/EUR and BRD**

| Variable at lag | coefficient | vector |
|---|---|---|
| RONEUR(-1) | 0.183532 | covariance |
| BRD(-1) | 1.050244 | |
| RONEUR(-2) | -0.078388 | covariance |
| BRD(-2) | -0.057168 | |

*Source of data: Bucharest Stock Exchange and Yahoo Finance. Calculations by the author*

**Table no. 10 Result of VAR estimate for model relation between RON/EUR and TLV**

| Variable at lag | coefficient | vector |
|---|---|---|
| RONEUR(-1) | 3.259037 | covariance |
| TLV(-1) | 0.019423 | |
| RONEUR(-2) | -2.555484 | covariance |
| TLV(-2) | -0.024290 | |

*Source of data: Bucharest Stock Exchange and yahoo Finance. Calculations by the author*

**Table no. 11 Result of VAR estimate for model relation between RON/EUR and EBS**

| Variable at lag | coefficient | vector |
|---|---|---|
| RONEUR(-1) | -205.9044 | contra-variant |
| EBS(-1) | 0.045625 | |
| RONEUR(-2) | -26.06583 | contra-variant |
| EBS(-2) | 0.007160 | |

*Source of data: Bucharest Stock Exchange and yahoo Finance. Calculations by the author*

**Table no. 12 Result of VAR estimate for model relation between RON/EUR and DBK**

| | | |
|---|---|---|
| RONEUR(-1) | 73.65952 | |
| DBK(-1) | 0.051544 | covariance |
| RONEUR(-2) | 22.04028 | |
| DBK(-2) | -0.091450 | contra-variant |

*Source of data: Bucharest Stock Exchange and yahoo Finance. Calculations by the author*

We can conclude that between the RON / EUR exchange rate and the romanian stock price (BRD and TLV) we have the covariate.

Between the RON / EUR exchange rate and the foreign stock price (EBS and BRD) we can speak of the contra-variant vector. We then used the VAR Granger Causality model to surprise the relationship between the stock price and the RON/ USD exchange rate.

**Table no. 13 Result of VAR estimate for model relation between BRD and RON/USD**

| | | |
|---|---|---|
| BRD(-1) | -0.000410 | contra-variant |
| RONUSD(-1) | 0.048730 | |
| BRD(-2) | 0.000381 | contra-variant |
| RONUSD(-2) | -0.024399 | |

*Source of data: Bucharest Stock Exchange and yahoo Finance. Calculations by the author*

**Table no. 14  Result of VAR estimate for model relation between TLV and RON/USD**

| | | |
|---|---|---|
| TLV(-1) | -0.004233 | contra-variant |
| RONUSD(-1) | 0.050784 | |
| TLV(-2) | -0.000892 | covariance |
| RONUSD(-2) | -0.020226 | |

*Source of data: Bucharest Stock Exchange and yahoo Finance. Calculations by the author*

**Table no. 15  Result of VAR estimate for model relation between  EBS and RON/USD**

| | | |
|---|---|---|
| EBS(-1) | 6.02E-05 | covariance |
| RONUSD(-1) | 0.046460 | |
| EBS(-2) | -5.15E-06 | covariance |
| RONUSD(-2) | -0.022610 | |

*Source of data: Bucharest Stock Exchange and yahoo Finance. Calculations by the author*

**Table no. 16  Result of VAR estimate for model relation between DBK and RON/USD**

| | | |
|---|---|---|
| DBK(-1) | 0.000320 | covariance |
| RONUSD(-1) | 0.042369 | |
| DBK(-2) | 0.000123 | contra-variant |
| RONUSD(-2) | -0.031615 | |

*Source of data: Bucharest Stock Exchange and yahoo Finance. Calculations by the author*

We cannot tell exactly what the relationship between the bank's price and the RON / USD exchange rate is, given that we have the covariance when the vector is contra-variant (Tables 13-16).

## Conclusions

In conclusion for the study period, March 2008-June2017, the relationship between the RON / EUR exchange rate was unidirectional, and we can talk about the impact of the exchange rate on the stock prices of the banks traded on the Bucharest Stock Exchange and not vice versa.

In the case of RON / USD, there was an opposite situation, but VAR could not determine precisely what kind of relationship it is.

During the crisis in the case of the banking companies (Romanian and foreign) it was noticeable that the volatility increased significantly, the uncertainty situation producing the same effect on the foreign exchange market (Table no. 17).

From the same table it can be noticed a volatility decreasing in the post-crisis period, between March 2009 and June 2017.

**Table no. 17. Volatility of the banking sector and exchange rate during/after the crisis**

|  | RON/ EUR | RON/ USD | BRD | TLV | PBK | EBS | DBK |
|---|---|---|---|---|---|---|---|
| **St. Dev. Mar 08- June17** | 0.0008 | 0.0025 | 3.4674 | 0.0411 | 0.0620 | 2.7894 | 0.8000 |
| **St. Dev. Mar 08-Febr 09** | 0.0017 | 0.0041 | 4.2959 | 0.0721 | 0.0357 | 5.2157 | 1.4571 |
| **St. Dev. Mar 09- June17** | 0.0005 | 0.0021 | 2.1496 | 0.0373 | 0.0234 | 2.4670 | 0.6762 |

Source of data: Bucharest Stock Exchange and Yahoo Finance. Calculations by the author

We observe the same evolution regarding the correlation between the exchange rates and the price of the shares of the commercial banks studied (table no. 18).

The uncertainty and panic that governed the financial markets in 2008-2009 led to a visible increase in the correlation between markets during the crisis (negative news and shocks having a far greater impact than the economic realities).

The correlation between markets diminished in intensity in the post-crisis period as economies began to recover, capital markets recorded increases and the foreign exchange market stabilized.

**Table no.18 - Bank shares correlation with RON/EUR and RON/USD during/after crisis**

|  | RON/ EUR | RON/ USD | BRD | TLV | PBK | EBS | DBK |
|---|---|---|---|---|---|---|---|
| **RON/EUR (whole per)** | 1.0000 | 0.5649 | 0.0053 | 0.0160 | -0.0213 | 0.0681 | 0.0232 |
| **RON/EUR (crisis per)** | 1.0000 | 0.6323 | 0.0192 | 0.0775 | 0.0472 | 0.1092 | 0.0060 |
| **RON/EUR (post-crisis)** | 1.0000 | 0.0287 | 0.0113 | -0.0084 | 0.0239 | 0.0401 | 0.0034 |
|  |  |  |  |  |  |  |  |
| **USD/EUR (whole per)** | 0.5649 | 1.0000 | -0.0327 | 0.0380 | -0.0184 | 0.0487 | 0.0351 |
| **USD/EUR (crisis per)** | 0.6323 | 1.0000 | 0.1713 | 0.1636 | 0.2293 | 0.1226 | 0.0161 |
| **USD/EUR (post-crisis)** | 0.0287 | 1.0000 | -0.0121 | 0.0109 | 0.0330 | -0.0313 | -0.0199 |

*Source of data: Bucharest Stock Exchange and Yahoo Finance. Calculations by the author*

In conclusion, we can speak of a unidirectional influence of the RON / EUR exchange rate on the prices of the Romanian banks traded on Bucharest Stock Exchange (except for Patria Bank) and of a bidirectional influence in the case of foreign banks.

## References

[1]    Bekaert, G., and  Harvey, C.R., and Ng, A., 2005. *Market integration and contagion..*  Journal of Business, 78(1), pp. 39-69.

[2]    Bekaert, G., and Harvey, C.R., 1997. *Emerging Equity market volatility.*  Journal of Financial Economics, 43, pp. 29-77.

[3]    Bonaci, C.G., Matis, D., 2010. *Accounting Information and its impact on investors' behavior: Analysis on the Romanian capital market.* AMIS 2010. Proceedings of the 5th International Conference, Accounting and Management Information Systems, pp. 903-921.

[4]    Box, G.E.P., and George, C., 1965. *A Change in Level of a Non-Stationary Time Series*. Biometrika, 52 (4/2), pp. 181-192.

[5]    Choe, H., and Kho, B.C., and Stulz, R.M., 1999. *Do foreign investors destabilize stock markets? The Korean experience in 1997*.Journal of Financial Economics, 54 (2), pp. 227-264.

[6]    Fama, E.F., 1965. *The behavior of stock market prices.* Journal of Business, 38, pp. 34 – 105.

[7]    Hamilton, J.D., 1994.  *Time Series Analysis.* Princeton University Press, Princeton, New Jersey

[8]    Hartmann, P., and Straetmans. S., and de Vries, C.G., 2004. *Asset market linkages in crisis periods*. Review of Economics and Statistics, 86(1), pp. 313-326.

[9]    Ong, L.L., Izan, H.Y., 1999. *Stock and Currencies: Are they Related?* Applied Financial Economics, 9(5), pp. 523-532.
       http://dx.doi.org/10.1080/096031099332186

[10] Kutty, G., 2010. *The Relationship between Exchange Rates and Stock Prices: The Case of Mexico*. North American Journal of Finance and Banking Research, volume 4(4), pp. 1-12.

[11] Kurihara, Y., 2006. *The Relationship between Exchange Rate and Stock Prices during the Quantitative Easing Policy in Japan*. International Journal of Business, 11(4).

[12] Lee, N., 2001. *Dynamic Relationship between Stock Prices and Exchange Rate for G-7 countries*. Quarterly Review of Economics and Finance, 41(4), pp. 477- 490. http://dx.doi.org/10.1016/S1062-9769(01)00085-0

[13] Miron, D., Tudor, C., 2009. *Testing the impact of trading volume on stock returns and volatility on the Romanian capital market*. China-USA Business Review, nr. 8

[14] Panait, I., 2011. *Study of the correlation between the Romanian stock market and S&P500 index during 2007-2009.* The Romanian Economic Journal, 39, pp. 233-255.

[15] Ruey, S.T., 2010. *Analysis of Financial Time Series*, John Wiley & Sons Inc. ISBN: 9780470414354

[16] Sekmen, F., 2011. *Exchange rate volatility and stock returns for the United State*. African Journal of Business Management, 5, pp. 9659-9664.

[17] Wickremasinghe, G. B., 2004. *Efficiency of foreign exchange markets: A developing country perspective*. [e-journal], 10(1), pp. 1-25. http://dx.doi.org/10.2139/ssrn.609285

[18] Tabak, B. M, 2006. *The Dynamic Relationship between Stock Prices and Exchange Rates: Evidence for Brazi*l. International Journal of Theoretical and Applied Finance, 9(8), pp. 219-249. http://dx.doi.org/10.1142/S0219024906003974

[19] Yang, G. H., 2000. *A Bivariate Causality between Stock Prices and Exchange Rates: Evidence from recent Asianflu*. The Quarterly Review of Economics and Finance, 40(3), 337-354. http://dx.doi.org/10.1016/S1062-9769(00)00042-9

[20] Zhao, H., 2010. *Dynamic Relationship between Exchange Rate and Stock Price: Evidence from China*. Research in International Business and Finance, 24(2), 103-112. http://dx.doi.org/10.1016/j.ribaf.2009.09.001

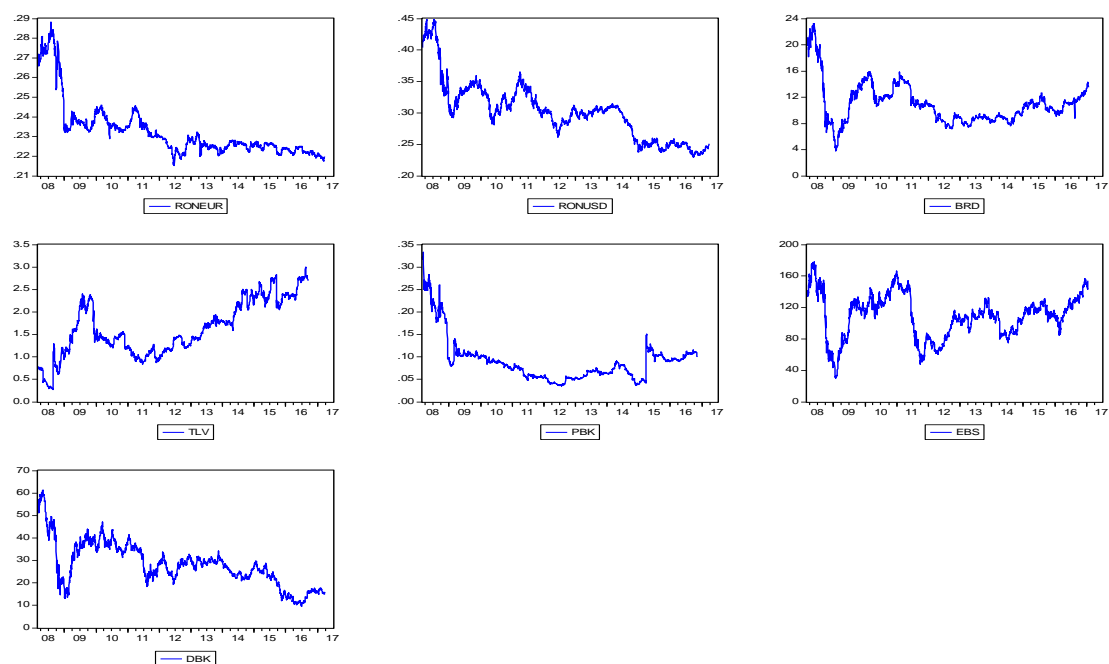[21] http://www.bvb.ro/

**Appendix**



**Figure no. 1 Initial Data Series: Evolution RON / EUR, RON / USD and BRD, TLV, PBK, EBS and DBK**