

Associate Professor Diana Claudia SABĂU-POPA, PhD
Associate Professor Marcel Ioan BOLOS, PhD
University of Oradea
Professor Emil SCARLAT, PhD
Camelia DELCEA, PhD
E-mail: camelia.delcea@yahoo.com
Ioana-Alexandra BRADEA, PhD Student
The Bucharest Academy of Economic Studies

EFFECTS OF MACROECONOMIC VARIABLES ON STOCK PRICES OF THE BUCHAREST STOCK EXCHANGE (BSE)

Abstract. *Through this study we intend to demonstrate that the capital market index in Romania is influenced by the real GDP, the stock exchange indices, the real interest rate, the exchange rate RON/USD and the inflation rate. Therefore, the grey systems theory has been used, namely the degrees of grey incidences have been calculated for the considered variables for the January 2010-August 2014 period. As a result, there have been determined a significant incidence between the benchmark index of the Bucharest Stock Exchange and the Romania's Gross Domestic Product. For this, in order to support a robust stock market, the authorities will need to maintain: the economic growth, the fiscal discipline, the currency appreciation and a low rate of interest and inflation.*

Key words: *macroeconomic factors, volatility, stock prices, grey incidence analysis, grey models.*

JEL Classification: B22, C22, G10

1. Introduction:

The performance obtained in time by the stock market and the complex activity of the stock exchange, are expressed by a system of indices, which quantify quantitatively and qualitatively: the traded processes and the impact of financial instruments' supply and demand. The indices are useful to investors, their development being considered in the processes of capital's placement and fructification, investors seeking a structure of their portfolio securities corresponding to the structure of these indices [Sabău-Popa C. D., Zăpodeanu D., 2008].

The indices of the stock exchange are very sensitive to the fundamental changes in the economy and to future prospects. It is assumed that the foundations

of the national economy play a decisive role in the performance of the stock market. However, in the global economy, the domestic economic variables may also change due to the policies adopted by other countries, or due to some events occurred in the world economy. The external factors influence especially the interest rate and the exchange rate. For example, the inflows and outflows of capital are not determined by the national interest rate, but by the changes in the interest rate from the most developed countries in the world [Sharma G.D., Mahendru M., 2010].

Since the early 1990s, in Romania, a series of initiatives have been taken to liberalize the economy. At the same time, a large number of measures has been taken to strengthen the stock market, such as the opening of stock markets to foreign investors in Romania, the regulatory power of CNVM (National Securities Commission), the trading of financial derivatives, etc. Currently, the changes in the Bucharest Stock Exchange are carefully reviewed by a large number of players. Understanding the macro dynamics of the Bucharest Stock Exchange could be useful for policy makers, intermediaries and investors.

In this paper we analyse the long-term relationship between BET index of the BSE and the main macroeconomic variables, in order to investigate the relationship between these. Among the indices calculated by BSE, we chose BET index because it is the benchmark of the stock market in Romania and is calculated considering the most 10 liquid companies listed on the BSE. Its methodology allows it to be an underlying for derivatives and structured products. The paper also aims to identify the correlations between BET index and the key macroeconomic variables: the GDP growth, the unemployment rate, the consumer price index, the benchmark interest rate, the exchange rate RON/Euro and the exchange rate RON/USD.

The results of this study should reveal whether the shares price movement is driven by the macroeconomic changes or otherwise. The study also is expected to consider whether the indices variations are associated with the real economy, or with the financial sector, or both.

2. Literature review

Many studies attempt to analyse the factors affecting stock returns. The most popular model is the CAPM, which uses the market as the only factor for determining stock returns. Due to its advantages, such as the fact that it is a good theoretical background and is easy to use, this single-factor model is very popular in many finance books and is used by many practitioners. However, several researchers proposed a multi-factor model to explain stock returns. One of the most popular multi-factor model, which explains the stock returns, is the macroeconomic variables model. This uses four macroeconomic variables: the unemployment rate, the interest rate, the inflation rate and the exchange rate. The unemployment rate is used to assess the overall economic situation and cyclical

Effects of Macroeconomic Variables on Stock Prices of the Bucharest Stock Exchange (BSE)

factors. The interest rate on government bonds is measured over five years. Inflation is estimated based on the consumer price index. The exchange rate reflects the international business activity of the economy [Tangjitprom N., 2011].

In the paper of Tangjitprom (2011) it is used a regression model to study the relationship between stock returns and macroeconomic variables: the unemployment rate, the interest rate on government bonds, CPI and the Baht/USD exchange rate. The result of the regression analysis shows that the macroeconomic variables, excepting the unemployment rate and the inflation rate, can significantly explain the stock return. The lead-lag relationships between variables are examined by the Granger causality test. The result illustrates that only a few macroeconomic variables can predict future stock returns, whereas stock returns can predict future values of most macroeconomic variables, excepting the unemployment rate. This indicates that the stock market performance is a key indicator for forecasting the macroeconomic condition.

This year's laureate in economics, Sargent T.J. and Sims C.A. have developed methods to reflect the causal relationship between economic policy and different macroeconomic variables, such as: GDP, inflation, employment rate and investment. The national economies are constantly affected by unanticipated events. The oil price increases unexpected, the central bank sets an interest rate unforeseen by the lenders or creditors and the household consumption is suddenly in declining. Such phenomena are often called unexpected shocks. Also, national economies are affected by long-term changes such as a change in monetary policy regarding stricter disinflationary measures or fiscal policy with more stringent budgetary rules. Sargent explained the effects of systematic policy changes, while Sims has focused on how shocks spread throughout the economy.

In the paper of Sharma and Mahendru (2010) is considered the long-term relationship between the benchmark index of the stock exchange in India, S&P BSE Sensex, and several macroeconomic variables: inflation rate, foreign reserves, exchange rate and gold price, using the multiple linear regression. The regression analysis revealed a high correlation between the variables of the regression equation and, moreover, a great influence of the exchange rate and the price of gold on S&P BSE Sensex index, on one hand, and an insignificant influence of foreign reserves and inflation rate on the other hand.

Another study has identified the factors affecting the capital market volatility in India, using the autoregressive vector technique and the Granger causality test. For this, they considered the following macroeconomic variables: the exchange rate of INR /USD, the oil prices, the interest rate and the gold price. The survey results reflect the fact that none of the macroeconomic factors considered don't influence the S&P CNX Nifty index, while the changes in S&P CNX Nifty index significantly influence the INR /USD exchange rate [Lairellakpam G., Mihir

D., 2012]. The results are consistent with those obtained by Dash and Rao [Dash M., Rao R., 2011].

In other study is examined the impact of: inflation, GDP, unemployment, and money supply on the price of 10 shares listed on the New York Stock Exchange. To determine whether it is a relationship between the dependent variable (the marked stock prices) and the four independent variables (inflation, GDP, unemployment and money supply), the author uses the multiple regression equation. The study results indicate the influence of macroeconomic variables on the selected stock prices. The biggest positive influence on chosen share prices has, according to the study, the money supply, which can be used in predicting the stock prices. Also, the GDP has a significant influence on the marked stock prices. The inflation and unemployment rates have a weak influence on the majority of the selected share prices [Shiblee L., 2009].

The relationship between the share's rates and macroeconomic factors is well documented in the developed countries [Chen, Roll and Ross (1986), Mukherjee and Naka (1995), Mookerjee and Yu (1997)]. These studies have provided different results, depending on the used macroeconomic variables.

3. Macroeconomic variables. Bet Index

Further a brief description of the macroeconomic variables and of the BET index is realised. BET composite index is the BSE benchmark index, which can be defined as a numerical expression of the prices evolution of the most liquid companies listed on the regulated market of BSE. Below, is shown a graphical evolution of BET index, from its introduction to the present:



Figure 1. Evolution of the BET index

Source: <http://www.bvb.ro/IndicesAndIndicators/indices.aspx?t=4&p=BSE&i=BET&m=&d=10%2f12%2f2014>

Effects of Macroeconomic Variables on Stock Prices of the Bucharest Stock Exchange (BSE)

As it is shown in the figure, the BET index faithfully reflects the economic developments in the country, represents a barometer of the Romanian economy. More specifically, since its introduction on BSE until June 2008, it had a steadily upward trend, increasing from 1,000 lei (22.09.1997) to 8000 lei (01.06.2008). During the financial crisis, we are witnessing a sharp drop from 8000 lei (01/06/2008) to 3000 lei (01.05.2009), which cancels most of the gains of the past 10 years. Also, from 01.05.2009, the BET index shyly starts to increase to reach 7013.74 points on 30.06.2014. So we can say that BET is a barometer of the Romanian economy.

The RON/USD exchange rate can be defined as the price of RON, set by reference to USD. There are several factors that influence the RON/USD exchange rate, including: the economic and political phenomena from Romania and USA and the economical, political and military factors from international market. The RON/USD exchange rate is the result of the relationship between supply and demand. The exchange rate fluctuations are given by variations of supply and demand for USD, thus increasing the demand for USD leads to an increased exchange rate and to a depreciation of the national currency. Also, a decline in demand for USD decreases the exchange rate, resulting the appreciation of RON.

The unemployment rate is determined by dividing the number of registered unemployed in the active population and is one of the most important macroeconomic indicator of a country.

The inflation rate reflects the declining of the purchasing power of a monetary unit. Inflation can be defined as the process of significant and continuing increasing of the price level. The inflation rate can be measured by several indicators, of which the most relevant for Romania is the consumer price index (CPI), that measures the changes in prices of a significant basket of goods for the expenditures of a representative household population. In this sense, the inflation rate is calculated by subtracting 100 from the consumer price index (CPI).

GDP is the best indicator for the performance of an economy. Gross domestic product (GDP) reflects the total value of goods and services within a country in a given period of time. It represents the sum of consumption expenditures, gross investment expenditures, earnings from exports minus imports costs.

The interest rate of the monetary policy is the highest interest rate at which the central bank attracts the weekly deposits on the money market.

4. Research methodology

The study is focused on analysing the impact of five macroeconomic variables (the exchange rate RON/USD, the unemployment rate, the inflation rate,

the GDP variation and the benchmark interest rate) on BET index. Using these variables we try to find the relationship between the BET index (dependent variable) and macroeconomic variables (as independent variables), taking into account the monthly average for the period January 2010-June 2014.

To achieve this, we used a method taken from grey system theory (GST). Recently appeared, GST is an interdisciplinary theory created in China by Professor Deng Julong, in 1982. It is currently used in all fields, in analysis, modelling, prediction and control. The main feature of GST is the ability to achieve high performance even if is used a small number of data and many variables. The grey systems are those that contain uncertain information, partially known (white), partially unknown (black). Thus we get a mix of black and white, grey [Sifeng L., Scarlat E., Delcea C., 2014].

The method used is the grey incidence analysis, which illustrates the correlations between variables, being extremely useful in decision making. In this analysis, there are three types of indicators, which reflect the degree of grey incidence.

4.1. The Absolute Degree of Grey Incidence

There are considered two sequences of data with non-zero initial values and with the same length, data X_0 and X_j , $j=1..n$, with $t =$ time period and $n =$ variables: [Sifeng L.S., Lin Y., 2010]

$$X_0 = (x_{1,0}, x_{2,0}, x_{3,0}, x_{4,0}, \dots, x_{t,0}), \quad (1)$$

$$X_j = (x_{1,j}, x_{2,j}, x_{3,j}, x_{4,j}, \dots, x_{t,j}), \quad (2)$$

The zero-start points' images are:

$$X_j^0 = (x_{1,j} - x_{1,j}, x_{2,j} - x_{1,j}, \dots, x_{t,j} - x_{1,j}) = (x_{1,j}^0, x_{2,j}^0, \dots, x_{t,j}^0) \quad (3)$$

The absolute degree of grey incidence is:

$$\varepsilon_{0j} = \frac{1 + |s_0| + |s_j|}{1 + |s_0| + |s_j| + |s_0 - s_j|} \quad (4)$$

with $|s_0|$ and $|s_j|$ computed as follows:

$$|s_0| = \left| \sum_{k=2}^{t-1} x_{k,0}^0 + \frac{1}{2} x_{t,0}^0 \right| \quad (5)$$

$$|s_j| = \left| \sum_{k=2}^{t-1} x_{k,j}^0 + \frac{1}{2} x_{t,j}^0 \right| \quad (6)$$

4.2. The Relative Degree of Grey Incidence

There are two sequences of data with non-zero initial values and with the same length, X_0 and X_j , $j=1\dots n$, with t = time period and n = variables [Sifeng L.S., Lin Y., 2010]:

$$X_0 = (x_{1,0}, x_{2,0}, x_{3,0}, x_{4,0}, \dots, x_{t,0}), \quad (7)$$

$$X_j = (x_{1,j}, x_{2,j}, x_{3,j}, x_{4,j}, \dots, x_{t,j}), \quad (8)$$

The initial values images of X_0 and X_j are:

$$X'_0 = (x'_{1,0}, x'_{2,0}, \dots, x'_{t,0}) = \left(\frac{x_{1,0}}{x_{1,0}}, \frac{x_{2,0}}{x_{1,0}}, \dots, \frac{x_{t,0}}{x_{1,0}} \right) \quad (9)$$

$$X'_j = (x'_{1,j}, x'_{2,j}, \dots, x'_{t,j}) = \left(\frac{x_{1,j}}{x_{1,j}}, \frac{x_{2,j}}{x_{1,j}}, \dots, \frac{x_{t,j}}{x_{1,j}} \right) \quad (10)$$

The zero-start points' images calculated based on (9) and (10) for X_0 and X_j are:

$$X_0^{0'} = (x'_{1,0} - x'_{1,0}, x'_{2,0} - x'_{1,0}, \dots, x'_{t,0} - x'_{1,0}) = (x_{1,0}^0, x_{2,0}^0, \dots, x_{t,0}^0) \quad (11)$$

$$X_j^{0'} = (x'_{1,j} - x'_{1,j}, x'_{2,j} - x'_{1,j}, \dots, x'_{t,j} - x'_{1,j}) = (x_{1,j}^0, x_{2,j}^0, \dots, x_{t,j}^0) \quad (12)$$

The relative degree of grey incidence is computed as:

$$\eta_{0j} = \frac{1 + |s'_0| + |s'_j|}{1 + |s'_0| + |s'_j| + |s'_0 - s'_j|} \quad (13)$$

with $|s'_0|$ and $|s'_j|$:

$$|s'_0| = \left| \sum_{k=2}^{t-1} x_{k,0}^0 + \frac{1}{2} x_{t,0}^0 \right| \quad (14)$$

$$|s'_j| = \left| \sum_{k=2}^{t-1} x_{k,j}^0 + \frac{1}{2} x_{t,j}^0 \right| \quad (15)$$

4.3. The Synthetic Degree of Grey Incidence

The synthetic degree of grey incidence is based on both the absolute and the relative degrees of grey incidence: [Lian Z., Dang Y., Wang Z., Song R., 2009]

$$\rho_{0j} = \theta \varepsilon_{0j} + (1 - \theta) \eta_{0j}, \quad (16)$$

with $j = 2, \dots, n$, $\theta \in [0,1]$ and $0 < \rho_{0j} \leq 1$.

Grey incidence analysis is used increasingly more, because it focuses on the closeness of relations between factors, based on the similarity level of the geometrical patterns of sequence curves [Bo Z., Liu S., 2009]. The size of the degree of incidence is directly proportional to the degree of similarity between curves.

5. Case Study

The data have been gathered from the Bucharest Stock Exchange web-site, the annual reports from the Romanian Central Bank and Eurostat database for the January 2010 – August 2014 period.

These data have been normalized and after that the grey incidence analysis was performed using the Grey System Theory Modeling Software 6.0. (see Figure no. 2 below).

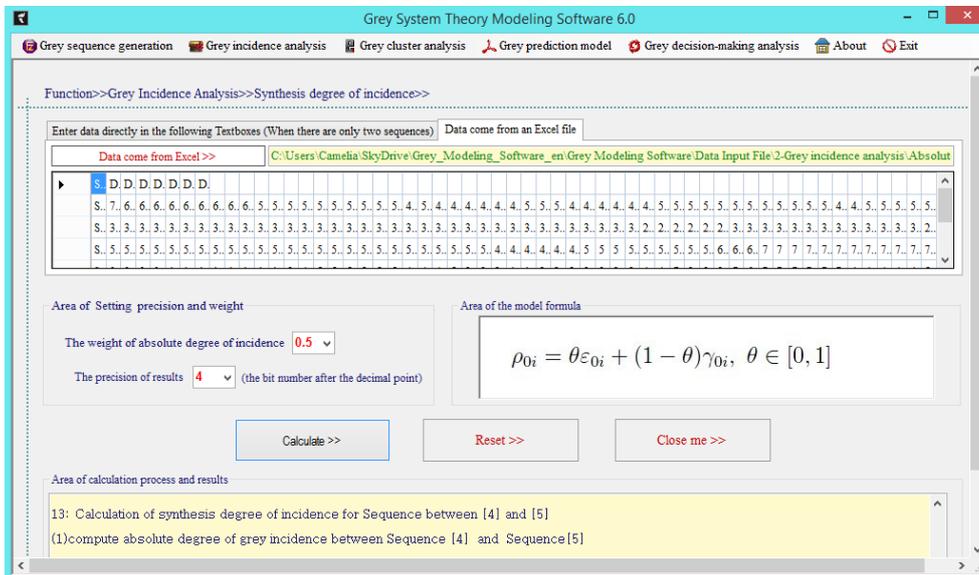


Figure 2. GSTM 6.0. Software Tool

Effects of Macroeconomic Variables on Stock Prices of the Bucharest Stock Exchange (BSE)

By applying the grey systems theory, the values for the three degrees of grey incidence have been obtained: the absolute degree of grey incidence, the relative degree of grey incidence and the synthetic degree of grey incidence.

These values have been gathered in Table no. 1 below.

As the values for all the grey degrees of grey incidences lie between 0 and 1, a value closer to 1 is indicating a higher incidence among the considered variables, while a value closer to 0 is showing a weaker relationship.

Table 1. The degrees of grey incidence

	Absolute	Relative	Synthetic
BET - RON/USD Exc. rate	0.5231	0.5608	0.54195
BET -Unempl. rate	0.5022	0.5139	0.50805
BET - Infl. rate	0.5009	0.5008	0.50085
BET - GDP var. rate	0.8280	0.6867	0.75735
BET - Bench. int. rate	0.5012	0.5051	0.50315

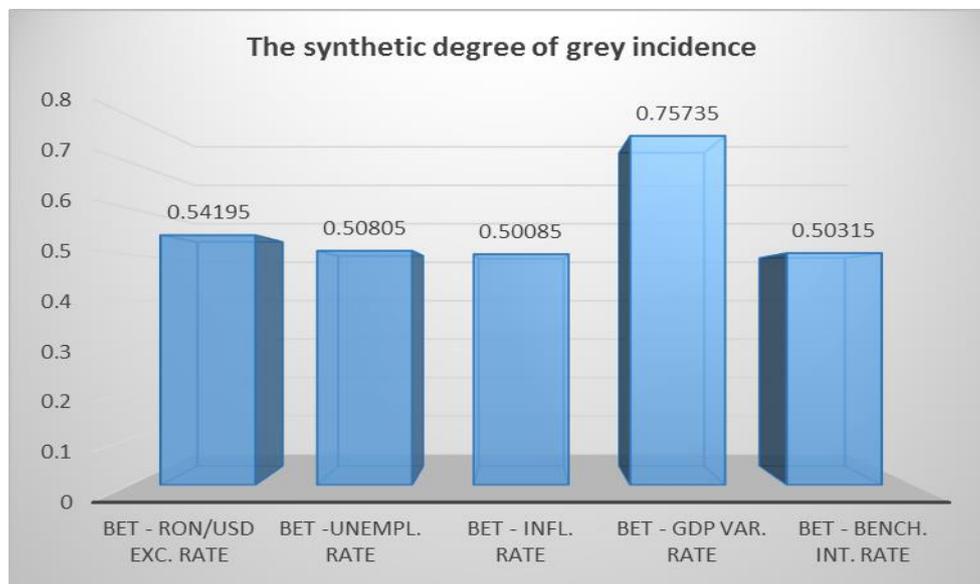


Figure 3. The synthetic degree of grey incidence among the macroeconomic variables and BET index – GSTM 6.0.

As shown in Figure no. 3, the highest synthetic degree of grey incidence is obtained between GDP variation rate and the BET index, while the other four macroeconomic variables have a smaller influence on the assets traded on BSE. Among them, the unemployment rate, the benchmark interest rate and the inflation rate have almost the same influence on the BET index, being situated around the 0.5 value for the synthetic degree.

6. Conclusions:

The objective of the study is to determine the interdependence between shares prices listed on the regulated stock market of BSE and five macroeconomic variables: the RON/USD exchange rate, the unemployment rate, the inflation rate, the GDP variation and the benchmark interest rate. This study enriches the literature by considering the effects of macroeconomic variables on stock indices. In this paper, is used the grey system theory to test the effects of macroeconomic variables on stock prices over the period January 2010 to August 2014.

As a result, it can be concluded that the variable with the biggest influence on the prices of the Bucharest stock exchange assets is the GDP. This is specific to the emerging financial markets, such as the Romania's.

Acknowledgments:

This work was cofinanced from the European Social Fund through Sectorial Operational Programme Human Resources Development 2007-2013, project number POSDRU/159/1.5/S/134197 „Performance and excellence in doctoral and postdoctoral research in Romanian economics science domain”. Also, this work was co-financed from the European Social Fund, through the Sectorial Operational Programme Human Resources Development 2007-2013, project number POSDRU/159/1.5/S/138907 “Excellence in scientific interdisciplinary research, doctoral and postdoctoral, in the economic, social and medical fields - EXCELIS”, coordinator The Bucharest University of Economic Studies.

REFERENCES

- [1] Bo Z., Liu S. (2009), *A New Improved Model of the Degree of Grey Slope Incidences Based on the Change Rate of Slope*; *Proceedings of 2009 IEEE; International Conference on Grey Systems and Intelligent Services*, Nanjing, China, pp. 57-61;
- [2] Chen N., Roll R., Ross S. (1986), *Economic Forces and the Stock Market*; *Journal of Business*, vol. 59, issue 3, pp. 383-403;

- [3] **Dash M., Rao R. (2011)**, *Asset Pricing Models in Indian Capital Market*; *Indian Journal of Finance*, vol. 5(11), pp. 56-68;
- [4] **Lairellakpam G., Mihir D. (2012)**, *A Study of Granger Causality of Macroeconomic Factors on Indian Stock Markets*; pp. 4-9;
- [5] **Lian Z., Dang Y., Wang Z., Song R. (2009)**, *Grey Distance Incidence Degree and Its Properties*; *Proceedings of 2009 IEEE International Conference on Grey Systems and Intelligent Services*, Nanjing, China, pp. 37-41;
- [6] **Liu S.F., Scarlat E., Delcea C. (2014)**, *Sisteme gri în economie. Teorie si aplicatii*; ASE Publishing House, ISBN: 978-606-505-788-3;
- [7] **Mookerjee R., Yu Q. (1997)**, *Macroeconomic Variables and Stock Prices in Small Open Economies - The Case of Singapore*; *Pacific Basin Finance Journal*, vol. 5, pp. 377-388;
- [8] **Mukheerjee T.K., Naka A. (1995)**, *Dynamic Relations between Macroeconomic Variables and the Japanese Stock Market: An Application of a Vector Error Correction Model*; *The Journal of Financial Research*, vol. 2, pp. 223-237;
- [9] **Sabău-Popa C. D., Zăpodeanu D. (2008)**, *Introducere în studiul pieței de capital*; *University of Oradea Publishing House*, pp. 255-265;
- [10] **Sharma G.D., Mahendru M. (2010)**, *Impact of Macro-economic Variables on Stock Prices in India*; *Global Journal of Management and Business Research*; Vol. 10, No. 7, pp.1-7.
- [11] **Shiblee L. (2009)**, *The Impact of Inflation, GDP, Unemployment and Money Supply on Stock Prices* ; *Arab BANK, SYRIA*, pp. 39-47;
- [12] **Sifeng L.S., Lin Y. (2010)**, *Grey Systems – Theory and Applications, Understanding Complex Systems Series*; Springer-Verlang Berlin;
- [13] **Tangjitprom N. (2011)**, *Macroeconomic Factors of Emerging Stock Market: The Evidence from Thailand* . *International Journal of Financial Research*, vol. 3, no. 2, pp. 105-114.