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# **Expert Journal of Finance**

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# Expert Journal of Finance

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## Aims and Scope

*Expert Journal of Finance* provides an open access scientific journal and outlet for financial research articles meant to enhance the dissemination of original theoretical and empirical papers. The editors encourage the submission of well-documented papers that examine essential issues in finance. This scientific journal is dedicated to the understanding of the full spectrum of finance topics, concepts, and current issues in relation to their practical applications or theoretical development.

The scientific journal of finance focuses on business and academia audiences and welcomes high-quality contributions from scholars in both these communities. *Expert Journal of Finance* offers a platform to help academics, students, bankers, asset managers, financial analysts and managers from around the world in an exchange of ideas and information on finance-related matters.

*Expert Journal of Finance* aims to support research that integrates theory and practice in all finance fields. Manuscripts can present empirical, conceptual and review papers, teaching notes, case studies, book reviews that provide relevant insights in banking and finance. The submitted manuscripts should exhibit relevancy, value, originality, argumentation, reasoning, and analysis. All papers submitted should represent original works and should not be under consideration for publication elsewhere. *Expert Journal of Finance* is double peer-reviewed journal and is published quarterly by Sprint Investify.

Topics areas which will be addressed, but are not necessarily limited to, include: Asset or Capital Management; Investments; Stochastic Models for Asset and Instrument Prices; Risk Management; Regulation and Taxation; Insurance; Personal Finance; Corporate Finance; Exchange Rates; Financial Analysis and Forecasting; Financial Econometrics; Financial Engineering and Management; Behavioral Finance; Banking Efficiency; Hedging; Derivatives and Securities; Credit Rating and Risk Modeling; Financial Applications of Decision Theory or Game Theory; Financial Simulation; Modeling Portfolio Performance; Portfolio Optimization and Trading; Microstructure Analysis; Financial Market Structure; Modeling of International Financial Markets; Bank Solvency and Capital Structure; Financial Contracting.

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## Editor's Introduction of a New Economics Journal: Expert Journal of Finance

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### 1. Introduction

As the Editor-in-Chief for *Expert Journal of Finance*, it is with a great pleasure to provide my first editorial for the first issue of this new finance journal. The objective of this editorial is to outline the strategy for *Expert Journal of Finance* and how it will be implemented.

Firstly, *Expert Journal of Finance* is an international, double-blind peer-reviewed, open-access journal for academics and practitioners of finance. This journal is for business managers, as well as for bankers, consultants, lawyers, academics, students and other professionals who need a solid and practical understanding of how business makes profit, cash flow from profit, the assets and capital needed to support profit-making operations, the cost of capital, and other pending financial issues of interest. Financial markets and institutions evolve in response to the desires, technologies, and regulatory constraints of the investors in the economy.

### 2. Objectives

*Expert Journal of Finance* aims to become a widely circulated journal that will be recognized as a leader in its field. This main purpose, has two other related objectives, namely that articles be both scholarly (i.e., conceptually strong and theory-driven) and managerially relevant for finance executives and practitioners.

We truly believe that for this journal to be a success, we have to undertake an ambitious outreach initiative for the journal to get more involved with practitioners and executives. It would broaden and deepen our understanding of finance. It would provide a context and perspective for contemporary practices and ideas for implementation. Without practical awareness, we have no baseline for evaluating the significance of new knowledge in finance.

Expert Journal of Finance has a two-stage review process in order to be accepted for publication. In the first stage, the online sent articles on finance are reviewed by one editor who will verify the reasoning of the paper and if the article fits the aim and scope of *Expert Journal of Finance*. Articles that do not concur to the journal's scope are rejected. In the second stage, the paper will be verified by at least one reviewer for detailed comments on how to improve the paper. In the peer review process of *Expert Journal of Finance*, the identities of the reviewers and authors remain anonymous. Even though, we just started our activity as a new journal, we managed to gather a team of finance experts that are willing to review received manuscripts on a voluntary and regular basis.

In order to fulfil the main objective of *Expert Journal of Economics*, there are a number of initiatives that require attention and implementation, such as:

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- openness to innovative research from all over the world,
- openness to different disciplinary approaches (behavioural, economic, statistical, quantitative, etc.)
- efficient online peer review process,
- fast and efficient of editorial decisions,
- development of citations and increasing the journal's impact,
- adequate revisions of the submitted articles,
- fast time to provide an answer to authors,
- quick dissemination of findings to a wide audience,
- promotion of accepted articles among various social media outlets,
- broaden the audience of authors and readership.

### 3. Content

The editorial policy of *Expert Journal of Finance* is very broad; it places few constraints on the topics of articles. However, there are certain fundamental questions that can further develop and extend financial research articles:

- How does expertise in corporate finance help a company become successful?
- How many features of the investment environment are natural responses of profit-seeking firms and individuals to opportunities created by the demands of these sectors?
- What are the driving forces behind financial innovation?
- Which are the recent trends in financial markets?
- How does the relationship between households and the business sector evolve in particular economies?

I believe that these questions will continue to be relevant in the years ahead. Thus, *Expert Journal of Finance* must attract and publish the best articles available across the entire spectrum of finance. Finally, it must value interdisciplinary work and the use of multiple research methods.

- (1) Empirical papers can serve as evidence of sustaining or refuting certain hypotheses that which should be clearly defined and answerable. With the use of quantitative methods, such finance articles can produce important general substantive findings, while emphasizing specific contribution to modelling methods.
- (2) Conceptual and theoretical papers should try to define and develop different finance concepts by providing relevant underpinnings in new disseminations from an academic perspective and a practical perspective. Such finance articles usually follow an argumentative pattern and are organised around the solution of a recognized problem.
- (3) Technical reports can consist of in depth *analyses*, data, trends, market share, and/or forecasts of events that take place in different industries or countries.
- (4) Case studies are highly encouraged and should reflect analysis of a manager, company, event or industry, while emphasizing certain learning objectives;
- (5) Teaching notes will be published in relation to case studies or as theoretical developments for management or general business lectures, meant to help educators and academics;
- (6) Book reviews should reflect analyses based on content of finance books, by providing subjective opinions and recommendations.

### 4. Emerging Topics

The *Expert Journal of Finance*'s content arises from the collective efforts of the intellectual community, so it is neither feasible nor desirable for the editor's personal preferences to influence the contents of the journal.

### 5. Call for More Submissions

The journal welcomes contributions from around the world that adopt new and interesting approaches in finance. Papers are invited from all research traditions that aim to enhance our conceptual understanding of the new 'territories' in finance. *Expert Journal of Finance* wishes to publish the best work

in finance as it is carried out in different subfields, and, in this way contributes to the further development of finance concepts. Please help us locate and disseminate such contributions for future issues and volumes of our *Journal*.

## **6. A Final Thought**

The finance community is diverse in its approach to finance questions. However, as a reader or author, scholar or executive, all want to know more about marketing phenomena. I hope some answers surrounding today's ever expanding environment can be found in *Expert Journal of Finance*.

On behalf of the department editors and the submitting authors, we sincerely acknowledge our reviewers' service to the journal, and gratefully appreciate their contributions to our profession.

# Estimation of Value-at-Risk on Romanian Stock Exchange Using Volatility Forecasting Models

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*This paper aims to analyse the market risk (estimated by Value-at-Risk) on the Romanian capital market using modern econometric tools to estimate volatility, such as EWMA, GARCH models. In this respect, I want to identify the most appropriate volatility forecasting model to estimate the Value-at-Risk (VaR) of a portfolio of representative indices (BET, BET-FI and RASDAQ-C). VaR depends on the volatility, time horizon and confidence interval for the continuous returns under analysis. Volatility tends to happen in clusters. The assumption that volatility remains constant at all times can be fatal. It is determined that the most recent data have asserted more influence on future volatility than past data. To emphasize this fact, recently, EWMA and GARCH models have become critical tools in financial applications. The outcome of this study is that GARCH provides more accurate analysis than EWMA. This approach is useful for traders and risk managers to be able to forecast the future volatility on a certain market.*

**Keywords:** Value-at-Risk, volatility forecasting, EWMA, GARCH models, autocorrelation

## 1. Introduction

Value at Risk (VaR) is one of the widely used risk measures. VaR estimates the maximum loss of the returns or a portfolio at a given risk level over a specific period. VaR was first introduced in 1994 by J.P.Morgan and since then it has become an obligatory risk measure for thousands of financial institutions, such as investment funds, banks, corporations, and so on.

Classical VaR methods have several drawbacks. These methods include historical simulation, unconditional approaches and RiskMetrics. For instance, historical simulation method always assumes joint normality of the returns. On the other hand, the basic driving principle of the historical simulation method is its assumption that the VaR forecasts can be based on historical data. In the unconditional approach I use a standard deviation to estimate VaR and assume that the volatility constant over time. However, in reality these assumptions do not hold in most cases.

RiskMetrics measure the volatility by using EWMA model that gives the heaviest weight on the last data. Exponentially weighted model give immediate reaction to the market crashes or huge changes. Therefore, with the market movement, it has already taken these changes rapidly into effect by this model. In

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this way EWMA responds the volatility changes and EWMA does assume that volatility is not constant through time.

The above models do not, however, incorporate the observed volatility clustering of returns, first noted by Mandelbrot (1963). The most popular model taking account of this phenomenon is the Autoregressive Conditional Heteroscedasticity (ARCH) process, introduced by Engle (1982) and extended by Bollerslev (1986).

Considering the above models, this study aims to estimate Value-at-Risk (VaR) of a portfolio of three representative indices on the Romanian capital market (BET, BET-FI and RASDAQ-C) using the most appropriate volatility forecasting model.

The data are daily (trading days) and cover the period from March 4, 2009 (date of the minimum reached on the capital market in Romania during the crisis) to November 30, 2013 (date of this study), for a total of 1218 daily observations.

The paper is structured as follows: The first part treats, from theoretical point of view, the concept and methodology of VaR and the volatility forecasting models. The second part presents the most relevant works in this field in Romania and abroad. The third part describes the data and methodology used. Also, results are interpreted. The last part summarizes the most important findings of the study.

## 2. Theoretical Framework

The VaR is a useful measure of risk. It was developed in the early 1990s by the corporation JPMorgan. According to Jorion (2001, p 19) “VaR summarizes the expected maximum loss over a target horizon with a given level of confidence interval.”

In financial market, the typical time horizon is 1 day to 1 month. Time horizon is chosen based on the liquidity capability of financial assets or expectations of the investments. Confidence level is also crucial to measure the VaR number. Typically in the financial markets, VaR number calculates between 95% to 99% of confidence level. Confidence level is chosen based on the objective such as Basel Committee requests 99% confidence level for banks regulatory capital.

In practice a variety of methods can be applied for calculation of VaR. These methods rely upon different assumptions. All VaR techniques can be divided into 2 broad categories:

a) *Historical approaches*, which rely on historical data and divide further on parametric and non-parametric models.

- Parametric models involve imposition of specific distributional assumptions on risk factors. *Log-normal approach* is the most widely used parametric model, which implies that market prices and rates are log-normally distributed. This kind of distribution is characterized only by 2 parameters: mean and standard deviation. Under the assumption of normality the VaR can be calculated as:

$$VaR = Z * \sigma * \sqrt{T}$$

where: Z - the quantile of normal distribution

T - holding period

$\sigma$  – standard deviation of a risk factor

So, for the assessment of risk one needs only to know the volatility, which can be in turn estimated with the help of various techniques. The most popular are equally variance-covariance, weighted MA, EWMA and GARCH approaches. MA is simple a usual historical deviation, calculated over specific past period. EWMA on the other hand puts more weights on recent observations. This approach is justifiable when distant past influences the near future negligible (the situation of changing market conditions).

- Non-parametric approaches use historical data directly without any assumptions of risk factors' distributions. *Historical Simulation* is the easiest non-parametric model for practical implementation and assumes that risk factor volatility is a constant.

b) *Non-historical approaches* implies specific and explicitly given statistical model for distribution of the risk factors. Monte-Carlo simulation is a best-known representative of this class of models.

According to Allen (2004, p.54), Log-normal model involves estimation of risk factor distribution parameters using all available data. This approach assumes that risk factors are log-normally distributed.

Also, variance-covariance and weighted MA approaches use only the historical deviation and for this reason they are rarely applied in practice. Mostly EWMA and GARCH are used.

- *Exponentially Weighted Moving Average:*

In real life applications, some financial models assume the volatility is constant through time. This may be a mistake or can be misleading the results. According to Butler (1999, p. 190) “any financial assets that could currently have a lower volatility may have a much higher volatility in the future”. In order to solve this problem, Butler (1999, p. 200) considers that risk managers use EWMA model to give more weight on the latest data and less on the previous data.

Allen (2004) describes EWMA (exponential smoothing) as the improved method for predicting risk factor future volatility. Weights on more distant historical observations decline exponentially from initial weight to zero at the rate which is determined by decay factor (smoothing parameter).

This method was developed by J.P. Morgan (1996). The conditional volatility is estimated based on the following method:

$$\sigma_t^2 = \lambda \sigma_{t-1}^2 + (1 - \lambda) \varepsilon_{t-1}^2$$

where  $\sigma_t^2$  is the forecast of conditional volatility,  $\lambda = 0.94$  is the decay parameter ( $\lambda$  is set at 0.94 for daily data as suggested in RiskMetrics), and  $\varepsilon_{t-1}$  is the last period residual which follows the standard normal distribution.

$\varepsilon_t$  is a random variable (in this paper expressed in returns) with a zero mean and variance conditional on the past time series  $\varepsilon_1, \dots, \varepsilon_{t-1}$ .

$$\varepsilon_t = r_t - \mu$$

Where:

$r_t$  - is continuous composed return of index at time  $t$ ;

$\mu$  - is the mean of the returns

The VaR is calculated as follows:

$$VaR_t = Z_p \sigma_t$$

where  $Z_p$  is the standard normal quantile for  $p = 0.01; 0.05; 0.1; etc$

Note that EWMA estimation differs for various smoothing parameters. Under a weighting scheme with  $\lambda$  close to 1 recent information is more relevant and effective sample is shorter than under a weighting scheme with low  $\lambda$ . Optimal value of  $\lambda$  can be estimated using Maximum Likelihood Method.

The RiskMetrics model is relatively easier to implement than other methods. However, the RiskMetrics model is subject to criticism because it ignores the asymmetric effect, the violation of the normality and risk in the tails of the distribution as often observed in the equity return data.

As a remedy, I can apply more complex and advanced models for determining the volatility to get a better proxy of the tail distribution. On the developed capital markets there are applied different models to estimate volatility.

Various advanced techniques for obtaining estimators of volatility have been continuously developed over the past period. They range from very simple models using the so-called random-walk assumptions to models regarding complex conditional heteroskedastic ARCH group (up to GARCH and derivatives thereof).

- *Heteroskedasticity models*

These models are divided into two categories: conditional models and unconditional models (or independent time variable). Although, there have been written a fairly extensive literature on the issue of independent volatility over time (homoskedasticity), practitioners have turned their attention to the second category approach of this issue, considering it more plausible, at least in terms of intuitive: volatility is not the same from one moment to another.

The most discussed univariate volatility models are autoregressive models with conditional heteroskedasticity (ARCH - *Autoregressive conditional heteroskedasticity*) proposed by Engle (1982) and the general GARCH (*Generalized Autoregressive conditional heteroskedasticity*) proposed by Bollerslev (1986). Many of these extensions have gained further importance as *Exponential* - GARCH (EGARCH)



proposed by Nelson (1991), which empirically explains an asymmetric reaction of volatility to the impact of shocks in the market. Generally, each model has its own advantages and disadvantages, so, with a large number of models, all designed to serve to the same purpose, it is important to distinguish and correctly identify each model, with each features in order to establish the one who gives the best predictions. Jorion (2001, p. 170) states that the models for calculating VaR that use GARCH are more precise, principally in cases where there are volatility clusters.

In the following, I will make a brief presentation of these models.

### **ARCH(1)**

The model was introduced in 1982 by the econometrician R. Engel in the journal *Econometrica*, and proposed a change in vision about how to estimate volatility. He said the standard deviation, by its way of calculating, gives equal weight ( $1/n$ ) to any historical observations considered in the determination of volatility.

Engel's model solves this inconvenience, giving more weight to the most recent observations and reducing weights of more distant observations. Thus, the variance (dispersion) from whose square root is resulting volatility, is expressed as:

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2$$

where:

$\sigma_t^2$  - variance of the dependent variable in the current period;

$\omega$  - constant dispersion equation;

$\alpha$  - coefficient "ARCH";

$\varepsilon_{t-1}$  - residuals from the previous period;

### **GARCH(1,1)**

It was proposed by T. Bollerslev (Engel's student) in 1986 in the *Journal of Econometrics*, and is part of a larger class of models GARCH (q, p). But it enjoys a great popularity among practitioners because of its relative simplicity. This model are similar to Engel's model. Variance formula is:

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2$$

where:

$\sigma_t^2$  - variance of the dependent variable in the current period;

$\omega$  - constant dispersion equation;

$\alpha$  - coefficient "ARCH";

$\varepsilon_{t-1}$  - residuals from the previous period;

$\sigma_{t-1}^2$  - variance of the dependent variable in the previous period;

$\beta$  - coefficient "GARCH".

The model suggests that the variance forecast is based, in this case, on the most recent observation of assets return and on the last calculated value of the variance. The general model GARCH (q, p) calculates the expected variance on the latest q observations and the latest p estimated variances.

In the GARCH (1,1) model, described above, the first number shows that the residual terms of the previous period acts on dispersion and the second number shows that the dispersion of the previous period has influence on current dispersion. In fact, for very large series, GARCH (1.1) can be generalized to GARCH (p, q).

Because this application refers to volatility analysis of a selected portfolio, I will focus only on the dispersion equation. The model can be used successfully in volatile situations. GARCH model includes in its equation both terms and the phenomenon of heteroskedasticity. It is also useful if the series are not normally distributed, but rather they have "fat tails". No less important is that confidence intervals may vary over time and therefore more accurate intervals can be obtained by modeling of the dispersion of residual returns.

Different heteroskedastic volatility models (ARCH, GARCH, EGARCH, etc.) is based on historical prices. One advantage of these models from the implied volatility is given by the relatively recent research in finance, which shows a better estimation of the heteroskedasticity models from the initially more preferred implied volatility.

In this paper I use two univariate models: ARCH and GARCH in estimating VaR. VaR calculation consists of two steps:

- I forecast volatility using the models mentioned above;
- Calculate VaR based on the conditional volatility prediction:

$$VaR_t = Z_p \sigma_t$$

Where:

- $\sigma_t$  is the volatility estimated from heteroskedastic volatility models;
- $Z_p$  is p% quantile from the normal distribution.

After using different techniques in VaR estimation I need to check their predictive accuracy using various statistical tests. There are many VaR methodologies, and it is necessary to find the best model for risk forecasting. For the purposes of this paper, I explain and use “Violation ratio” of Danielsson (2011, p.145) for evaluating the quality of VaR forecasts.

If the actual loss exceeds the VaR forecast, then the VaR is considered to have been violated. The violation ratio is the sum of actual exceedences divided by the expected number of exceedences given the forecasted period. The rate is calculated as:

$$VR = \frac{\text{Observed number of violations}}{\text{Expected number of violations}} = \frac{E}{p \times N}$$

Where:

- $E$  is the observed number of actual exceedences
- $p$  is the VaR probability level, in this case  $p=0.05$  or  $0.01$
- $N$  is the number of observations used to forecast VaR values.

### 3. Literature review

There are numerous research papers dedicated to analysis, development and practical application of the VaR methodology.

The VaR result could vary on the method chosen and the assumption of the correlation. Although VaR and other methods are accepted as effective risk management tools, they are not sufficient enough to monitor and control risk at all. The hope is to have only one powerful risk mesurment program that can solve the problems of investors and institutions, and able to measure risk effectively and systematically.

Jorion (2001) has mentioned the intricate parts of VaR calculations in his work. During the time when portfolio position is assumed to be constant that in reality does not apply to practical life. The disadvantage of VaR is it cannot determine where to invest. VaR simply illustrates the various speed of risk that are embedded from the derivative instruments.

The second and third Basel Accord (International Convergence of Capital Measurement and Capital Standards, 2006 and Revisions to the Basel II Market Risk Framework, 2009) have laid down market risk capital requirements for trading books of banks. The market risk capital calculations can be done using either the standardized measurement method or the Internal Models approach. The internal models approach allows banks to calculate a market risk charge based on the output of their internal Value-at-risk (VaR) models.

Manganelli and Engle (2001) review the assumptions behind the various methods and discuss the theoretical flaws of each. The historical simulation (HS) approach has emerged as the most popular method for Value-at-risk calculation in the industry.

Hendricks (1996) compared twelve different VaR methods, namely equally weighted moving average (EQMA), exponentially weighted moving average (EWMA), and historical simulation (HS). For the 99% VaR it was observed that the HS approach provided better coverage than the other two VaR methods.

Hull and White (1998) improve the HS method by altering it to incorporate volatility updating. They adjust the returns using a conditional volatility model like GARCH or EWMA. According to these tests, the GARCH (1,1) model is suitable to estimate the conditional volatility, and is thus used to calculate the VaR.

In this paper I continue the scientific activity, aiming to identify the most appropriate volatility forecasting model to estimate the Value-at-Risk (VaR) of a portofolio of representative indices of Bucharest Stock Exchange. Given the emerging nature of the capital market in Romania, for representativity it was selected the period from the minimum reached during the Romanian capital market as a result of the recent financial crisis till the time of the present analysis.

The originality of our contribution to the current state of research in this field is generated by the following:

- I selected a portfolio of indices, so that it is included characteristics for the entire capital market in Romania (inclusion in the study of BET, BET-FI and RASDAQ-C indices);
- study was not just about applying a single methodology, being tested several models in order to select the most appropriate;
- study refers to recent years (though, being considered a representative number of observations) which determines the actuality of conclusions.

#### 4. Data series and methodology

For portfolio construction, there were used data since March,04 2009 (date of the minimum reached on the capital market in Romania during the crisis) – to November, 30 2013 (date of this study), comprising a total of 1218 daily observations. I used in our analysis BET, BET-FI and RASDAQ-C indices.

The portfolio was selected with the following weights: 40% BET, BET-FI 30%, 30% RASDAQ-C. Criteria considered in determining these weights are based on the following assumptions: risk diversification by selecting indices whose composition covers a wide range of capital market in Romania, the weight of the average trading volume for the companies included in the indices.

In this paper, I use an out-of-sample VaR estimates to identify the most appropriate risk forecasting model. Out-of-sample VaR estimates are obtained based on the previous years' observations (values since March, 04 2009 to December, 31 2012) and are compared with the data from the last year (January, 02 2013 – November, 30 2013).

Based on primary data, there were calculated daily returns of the portfolio for the selected indices. Return was calculated using the following formula:

$$rt = \ln \frac{p_t}{p_{t-1}} = \ln p_t - \ln p_{t-1}$$

Where:

$rt$  is continuous composed return of index at time  $t$ ,  $p_t$  is the index value at time  $t$ .

The reason I've decided to use logarithmic returns in our study was highlighted by Strong (1992, p. 533) thus: "there are both theoretical and empirical reasons for preferring logarithmic returns. Theoretically, logarithmic returns are analytically more tractable when linking together sub-period returns to form returns over long intervals. Empirically, logarithmic returns are more likely to be normally distributed and so conform to the assumptions of the standard statistical techniques."

For this study, in the first phase I proceed to analyze the descriptive statistics of daily returns of selected indices and portfolio, then I apply various tests of normality and stationarity to highlight the characteristics of daily returns series. The next step will be to test the presence of ARCH signature in the indices portfolio. If I notice the signature ARCH, I will proceed to analyze the volatility through GARCH methodology. Finally, I will estimate the Value-at-Risk of the selected portfolio by all methods described in this study in order to select the most appropriate model.

For this analysis, I use as technical support the application Eviews7.

Next, I present a primary statistical data. In the following table I consider daily returns of BET, BET-FI and RASDAQ-C as well as portfolio selected.

*Table 1. Descriptive Statistics*

	DAILY_RETURN_BET	DAILY_RETURN_BET_FI	DAILY_RETURN_RASDAQ_C	DAILY_RETURN_PORTFOLIO
Mean	0.001026	0.001133	-0.000301	0.000989
Median	0.000845	0.000712	0.000187	0.000903
Maximum	0.105645	0.138255	0.048494	0.115302
Minimum	-0.116117	-0.149741	-0.198265	-0.132069
Std. Dev.	0.017065	0.025048	0.009654	0.021088
Skewness	-0.169040	0.101382	-8.846412	-0.018240
Kurtosis	9.507520	8.073974	185.6334	8.188827
Jarque-Bera	1712.639	1040.049	1357942.	1085.985

Probability	0.000000	0.000000	0.000000	0.000000
Sum	0.993280	1.096817	-0.291609	0.957507
Sum Sq. Dev.	0.281601	0.606709	0.090122	0.430035
Observations	968	968	968	968

Source: author calculations

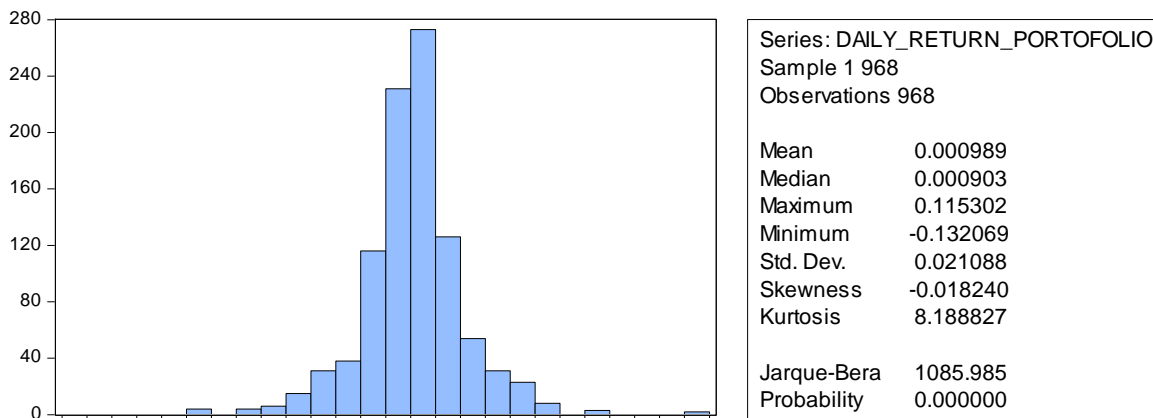
The table also indicates that all 3 indices and the selected portfolio not follow a normal distribution. This fact is highlighted by the Skewness and Kurtosis indicator values.

Skewness normal distribution is zero. A positive Skewness series shows that the distribution is right asymmetry. For a negative Skewness, situation is reversed.

For normal distribution kurtosis (who shows "fat tails" or how much the maximum and minimum values deviate from their average) is 3. For K less than 3, distribution is flatter than normal (platykurtic) and for k greater than 3 distribution is higher (leptokurtic).

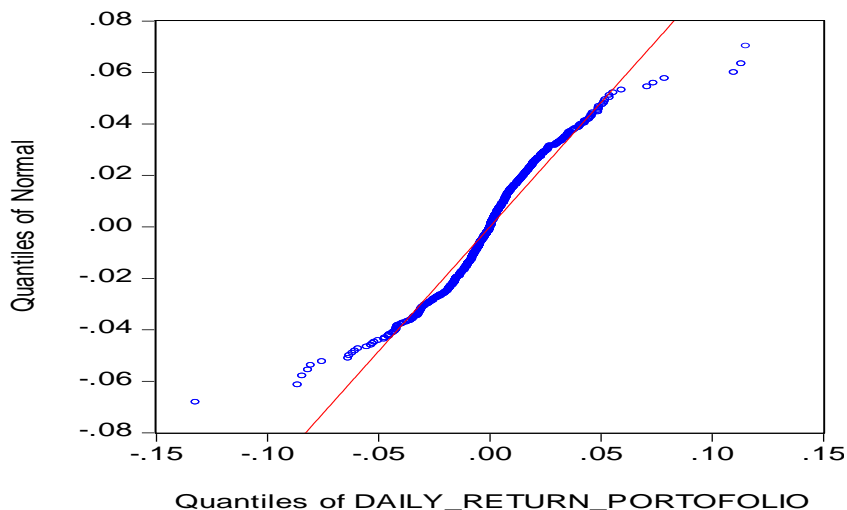
For the selected portfolio, skewness is  $-0.018$  which shows an asymmetry to the left of distribution returns, sign that on certain days there were very high quotes. Kurtosis is 8.18 which indicates that the distribution is higher than normal. Jarque-Bera test value is 1085 and the attached test probability is 0%. Test values are quite far from the corresponding normal distribution, reason due to which I say that the series is not normally distributed.

This conclusion is strengthened by the following graphs: Histogram Graph and QQ-Plot Graph:



**Figure 1. Histogram Graph**

Source: author calculations

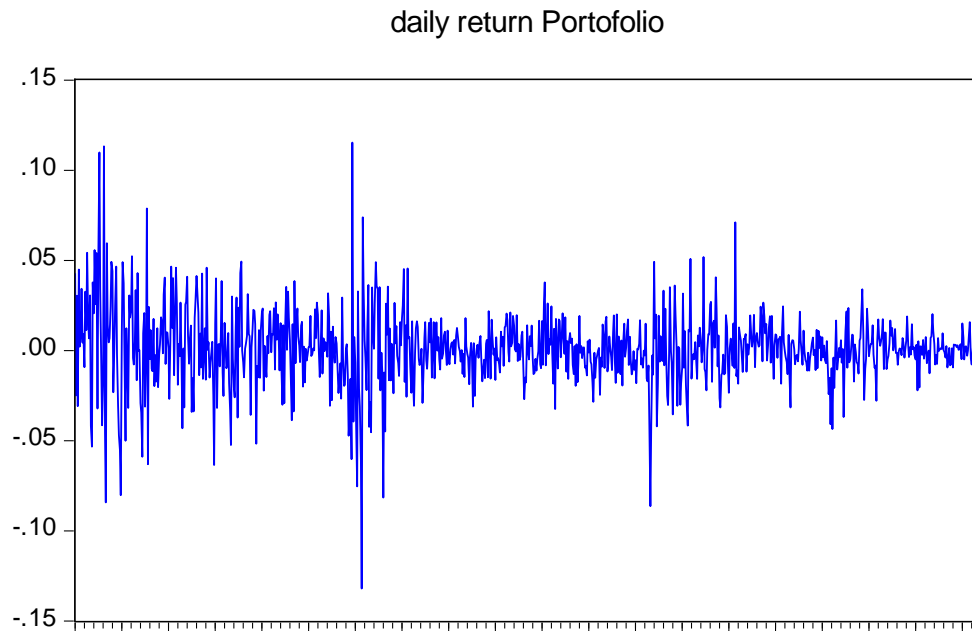


**Figure 2. QQ Plot**

Source: author calculations

QQ-plot is a method used to compare two distributions, specifically, is the graph of the empirical distribution against a theoretical distribution (in this case, the normal distribution). If empirical distribution would be normal, should result QQ chart is first bisectrix, in this case is different from the normal distribution.

A more detailed inspection of the evolution of daily returns is performed using the following graph:



**Figure 3. Returns Evaluation**  
 Source: author calculations

I see the chart above that there are pronounced extremities, another indication that the series is not normally distributed and an indication of possible "ARCH" signatures.

According to the ADF and Phillips-Perron tests, daily returns series are stationary for every level of relevance. Stationarity is defined as a quality of a process in which the statistical parameters (mean and standard deviation) of the process do not change with time. Otherwise, Shocks have transitory effects.

**Table 2. ADF Test**

Null Hypothesis: DAILY\_RETURN\_PORTOFOLIO has a unit root  
 Exogenous: Constant  
 Lag Length: 0 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-29.19315	0.0000
Test critical values:		
1% level	-3.436892	
5% level	-2.864317	
10% level	-2.568301	

Source: author calculations

**Table 3. Phillips-Perron Test**

Null Hypothesis: DAILY\_RETURN\_PORTOFOLIO has a unit root  
 Exogenous: Constant  
 Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-29.17246	0.0000
Test critical values:		
1% level	-3.436892	
5% level	-2.864317	

10% level -2.568301

Source: author calculations

The above analysis is very useful in describing the series and economic phenomena. However, for certainty analysis, I test this ARCH signature with radical correlogram of daily returns. Number of lags used is 15. The column labeled AC remark serial correlation coefficients, while the last column I have the probability to accept the hypothesis "there is no ARCH effects" (which is actually null hypothesis). If I notice the signature ARCH, I will proceed to analyze the volatility through GARCH methodology.

**Table 4. Correlogram of radical returns**

Sample: 1 968

Included observations: 966

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
*****	*****	1	-0.654	-0.654	414.43	0.000
*	***	2	0.161	-0.466	439.55	0.000
	**	3	-0.002	-0.340	439.55	0.000
	***	4	-0.045	-0.359	441.55	0.000
	**	5	0.072	-0.294	446.58	0.000
	*	6	-0.007	-0.148	446.62	0.000
*	*	7	-0.066	-0.159	450.92	0.000
	*	8	0.052	-0.167	453.55	0.000
	*	9	0.002	-0.111	453.55	0.000
		10	-0.011	-0.057	453.68	0.000
	*	11	-0.010	-0.067	453.78	0.000
		12	0.014	-0.051	453.96	0.000
		13	0.004	0.004	453.98	0.000
		14	-0.025	-0.029	454.59	0.000
		15	0.035	-0.010	455.78	0.000

Source: author calculations

Note that the null hypothesis probability value is 0, indicating that I can reject the null hypothesis and providing information there are ARCH effects.

The next step is finding the equation that best describes the portfolio volatility. In this respect, I estimate the equation of volatility with ARCH (1) and GARCH (1,1).

For volatility calculated by GARCH models, there was used Generalised Error Distribution (GED), given that the distribution is not normal series. The results are presented below.

**Table 5. ARCH equation**

Dependent Variable: DAILY\_RETURN\_PORTOFOLIO

Method: ML - ARCH (Marquardt) - Generalized error distribution (GED)

Sample: 1 968

Included observations: 968

Convergence achieved after 7 iterations

Presample variance: backcast (parameter = 0.7)

ARCH = C(1) + C(2)\*RESID(-1)^2

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	0.000236	2.13E-05	11.08085	0.0000
RESID(-1)^2	0.531057	0.101489	5.232653	0.0000
GED PARAMETER	1.090728	0.062854	17.35325	0.0000
R-squared	-0.002202	Mean dependent var		0.000989

Adjusted R-squared	-0.001167	S.D. dependent var	0.021088
S.E. of regression	0.021100	Akaike info criterion	-5.177622
Sum squared resid	0.430982	Schwarz criterion	-5.162512
Log likelihood	2508.969	Hannan-Quinn criter.	-5.171870
Durbin-Watson stat	1.863669		

Source: author calculations

To conclude if the above model is appropriate, I apply the Correlogram of Standardized Residuals.

**Table 6.** Correlogram of Standardized Residuals

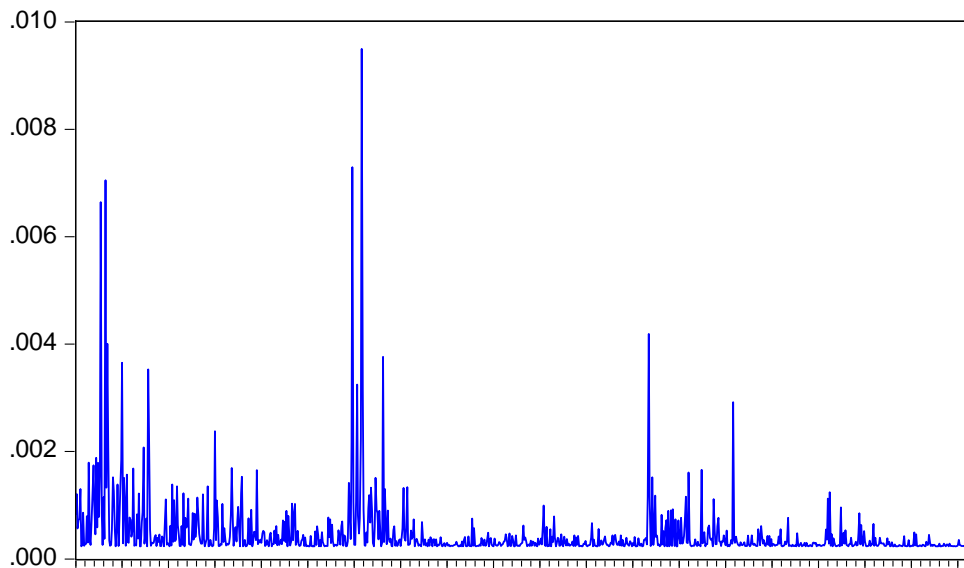
Sample: 1 968

Included observations: 968

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
		1	-0.033	-0.033	1.0647	0.302
*	*	2	0.134	0.133	18.432	0.000
	*	3	0.066	0.075	22.610	0.000
		4	0.039	0.027	24.094	0.000
*	*	5	0.139	0.126	43.049	0.000
		6	0.046	0.045	45.128	0.000
		7	0.072	0.040	50.213	0.000
*	*	8	0.138	0.120	68.779	0.000
		9	0.006	-0.008	68.819	0.000
*	*	10	0.149	0.099	90.444	0.000
		11	0.040	0.028	92.009	0.000
		12	0.069	0.024	96.630	0.000
		13	0.065	0.019	100.75	0.000
		14	0.071	0.049	105.74	0.000
		15	0.060	0.012	109.26	0.000

Source: author calculations

It is noted that all partial and total correlation coefficients exceed the limits, which indicates that there is correlation between residuals. Also, from the ARCH volatility chart, I see that volatility is not constant.



**Figure 4.** ARCH Graph

Source: author calculations

For GARCH (1,1) I have the following equation:

**Table 7. GARCH equation**

Dependent Variable: DAILY\_RETURN\_PORTOFOLIO  
 Method: ML - ARCH (Marquardt) - Generalized error distribution (GED)  
 Sample: 1 968  
 Included observations: 968  
 Convergence achieved after 13 iterations  
 Presample variance: backcast (parameter = 0.7)  
 GARCH = C(1) + C(2)\*RESID(-1)^2 + C(3)\*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	2.91E-06	1.48E-06	1.971756	0.0486
RESID(-1)^2	0.099492	0.017018	5.846384	0.0000
GARCH(-1)	0.895441	0.016147	55.45594	0.0000
GED PARAMETER	1.362369	0.079337	17.17201	0.0000
R-squared	-0.002202	Mean dependent var		0.000989
Adjusted R-squared	-0.001167	S.D. dependent var		0.021088
S.E. of regression	0.021100	Akaike info criterion		-5.318961
Sum squared resid	0.430982	Schwarz criterion		-5.298816
Log likelihood	2578.377	Hannan-Quinn criter.		-5.311293
Durbin-Watson stat	1.863669			

Source: author calculations

Following the results, I can highlight the following aspects:

- Coefficient of volatility C(1) is positive, indicating that when volatility increases, portfolio returns tend to increase;
- Coefficient C(2) that estimates ARCH effects in the data series analyzed, recorded a statistically significant amount. In other words, on the Romanian capital market, the periods characterized of high volatility continues throughout with high volatility, and vice versa.
- Coefficient C(3) which measures the asymmetry of the data series recorded a positive value, which suggests that negative shocks (bad news) generated less volatility than positive shocks (good news) on the Romanian capital market.

To validate this equation I apply the Correlogram of Standardized Residuals.

**Table 8. Correlogram of Standardized Residuals**

Sample: 1 968

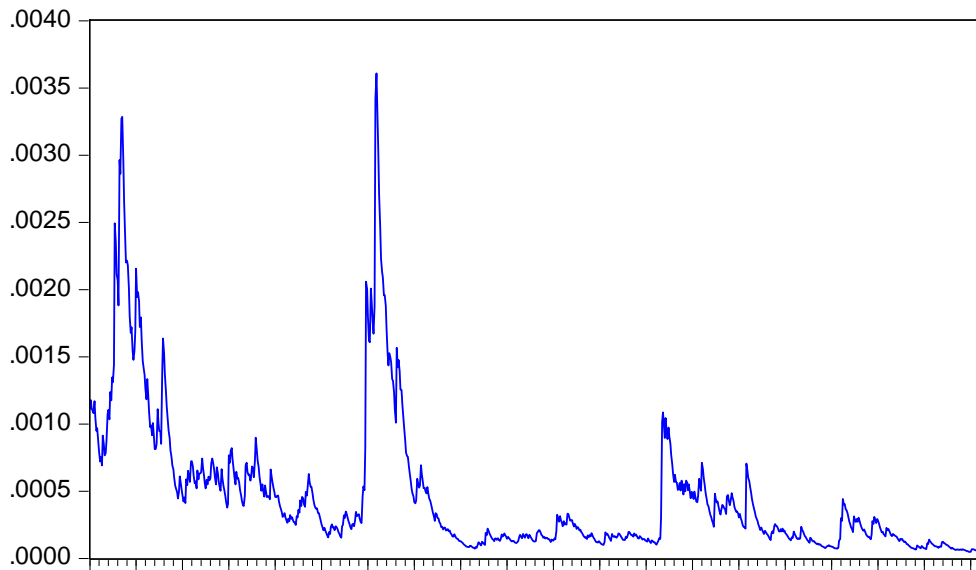
Included observations: 968

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
*	*	1	0.091	0.091	7.9941	0.005
		2	0.029	0.020	8.7861	0.012
		3	-0.006	-0.011	8.8230	0.032
		4	0.023	0.024	9.3433	0.053
		5	-0.007	-0.011	9.3967	0.094
*	*	6	-0.070	-0.070	14.128	0.058
		7	-0.019	-0.006	14.472	0.063
		8	0.017	0.022	14.761	0.064
		9	-0.051	-0.056	17.343	0.054
		10	0.028	0.040	18.117	0.053
		11	0.028	0.025	18.863	0.064
		12	-0.044	-0.060	20.801	0.053
		13	-0.034	-0.025	21.953	0.056



				14	0.023	0.034	22.496	0.069
				15	-0.018	-0.033	22.833	0.088

It is noted that partial and total correlation coefficients exceed the limits only for lag 1-3 and I can conclude that this model is quite suitable. The GARCH chart is the following:



**Figure 5. GARCH Graph**  
 Source: author calculations

In the following, I'll estimate the VaR by the three models: EWMA, ARCH and GARCH.

- Exponentially Weighted Moving Average:

The VaR is calculated as follows:

$$VaR_t = Z_p \sigma_t$$

where  $Z_p$  is the standard normal quantile for  $p = 0.01; 0.05$ ;

The conditional volatility is estimated based on the following method (suggested by RiskMetrics) :

$$\sigma_t^2 = 0.94\sigma_{t-1}^2 + (1 - 0.94)\varepsilon_{t-1}^2$$

where  $\sigma_t^2$  - variance of the dependent variable in the current period;

$\varepsilon_{t-1}$  - residuals from the previous period;

- ARCH:

The VaR is calculated as follows:

$$VaR_t = Z_p \sigma_t$$

where  $Z_p$  is the standard normal quantile for  $p = 0.01; 0.05$ ;

The conditional volatility is estimated based on the ARCH model:

$$\sigma_t^2 = 0.000236 + 0.531056 \varepsilon_{t-1}^2$$

where:

$\sigma_t^2$  - variance of the dependent variable in the current period;

$\varepsilon_{t-1}$  - residuals from the previous period;

- GARCH:

The VaR is calculated as follows:

$$VaR_t = Z_p \sigma_t$$

where  $Z_p$  is the standard normal quantile for  $p = 0.01; 0.05$ ;

$$\sigma_t^2 = 0.00000291 + 0.99492 \varepsilon_{t-1}^2 + 0.895441 \sigma_{t-1}^2$$

where:

$\sigma_t^2$  - variance of the dependent variable in the current period;

$\varepsilon_{t-1}$  - residuals from the previous period;

$\sigma_{t-1}^2$  - variance of the dependent variable in the previous period;

To find the best model for risk forecasting, I'll use the violation ratio of Danielsson (2011, p.145). For this reason I'll use an out-of-sample VaR estimates to identify the most appropriate risk forecasting model. This out-of-sample includes data from the last year (January, 02 2013 – November, 30 2013). If the actual loss exceeds the VaR forecast, then the VaR is considered to have been violated. The violation ratio is the sum of actual exceedences divided by the expected number of exceedences given the forecasted period. The confidence level is consider 95% and 99% and VaR is estimated daily.

$$VR = \frac{\text{Observed number of violations}}{\text{Expected number of violations}} = \frac{E}{p \times N}$$

where -  $E$  is the observed number of actual exceedences

-  $p$  is the VaR probability level, in this case  $p=0.05$  or  $0.01$

-  $N$  is the number of observations used to forecast VaR values, in this case 250 observations for year 2013.

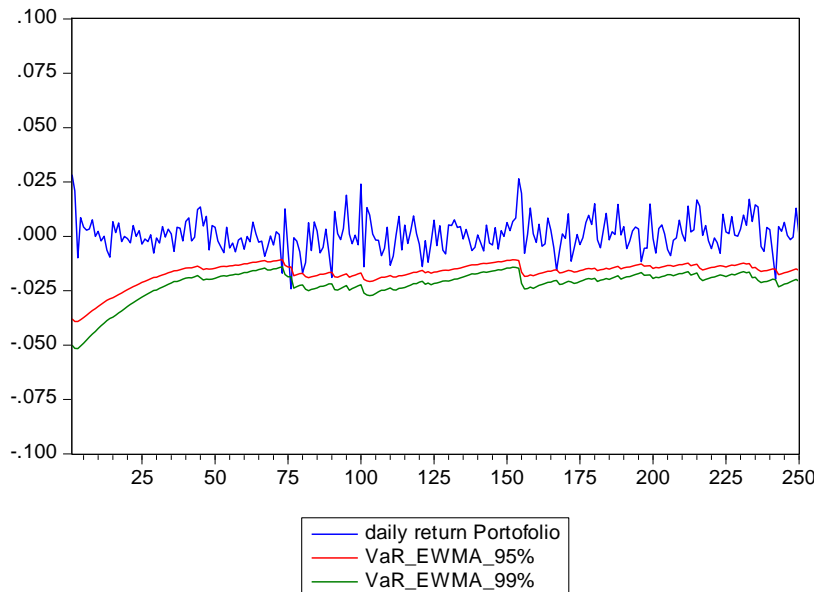
Applying this methodology, I've obtained the following situation:

**Table 9. Violation Ratio**

	EWMA		ARCH		GARCH	
	95%	99%	95%	99%	95%	99%
<b>Violation Ratio</b>	0.72	0.8	0	0	0	0

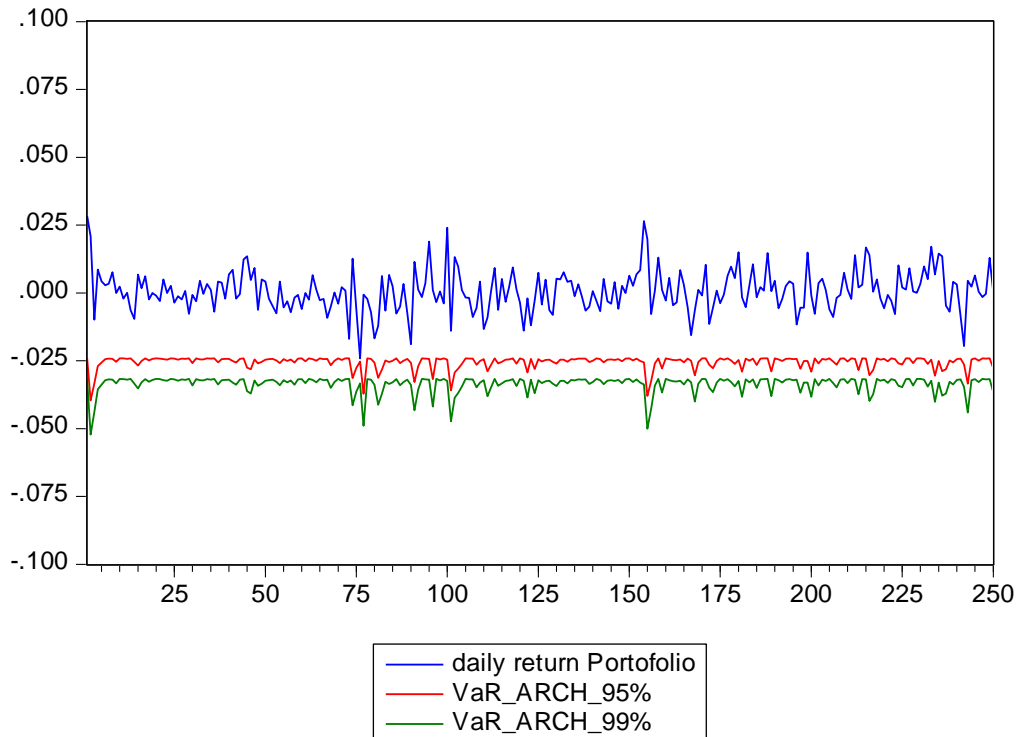
Source: author calculations

Graphically, the situation is as follows:

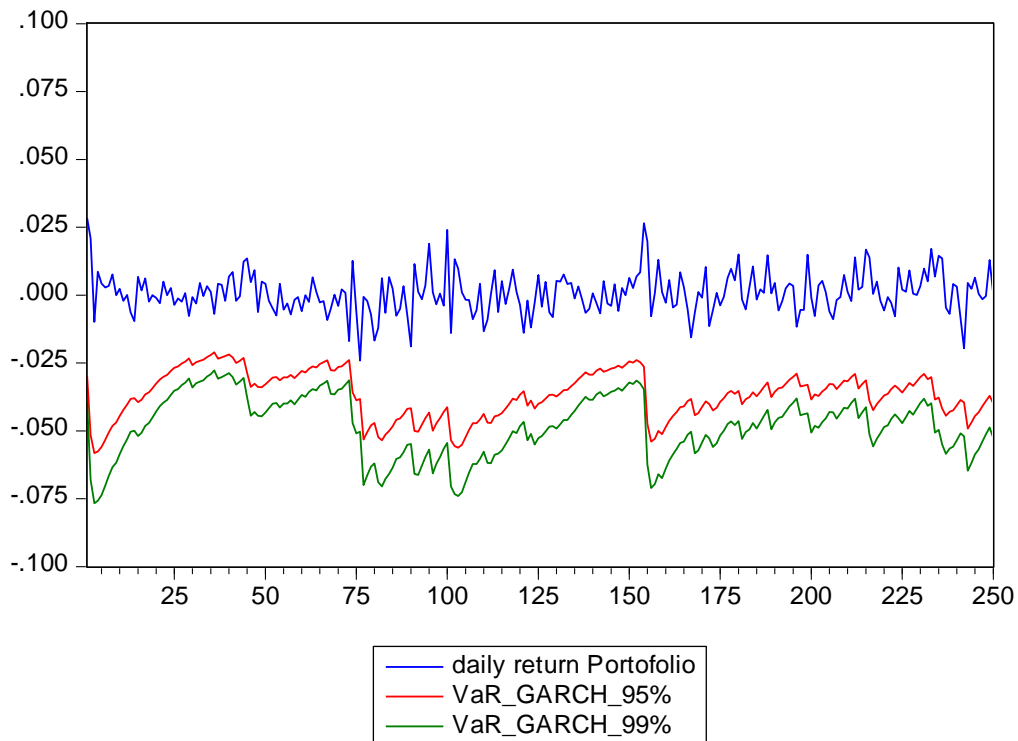


**Figure 6. VaR estimates obtained from EWMA Model**

Source: author calculations



**Figure 7.** VaR estimates obtained from ARCH Model  
Source: author calculations



**Figure 8.** VaR estimates obtained from GARCH Model  
Source: author calculations

Given the above results, I conclude that the ARCH and GARCH models are more appropriate for estimating VaR than EWMA model. Also, from the above graphs, it can be observed that the GARCH model implies a lower cost of risk and for this reason this model is the most appropriate volatility forecasting model to estimate the Value-at-Risk.

## 5. Conclusions

This study was conducted to analyse the market risk (estimated by Value-at-Risk) on the Romanian capital market using modern econometric tools to estimate volatility, such as EWMA, GARCH models. I've worked with a period of 4 years, considering three representative indices of Romanian capital market. Heteroskedasticity models have proved extremely useful in modeling volatility. After repeated attempts, the best model was found to be GARCH model (1.1). Analyzing the results obtained through GARCH equation, I can draw the following conclusions:

- Coefficient of volatility is positive, indicating that when volatility increases, portfolio returns tend to increase;
- Coefficient that estimates ARCH effects in the data series analyzed, recorded a statistically significant amount. In other words, on the Romanian capital market, the periods characterized of high volatility continues throughout with high volatility, and vice versa.
- Coefficient which measures the asymmetry of the data series recorded a positive value, which suggests that negative shocks (bad news) generated less volatility than positive shocks (good news) on the Romanian capital market.

VaR depends on the volatility, time horizon and confidence interval for the continuous returns under analysis. Volatility tends to happen in clusters. The assumption that volatility remains constant at all times can be fatal. It is determined that the most recent data have asserted more influence on future volatility than past data. To emphasize this fact, recently, EWMA and GARCH models have become critical tools in financial applications.

Applying the test of „violation ratio” I've found that Value-at-Risk estimated by GARCH model was the most appropriate to estimate the risk of a portfolio of the 3 indices on the Romanian capital market. So, GARCH provides more accurate analysis than EWMA. This approach is useful for traders and risk managers to be able to forecast the future volatility on a certain market.

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# From Liquidity Crisis to Sovereign Debt Crisis

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*This paper summarizes the results of empirical research on European Union's evolution in terms of macroeconomic stability in a period in which member countries crossed from a liquidity crisis to a sovereign debt crisis. So, the evolution of the EU member countries is analyzed as the sovereign debt crisis has worsened and has become increasingly dangerous for the stability of the European economy. The research that is the subject of this paper aims to segment the EU member countries according to the degree of macroeconomic stability. Also, this segmentation process is performed according to two indicators that are highly important for macroeconomic stability, namely the sovereign debt, expressed as public debt to GDP, and fiscal and budgetary discipline, expressed by the ratio of budget balance to GDP.*

**Keywords :** macroeconomic stability , sovereign debt , budget deficit

**JEL Classification:** H63

## 1. Introduction

In his transition from Federal Reserve Governor to a private life, Alan Greenspan (2008) provided in a singular image on an increasingly turbulent world. Greenspan (2008) analyzes the causes that led to the collapse of the markets and the evolution of the global crisis.

Turmoil in financial markets around the world began in the summer of 2007, when French bank BNP Paribas suspended trading for three of its mutual funds, stating that it can no longer assess the assets of these funds, because the market for them had evaporated. In just a few hours, short-term credit markets worldwide had practically experienced a seizure. Despite the efforts of all the world's major central banks to pump liquidity worth billion dollars into the banking system, the first full-fledged financial crisis of the twenty-first century was triggered. When investors realized that an indefinite amount of commercial paper was backed by subprime mortgages, they did not stop to examine the situation and got rid of all the sorts of this short term commercial paper in bulk, and this triggered the global credit crisis (Greenspan, 2008).

## 2. Literature Review

With the governments' implementation of massive recovery programs to overcome the financial crisis emerged worldwide and, mainly, in Europe, as new major problem emerged, namely the problem of

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sovereign debt. Thus, by the end of 2009, the economic crisis increased by 45% the sovereign debt worldwide, according to estimates by Moody's rating agency.

Of course not only the economic recovery programs determined the increased sovereign debt, as some states have yet to implement these programs. In fact, these are the effects of expansionary fiscal policies in recent years and especially the negative effects of governments' inability to apply early action to avoid the crisis. The direct effects of the crisis and the increased sovereign debt can be seen in increased investment risk in the affected countries.

These measures reveal another important component that affected macroeconomic stability, and the size of budget deficit. Thus, the budget deficit indicates a surplus of expenses in relation to definitive budgetary or of uses in relation to resources. Total budget deficit includes structural deficit and cyclical deficit. The structural deficit is the deficit that the budget would record if the economy would increase to the level of the potential GDP. Thus, when the economy grows faster (as in the past years), the budget deficit is lower than the structural deficit. Cyclical deficit is the price of loans needed during crises, namely when unemployment is high, public revenues are declining, and there is higher social spending. Economic theory says that the deficit will be amortized by the cyclical surplus that will occur during economic boom. The problem of budget deficits affected countries across Europe and the risk of these deficits has come to determine concern, due to the difficulty that European states have faced in the funding their negative balances of their budget balances.

In this contextual framework, the sovereign debt issues were the subject of several research papers. Thus, Tomz and Wright (2013) review the empirical literature about sovereign debt and default.

Mentzen (2012) summarizes "the results of empirical studies on the effects of sovereign debt, deficit and default on the economy. The obtained results shows that excessive debt and deficit are very harmful for economic growth, as opposed to default, which tend to heal the economy and usually is the end of crisis."

Manasse and Roubini (2009) investigated "the economic and political conditions that are associated to the occurrence of a sovereign debt crisis".

Kirsch and Ruhmkorf (2013) constructed "a quantitative model of endogenous credit structure and sovereign default that allows for self-fulfilling expectations of default".

Muellbauer (2013) proposes "that all new euro area sovereign borrowing be in the form of jointly guaranteed Eurobonds".

Afonso and Gomes (2010) observed "an overall downgrading in sovereign debt ratings from the computed predictions in the period 2009-2011. Therefore, fiscal worsening, together with less optimistic macro scenarios are indeed translated into lower sovereign ratings".

### 3. Research and Methodology

In this paper, the relationship between different levels of debt in EU countries and their budget deficit is analyzed. Thus, the two variables (public debt and budgetary balance) are expressed as shares in GDP, based on annual data from Eurostat.

The data obtained are analyzed and processed with SPSS 20, aiming at segmenting the EU countries by two indicators for each of year in the 2008 to 2012 timeframe, and then analyze the evolution of EU countries in the considered period.

The main objective of the research is the segmentation of EU countries according to the macroeconomic stability given by the weight of public debt in GDP and situation of budgetary balance. Segmentation involves grouping of the states based on a rating resulted by the degree of economic stability (marked with the letters A, B and C) determined by the level of debt in the economy, which is expressed by the ratio of government debt to GDP, and fiscal and budgetary discipline, which is expressed by the share of budget deficit in GDP.

Thus, after the study, EU countries will be classified into the following clusters:

Rating	Characterization	Features
A	High Macroeconomic Stability	Low degree of debt High level of fiscal and budgetary discipline
B	Medium Macroeconomic Stability	Medium degree of debt Medium level of fiscal and budgetary discipline
C	Low Macroeconomic Stability	High degree of debt Medium level of fiscal and budgetary discipline

#### 4. Analysis and Results

##### 4.1. EU Segmentation in 2008

Using the Two Step Cluster method with SPSS software, the first segmentation is conducted in year 2008 and targets the situation in the first year of the economic crisis. The analysis is focused on the segmentation of the EU countries based on the debt level and fiscal and budgetary discipline in the context of the European Union threatened by a liquidity crisis. Thus, the following situation was obtained for the year 2008:

Cluster	3	2	1
Label	B	C	A
Description	Medium Macroeconomic Stability	Low Macroeconomic Stability	High Macroeconomic Stability
Size	42.9% (12)	35.7% (10)	21.4% (6)
Inputs	d2008 29.32	d2008 77.11	d2008 30.52
	b2008 -3.92	b2008 -2.96	b2008 2.60

Figure 1. Clusters of EU Countries in 2008

The situation, resulted from the segmentation process of the indicators from 2008, is transposed in figure 2, which shows the map of the European Union according to the obtained segments in relation to the level of macroeconomic stability.

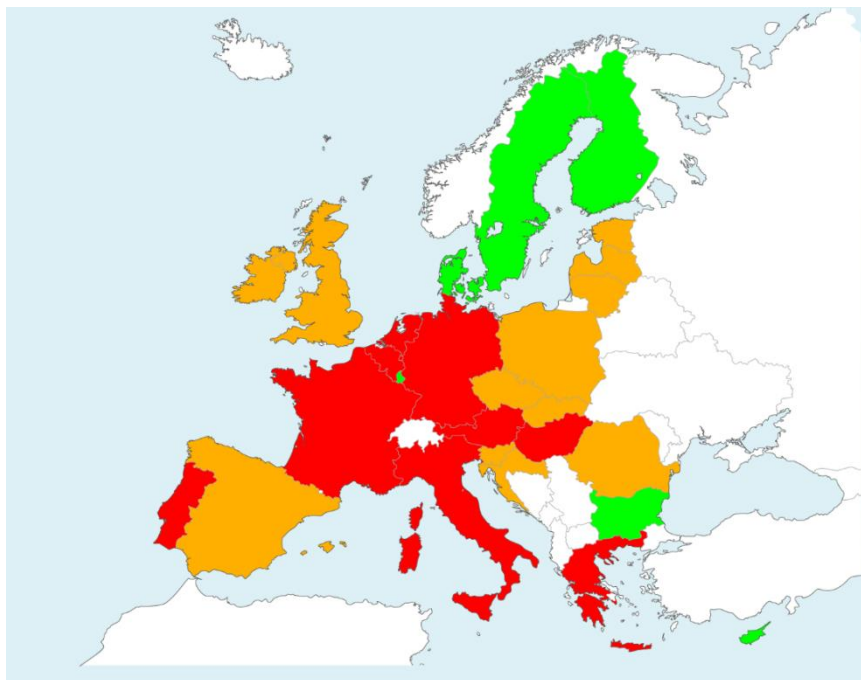





Figure 2. EU Clusters Map in 2008

Figures 1 and 2 show that in year 2008 macroeconomic stability was concentrated in northern Europe (Denmark, Finland and Sweden) and conjecturally in Bulgaria and Cyprus. At the same time, the instability was concentrated in central and southern Europe as a result primarily of the high level of public debt, while the budget deficit was in a normal range, like it was the case with the other two groups of countries.

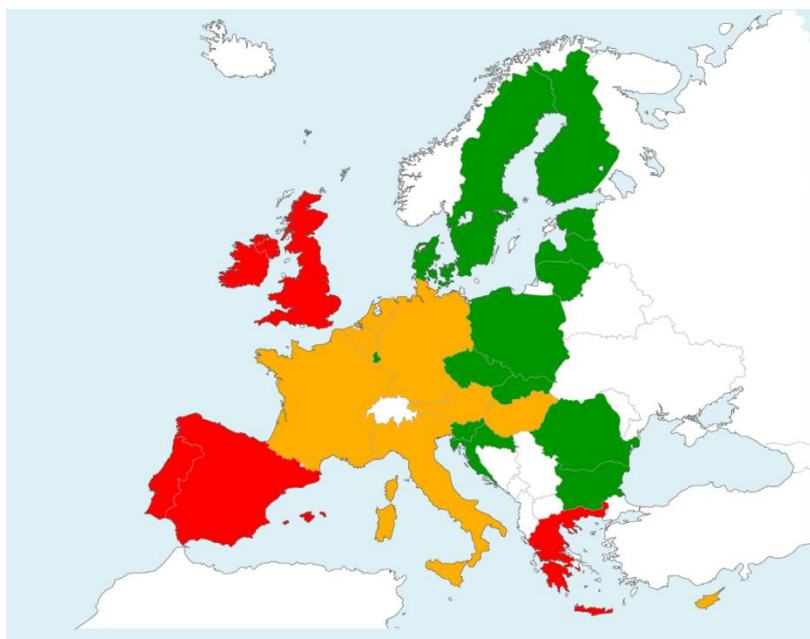
**4.2. EU Segmentation in 2009**

Using the Two Step Cluster method with SPSS software, the second segmentation is conducted in year 2009 and the following situation was obtained:

Cluster	1	2	3
Label	A	B	C
Description	High Macroeconomic Stability	Medium Macroeconomic Stability	Low Macroeconomic Stability
Size	 50.0% (14)	 32.1% (9)	 17.9% (5)
Inputs	d2009 31.91	d2009 77.84	d2009 79.78
	b2009 -5.11	b2009 -5.09	b2009 -12.38

*Figure 3. Clusters of EU Countries in 2009*

The situation, resulted from the segmentation process of the indicators from 2009, is transposed in figure 4, which shows the map of the European Union according to the obtained segments in relation to the level of macroeconomic stability.



*Figure 4. EU Clusters Map in 2009*



The first aspect that can be observed in Figures 3 and 4 is the negative impact of the crisis on European economies. The savings have been adversely affected, as this aspect is noticeable from the depreciation of the analyzed indicators, hence resulting in an depreciation of the macroeconomic stability.

In this context, the crossing of one group of countries from cluster B in 2008 in cluster A in 2009 is because the savings' stability of cluster A in 2008 have depreciated much faster and they reached the situation in which they displayed similar characteristics with a group of countries that have experienced the effects of the economic crisis much slower.

Thus, in cluster A were further added other countries, but with poor results, countries such as Poland, Czech Republic, Slovakia, Slovenia, Croatia and Romania, while the economic stability of Cyprus was heavily damaged. Countries in cluster A can be characterized since 2009 as countries with a high level of stability, but with a negative outlook.

Another important observation refers to the fact that the economic stability of Ireland, United Kingdom, Spain, Portugal and Greece was strongly affected by the sovereign debt crisis and the sovereign debt of these countries have reached alarming levels since 2009.

### 4.3. EU Segmentation in 2010

Using the Two Step Cluster method with SPSS software, the third segmentation is conducted in year 2010 and the following situation was obtained:

Cluster	1	2	3
Label	A	B	C
Description	High Macroeconomic Stability	Medium Macroeconomic Stability	Low Macroeconomic Stability
Size	53.6% (15)	42.9% (12)	3.6% (1)
Inputs	b2010 -4.61	b2010 -6.44	b2010 -30.60
	d2010 37.67	d2010 87.25	d2010 91.20

Figure 5. Clusters of EU Countries in 2010

The situation, resulted from the segmentation process of the indicators from 2010, is transposed in figure 6, which shows the map of the European Union according to the obtained segments in relation to the level of macroeconomic stability.

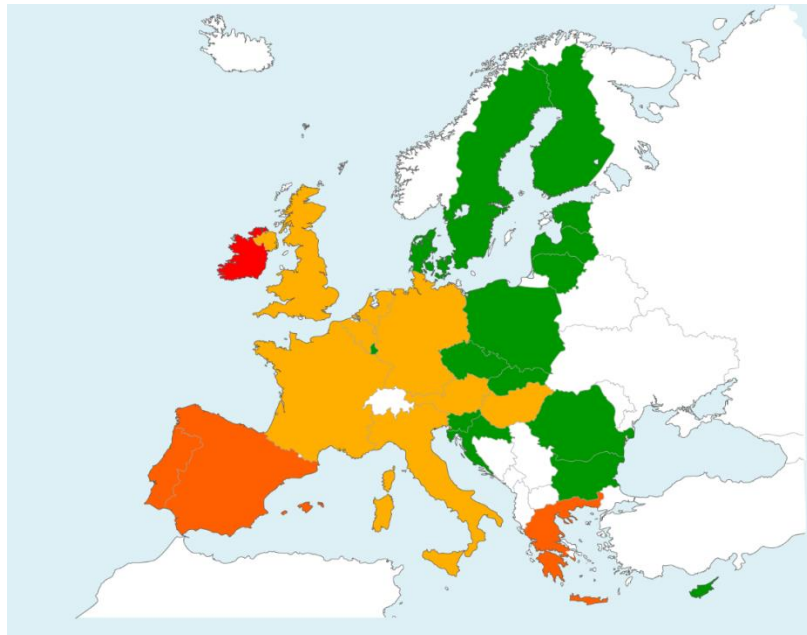


Figure 6. EU Clusters Map in 2010

The year 2010 was characterized by a tightening of the economic conditions and a strong evolution of the sovereign debt crisis. Thus, in year 2010 the economic stability of Ireland reaches alarming rates, and the disequilibrium of the budgetary balance is obvious after recording a value of 30.60% of GDP. This worsening of the situation allows other countries that were part of cluster C (Spain, Portugal, Greece, United Kingdom) to cross in cluster B, formed of countries with a medium level of economic stability, but with a negative outlook. The situations remain similar in terms of segmentation for the rest of the EU, but with a depreciation of the indicators for different countries.

#### 4.4. EU Segmentation in 2011

Using the Two Step Cluster method with SPSS software, the fourth segmentation is conducted in year 2011 and the following situation was obtained:

Cluster	2	1	3
Label	B	A	C
Description	Medium Macroeconomic Stability	High Macroeconomic Stability	Low Macroeconomic Stability
Size	42.9% (12)	39.3% (11)	17.9% (5)
Inputs	d2011 57.58	d2011 47.37	d2011 120.26
	b2011 -6.01	b2011 -0.80	b2011 -6.92

Figure 7. Clusters of EU Countries in 2011

The situation, resulted from the segmentation process of the indicators from 2011, is transposed in figure 8, which shows the map of the European Union according to the obtained segments in relation to the level of macroeconomic stability.

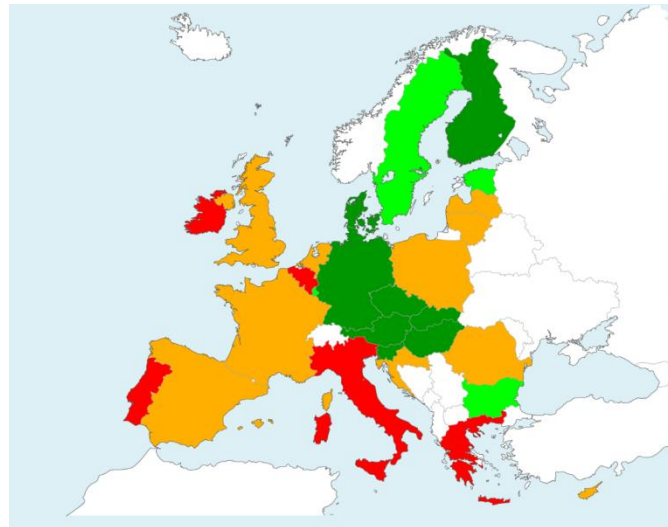


Figure 8. EU Clusters Map in 2011

Year 2011 is characterized by an acceleration of the sovereign debt crisis, as the macroeconomic stability of the countries in cluster C (Ireland, Portugal, Italy, Greece, Belgium) reaches alarming levels with possible negative effects for the entire community.

Also in 2011, the measures taken by the EU governments cause a change in the structure of clusters A and B. Thus, in cluster A, Sweden, Luxembourg, Estonia and Bulgaria strongly reduce their budget deficits, although public debts denote a slight increase but remain under control. At the same time, another group of countries leave cluster A and move to cluster B, which characterizes economies with an average level of macroeconomic stability. The measures of the economies in central Europe (Germany, Austria, Czech Republic, Slovakia, Slovenia) have results and allow them to record positive outlook.

#### 4.5. EU Segmentation in 2012

Using the Two Step Cluster method with SPSS software, the fifth segmentation is conducted in year 2012 and the following situation was obtained:

Cluster	2	3	1
Label	B	C	A
Description	Medium Macroeconomic Stability	Low Macroeconomic Stability	High Macroeconomic Stability
Size	50.0% (14)	32.1% (9)	17.9% (5)
Inputs	d2012 58.49	d2012 108.52	d2012 25.76
	b2012 -3.26	b2012 -6.50	b2012 -0.70

Figure 9. Clusters of EU Countries in 2012

The situation, resulted from the segmentation process of the indicators from 2012, is transposed in figure 10, which shows the map of the European Union according to the obtained segments in relation to the level of macroeconomic stability.

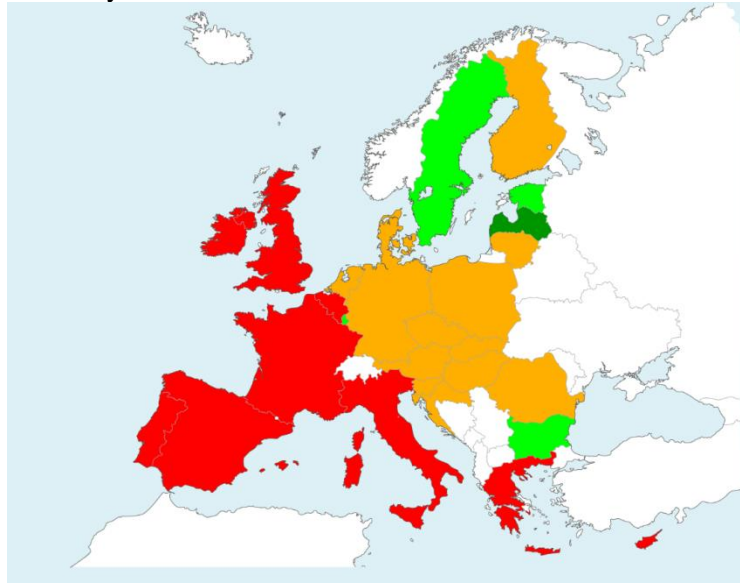


Figure 10. EU Clusters Map in 2012

### 5. Conclusion

The following table (Table 2) summarizes the situation at the European level in terms of macroeconomic stability.

Also, it is observed that the share of public debt in GDP is growing at an EU level (regardless of segment), while the budget deficit is on a downward trend after it peaked in 2009 (for clusters A and B) and in 2010 (for cluster C).

Table 2. : Table summarizing the situation of clusters and evolution of the EU member states

Clusters 2012	Country	D 2008	D 2009	D 2010	D 2011	D 2012	B 2008	B 2009	B 2010	B 2011	B 2012
<b>A</b>	Bulgaria	13.7	14.6	16.2	16.3	18.5	1.7	-4.3	-3.1	-2.0	-0.8
	Estonia	4.5	7.1	6.7	6.1	9.8	-2.9	-2.0	0.2	1.1	-0.2
	Latvia	19.8	36.9	44.4	41.9	40.6	-3.0	-6.8	-8.1	-3.6	-1.4
	Luxembourg	14.4	15.5	19.5	18.7	21.7	3.2	-0.7	-0.8	0.1	-0.6
	Sweden	38.8	42.6	39.4	38.6	38.2	2.2	-1.0	0.0	0.0	-0.5
	<b>Mean</b>	<b>18.2</b>	<b>23.3</b>	<b>25.2</b>	<b>24.3</b>	<b>25.8</b>	<b>0.2</b>	<b>-3.0</b>	<b>-2.4</b>	<b>-0.9</b>	<b>-0.7</b>
<b>B</b>	Austria	63.8	69.2	72.3	72.8	74.0	-1.0	-4.1	-4.5	-2.4	-2.5
	Czech Republic	28.7	34.6	38.4	41.4	46.2	-2.2	-5.8	-4.7	-3.2	-4.4
	Denmark	33.4	40.7	42.7	46.4	45.4	3.3	-2.8	-2.7	-2.0	-3.9
	Croatia	36.6	36.6	44.9	51.6	55.5	-5.3	-5.3	-6.4	-7.8	-4.9
	Finland	33.9	43.5	48.7	49.2	53.6	4.3	-2.7	-2.8	-1.0	-2.2
	Germany	66.8	74.5	82.5	80.0	81.0	-0.1	-3.1	-4.2	-0.8	0.1
	Hungary	73.0	79.8	82.2	82.1	79.8	-3.7	-4.6	-4.4	4.2	-2.1
	Lithuania	15.5	29.3	37.8	38.3	40.5	-3.3	-9.4	-7.2	-5.5	-3.3
	Malta	60.9	66.5	66.8	69.5	71.3	-4.6	-3.7	-3.5	-2.8	-3.3
	Netherlands	58.5	60.8	63.4	65.7	71.3	0.5	-5.6	-5.0	-4.3	-4.0
	Poland	47.1	50.9	54.9	56.2	55.6	-3.7	-7.5	-7.9	-5.0	-3.9
	Romania	13.4	23.6	30.5	34.7	37.9	-5.7	-9.0	-6.8	-5.6	-3.0
	Slovenia	22.0	35.2	38.7	47.1	54.4	-1.9	-6.3	-5.9	-6.3	-3.8
	Slovakia	27.9	35.6	41.0	43.4	52.4	-2.1	-8.0	-7.7	-5.1	-4.5
	<b>Mean</b>	<b>41.5</b>	<b>48.6</b>	<b>53.2</b>	<b>55.6</b>	<b>58.5</b>	<b>-1.8</b>	<b>-5.6</b>	<b>-5.3</b>	<b>-3.4</b>	<b>-3.3</b>

<b>C</b>	Belgium	89.2	95.7	95.7	98.0	99.8	-1.1	-5.6	-3.9	-3.9	-4.1
	Cyprus	48.9	58.5	61.3	71.5	86.6	0.9	-6.1	-5.3	-6.3	-6.4
	France	68.2	79.2	82.4	85.8	90.2	-3.3	-7.6	-7.1	-5.3	-4.8
	Greece	112.9	129.7	148.3	170.3	156.9	-9.9	-15.6	-10.8	-9.6	-9.0
	Ireland	44.2	64.4	91.2	104.1	117.4	-7.4	-13.7	-30.6	-13.1	-8.1
	Italy	106.1	116.4	119.3	120.7	127.0	-2.7	-5.4	-4.3	-3.7	-2.9
	Portugal	71.7	83.7	94.0	108.2	124.1	-3.7	-10.2	-9.9	-4.3	-6.5
	Spain	40.2	54.0	61.7	70.5	86.0	-4.5	-11.1	-9.6	-9.6	-10.6
	United Kingdom	51.9	67.1	78.4	84.3	88.7	-5.0	-11.3	-10.1	-7.7	-6.1
	<b>Mean</b>	<b>70.4</b>	<b>83.2</b>	<b>92.5</b>	<b>101.5</b>	<b>108.5</b>	<b>-4.1</b>	<b>-9.6</b>	<b>-10.2</b>	<b>-7.1</b>	<b>-6.5</b>

The situation resulted in 2012 splits the European Union map in two large groups of countries. The first group is composed of clusters A and B, considering the fact that the countries in cluster A (Sweden, Estonia, Latvia, Bulgaria and Bulgaria) have a high level of stability caused by the low level of public debt (25.76% of GDP) and a very low budget deficit (-0.7% of GDP) compared with the situation in cluster B where public debt records an average of 58.49% of GDP and an average deficit of 3.26% of GDP.

The second group is characterized by a low level of macroeconomic stability. This cluster records a 108.5% share of GDP for public debt and a share of -6.5% of GDP for budget deficit. Both values are at levels of alert and due to this cluster's countries it raises the level of risk for the European Union.

If we analyze the comparative maps in the 2008-2012 period, a paradox is observed: countries that were included in cluster C follow an ascending trend and, geographically, they tend to cover the largest area of the map in 2012, although the indicators show an improvement from year to year starting with 2010. This paradox shows that the risk in terms of a negative evolution of macroeconomic stability at the EU level is high and should be analyzed from the perspective of other indicators.

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# The National Income Between Monetary and Fiscal Actions

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*Andersen and Jordan (1968) and Andersen (1971) argued that fiscal actions have a negligible effect on nominal income and can not sustain a stable and balanced economic growth. Also, they argued, along with other researchers who have embraced monetarism ideas from the Federal Reserve Bank of St. Louis, that the budget deficit presents negative effects in the economy that limit private investment. In this article, we analyzed the empirical relationship that is established between the tax actions and the long and short term national income in the U.S. economy and the economies of Eurozone.*

**Keywords:** *fiscal actions, budget deficit, money supply, national income*

**JEL Classification:** *H30*

## 1. Introduction

The purpose of this research consists of determining, based on empirical data, the impact of fiscal and monetary actions on national income. The analysis of the impact of fiscal and monetary actions on national income has been the subject of study for many monetarists, including Andersen and Jordan (1968). The two researchers synthesized the monetarist ideas and following several discussions with Robert Basman, Karl Brunner, James Buchanan, Albert Burger, Keith Carlson, David Fand, Milton Friedman, Gary Fromm, Michael Levy, Thomas Mayer, A. James Meigs, David Meiselman, Allan Meltzer, Richard Pucket, David Rowan, James Tobin, Robert Weintraub and William Yohe, conducted a study based on empirical data that led them to assert that fiscal actions have little effect on national income, but can cause short-term changes production or employment. (Andersen and Jordan, 1968, pp.11-23)

Starting from this statement by Andersen and Jordan (1968, pp.11-23), the research subject of this paper will be to determine and analyze the relationship established between money supply, national income and budget deficit in two of the largest economies in the world, namely the U.S. economy and the European economy.

## 2. Research Methodology

To achieve purpose of the research, we use a methodology that involves conducting the following tests in order to determine the relationships between variables, i.e. to check the empirical validity of the assumption that fiscal actions have little effect on national income, but can cause short-term changes in output or employment:

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## (i) Augmented Dickey-Fuller test and Phillips-Perron test to examine the stationarity of time series

The Dickey-Fuller test simply shows that under the null hypothesis of a stationary test, the test does not show a conventional distribution of the t- Student test, but derives asymptotic results and stimulates critical values for various tests and sample sizes. The standard Dickey-Fuller test has the following equation:

$$\Delta y_t = \alpha y_{t-1} + x'_t \delta + \varepsilon_t$$

The simple Dickey-Fuller test is only valid if the series represent an autoregressive process (1). (Quantitative Micro Software, 2007, pp.92-93)

Phillips and Perron (1988) proposed an alternative (nonparametric) control method for serial correlation when testing stationarity. The PP method estimates the non-augmented equation of the Dickey-Fuller test and modifies the ratio of the coefficient so that the serial correlation does not affect the asymptotic distribution of the statistic test. (Quantitative Micro Software, 2007, p.95)

- (ii) The Granger test is used to test the causality between variables, more specifically whether an endogenous variable can be treated as an exogenous continuously variable. (Quantitative Micro Software, 2007, p.348)
- (iii) The Johansen test is used for testing the cointegration relationship of variables, namely establishing the existence of a relationship and getting the relationship between the analyzed variables.

Given a group of nonstationary series, the question is whether these series are cointegrated, and if they are, what is the cointegration relationship (long term relationship). Thus, in order to test the cointegration relationship the Johansen test was used.

## (a) "Vector Error Correction" for obtaining and testing short-term relationships

The "Vector Error Correction" (VEC) follows a smaller vector autoregression model, designed for nonstationary series that are known to be cointegrated. VEC has cointegration relationships, so that the model limits the long term behavior of the endogenous variables to converge to their cointegrating relationships, while allowing a dynamic short-term adjustment. The term of cointegration is known as the error correction because the deviation from the long term equilibrium is slowly corrected by a series of partial short-term adjustments. (Quantitative Micro Software, 2007, p.377)

This methodology will be applied by using the Eviews 6 software on empirical data to achieve the main objective of the research. Thus, for hypotheses testing we use macroeconomic data related to:

- (i) The U.S. economy
- (ii) The euro area economy

Regarding the application of the methodology, this is based on macroeconomic data from the following time series, extracted from the following databases: Federal Reserve of St. Louis, Eurostat and the European Central Bank, in accordance with the variables used in this research and presented in Table 1.

**Table 1.** Variables and time series used in the empirical research

Variables	US	Euro Area
Money ( <i>M</i> )	1982-2011	1995q1-2011q4
National Income ( <i>Y</i> )	1982-2011	1995q1-2011q4
Budgetary Deficit ( <i>BD</i> )	1982-2011	1995q1-2011q4
Government Revenue ( <i>GR</i> )	1982-2011	1995q1-2011q4
Government Expenditure ( <i>GE</i> )	1982-2011	1995q1-2011q4

### 3. Analysis and Results

To analyze the existence of a long-term relationship between fiscal and monetary actions, on the one hand and national income, on the other hand, firstly, we test stationarity of the time series, given that the existence of non-stationarity of the series is the basic condition for the existence of cointegration. Regarding the testing of series' stationarity we have to apply the Augmented Dickey- Fuller test and the Phillips Perron test, as the number of lags used is chosen by the minimizing SC criterion (Schwartz criterion). After applying the stationary tests, the results obtained in Eviews are presented in Table 2.

**Table 2. Results for stationary tests**

Economic Area	Variables	ADF Test	PP Test
United States	$\Delta Y$	I(1)	I(0)
	$\Delta M$	I(1)	I(1)
	$\Delta DB$	I(0)	I(0)
Euro Area	$\Delta Y$	I(0)	I(0)
	$\Delta M$	I(1)	I(0)
	$\Delta DB$	I(0)	I(0)

Table 2 presented above suggests that the variables are integrated at a 0 or 1 level, thus fulfilling the conditions for a valid cointegration.

After obtaining the nonstationary behavior for the time series related to the variables of interest, we can proceed to the analysis of the cointegrating relationships specific to each economic zone. Thus, the series' non-stationarity motivates the use of the Johansen procedure in the analysis to identify the presence of a stationary long-term relationship (cointegration) between the non-stationary series. The advantage of the Johansen procedure is that it allows highlighting of the speed adjustment toward the long-term equilibrium of the variables.

The optimum number of lags that will be used in cointegration will be equal to  $p - 1$ , where  $p$  is the optimum number of lags, according to the Schwarz criteria, for a VAR estimated with the variables of interest in the research.

After identifying the optimal number of lags, by applying the Johansen test, we confirm the existence of cointegration and identify the number of cointegrating equations. Table 3 provides the results.

**Table 3. Results of the Johansen cointegration tests**

Economic Area	$H_0$	$H_1$	Eigenvalue	Trace Statistic	0,05 Critical Value	Prob.	Max-Eigen Statistic	0,05 Critical Value	Prob.	Inference
USA	$r = 0$	$r \geq 1$	0,6689	36,1750	29,7971	0,0080	27,6333	21,1316	0,0053	R = 1
	$r = 1$	$r \geq 2$	0,2851	8,5418	15,4947	0,4094	8,3902	14,2646	0,3404	
	$r = 2$	$r \geq 3$	0,0060	0,1516	3,8415	0,6970	0,1516	3,8415	0,6970	
EURO	$r = 0$	$r \geq 1$	0,4430	58,4603	29,7971	0,0000	36,2799	21,1316	0,0002	R = 1
	$r = 1$	$r \geq 2$	0,1930	22,1805	15,4947	0,0042	13,2941	14,2646	0,0707	
	$r = 2$	$r \geq 3$	0,1335	8,8864	3,8415	0,0029	8,8864	3,8415	0,0029	

From the above table (Table 3), it is noted that the four variables are in a long-term relationship, resulting in the possibility of analyzing the monetary hypothesis stated by Andersen and Jordan (1968).

After determining the number of cointegrating equations, the next step is to estimate the coefficients' values of the long term equations. The equations' coefficients and the adjustment coefficients are shown in Table 4 together with the values of the t-test.

**Table 4. Estimation of the relationship between long-term variables**

Economic Area	Cointegration Equation				Adjustment Coefficients			
	$\Delta Y$	$\Delta M$	$\Delta B$	Const,	D( $\Delta Y$ )	D( $\Delta M$ )	D( $\Delta DB$ )	
USA	Coef,	1,000	-0,048	2,054	-310,477	-1,365	0,415	-1,522
	SE		0,268	0,485		0,291	0,145	0,299
	t-Statistic		-0,181	4,237		-4,692	2,861	-5,088
EURO	Coef,	1,000	-0,088	0,571	-7183,254	-0,208	3,871	-0,938
	SE		0,026	0,220		0,287	0,786	0,321
	t-Statistic		-3,356	2,594		-0,724	4,926	-2,920



After having verified the existence of a long-term relationship, we proceed to check the short-term causality by applying the Granger causality test. The results obtained after the application of the Granger test are shown in Table 5.

**Table 5.** The results of the short-term Granger causality

	US			Euro Area		
Dependent Variable: D( $\Delta$ Y)	Chi-sq	df	Prob,	Chi-sq	df	Prob,
D( $\Delta$ M)	8,8713	3	0,0311	5,8969	4	0,2070
D( $\Delta$ DB)	13,1297	3	0,0044	4,3434	4	0,3615
All	14,9802	6	0,0204	13,7311	8	0,0890
Dependent Variable: D( $\Delta$ M)	Chi-sq	df	Prob,	Chi-sq	df	Prob,
D( $\Delta$ Y)	6,9470	3	0,0736	20,8460	4	0,0003
D( $\Delta$ DB)	1,4357	3	0,6972	21,1292	4	0,0003
All	7,5102	6	0,2762	50,0040	8	0,0000
Dependent Variable: D( $\Delta$ DB)	Chi-sq	df	Prob,	Chi-sq	df	Prob,
D( $\Delta$ Y)	25,6205	3	0,0000	21,7650	4	0,0002
D( $\Delta$ M)	8,2685	3	0,0408	4,1331	4	0,3883
All	28,7194	6	0,0001	23,1074	8	0,0032

Given the results of previous estimates and the test procedure, the estimated cointegrating vectors can be used to estimate the VEC (Vector Error Correction) model in order to quantify the short-term elasticities.

The properties of the resulting model are checked using a set of tests:

- (i) Lagrange multiplier test for serial correlation verification, namely the independence hypothesis of errors;
- (ii) White test to check the hypothesis of homoskedasticity;
- (iii) Jarque-Berra test to verify the hypothesis of normality.

The results for the estimation model and its verification are summarized in Table 6.

**Table 6.** VEC estimated for the relationship between income, monetary actions and fiscal actions

Economic Area	VEC									
USA	$\Delta(\Delta Y) = -1,364 * (\Delta Y(-1)) - 0,048 * \Delta M(-1) + 2,053 * \Delta B(-1) - 310,477 + 1,562 * \Delta(\Delta Y(-1)) + 1,338 * \Delta(\Delta Y(-2)) + 0,267 * \Delta(\Delta Y(-3)) + 2,177 * \Delta(\Delta M(-1)) + 1,241 * \Delta(\Delta M(-2)) + 0,893 * \Delta(\Delta M(-3)) + 2,160 * \Delta(\Delta B(-1)) + 1,097 * \Delta(\Delta B(-2)) + 1,822 * \Delta(\Delta B(-3)) + 49,728$									
Euro	$\Delta(\Delta Y) = -0,207 * (\Delta Y(-1)) - 0,088 * \Delta M(-1) + 0,570 * \Delta B(-1) - 7183,254 - 0,387 * \Delta(\Delta Y(-1)) - 0,297 * \Delta(\Delta Y(-2)) - 0,364 * \Delta(\Delta Y(-3)) + 0,452 * \Delta(\Delta Y(-4)) - 0,087 * \Delta(\Delta M(-1)) - 0,072 * \Delta(\Delta M(-2)) - 0,013 * \Delta(\Delta M(-3)) - 0,031 * \Delta(\Delta M(-4)) + 0,090 * \Delta(\Delta B(-1)) + 0,043 * \Delta(\Delta B(-2)) - 0,148 * \Delta(\Delta B(-3)) - 0,158 * \Delta(\Delta B(-4)) - 59,320$									
Error Analysis Tests										
Economic Area	Lag interval s	Adj, R <sup>2</sup>	LM(1) F-statistic	LM(1) p-values	LM(2) F-statistic	LM(2) p-values	White $\chi^2$	White p-values	Jarque-Berra $\chi^2$	Jarque-Berra p-values
USA	3	0,643	5,355	0,802	11,416	0,248	23,936	0,245	4,198	0,123
Euro	4	0,972	8,342	0,500	8,482	0,486	35,68	0,098	2,67	0,263

As shown in table 6, the relationship estimated in the first part of the table is validated by the tests regarding the properties of the model.

#### **4. Conclusion**

From Tables 4, 5 and 6 it is noted that fiscal actions have coefficients attached to an absolute value greater than the coefficients attached to monetary actions. In another line of ideas, the hypothesis stated by Andersen and Jordan (1968) is not valid, and fiscal actions seem to have a more significant impact on national income. It should also be noted that since the publication of the studies, the results obtained by Andersen and Jordan have attracted criticism because of the methodology they used. Further, after all the structural changes and mutations of the global economy, this assumption is not valid in the new context of economic realities.

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# Foreign Direct Investment Drivers in Romania

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*Foreign Direct Investment (FDI) represents a condition sine qua non for a sustainable development of Romania, taking into consideration the fact that the domestic capital is not enough to assure a positive and significant growth. The present study uses the multiple linear regression to determine the main factors which influence FDI level in Romania. The international reserve and the capital market index BET have a direct and positive impact on the foreign investment flow, while the short, medium and long private and public external debt proved to influence direct, but in a negative way, the FDI.*

**Keywords:** Linear multiple regression, Foreign Direct Investment (FDI), International reserve, Capital market index BET, Short, medium and long term public and private external debt

## 1. Introduction

According to the National Bank of Romania (NBR), the foreign direct investment is seen as a “long term investment relation between a resident and a non-resident entity, which implies that the investor has a significant managerial influence in the company he has invested in.” Are considered to be FDIs: the paid-up capital and the reserves owed by a non-resident investor, who holds at least 10% of the subscribed capital of a resident company, the loans given by this investor to the organization he has invested in, as well as the reinvested profit.

According to the contribution foreign investors bring in a company, FDIs classify as:

- Greenfield: starting a business from zero by/with foreign investors;
- Mergers and acquisitions: the total/partial takeover of a company by foreign investors from residents;
- Companies' development: foreign investors hold the majority in the company.

The subject of FDIs, and more precisely of the factors influencing their level, remains extremely debated in the specialized literature. Economists from all over the world have tried to identify the reasons behind FDI flow in their countries, in order to help increase their level.

FDIs are extremely important for the economic growth of any country, especially of a developing one. The lack or the insufficiency of the domestic capital is balanced by such FDIs. Romania is no exception. For our country as well, FDIs represent the development leverage.

The present study aims at identifying the specific factors that determine FDIs in Romania and the extent to which FDI level depends on them. In this direction, we analyzed a series of 16 factors considered important in terms of their influence on the FDIs. However, after significance tests have been conducted, especially the t-Statistic test, only three of them proved to influence FDIs: the international reserve, BET and the external debt.

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## 2. Literature review

Specialized literature distinguishes two categories of factors that influence FDIs, external and internal. External factors, the so-called “push factors” (Tapsoba, 2012), include the economic conditions in the countries from where FDIs come and reflect the opportunity cost of investing in a specific country. Internal factors, the “pull factors” (Tapsoba, 2012), refer to the macroeconomic conditions and the institutional environment in the countries towards which FDIs are directed.

A low inflation rate determines a favorable climate for investments and puts the basis of a sustainable economic development. (Fischer & Modigliani)

Shamsuddin (1994) analyzed in his paper FDIs’ drivers in 36 less developed countries during the year 1983. The conclusions were that the highest influence on FDI is the host’s country (the country where the foreign capital flow enters) Gross Domestic Product (GDP)/capita, followed by the workforce cost and the investment climate, represented by the public debt/capita, price volatility and resources’ availability in the host country. The exports, the imports, the national infrastructure and various types of risk (country risk, political risk, interest rate risk) are other factors that influence FDI levels.

Balasubramanyam’s study (1996) concludes that host’s country trade policy represents a crucial factor in attracting FDIs. The explanation lays in the fact that the foreign capital flow has a higher impact on the economic development of countries promoting the exports, against those promoting the import.

Borenstein (1998) shows that FDIs support the economic development of the host country by the technology transfer from the higher developed countries. Moreover, the study explains the differences in terms of FDIs’ influence on the host’s country economic development, based on the different capacities to absorb newly introduced technologies.

In his paper “FDI and inflation: theory and evidence”, Sayek (1999) sustains that the relation inflation-FDIs is a negative one. Thus, he concluded that a 3% inflation growth in Canada determined a reduction of the USA’s FDIs in Canada with 2%, and that a 7% inflation growth in Turkey determined a reduction of the USA’s FDIs in Turkey with 1.9%. Price stability is an indicator of the economic stability. Usually, high inflation rates translate in a reduction of the FDI’s Return on Investment (ROI).

Nnadozie (2000) reveals that the most important factors which trigger USA’s FDIs in Africa are GDP, public debt, natural resources, inflation rate and political risks. Asiedu’s (2002) study confirms that FDIs in Africa are influenced by its natural resources, low inflation rates and market dimension, adding two more factors: a good infrastructure and a general framework which favors investments. On the other hand, corruption and political instability represent two barriers.

Niels and Robert (2003) realized a study on 67 less developed countries between 1970 and 1995, concluding that FDIs contribute to a host country economic growth only if the financial system of that country is a developed one.

Bushra, Hussain and Chaudhary (2003) sustain that countries which aim at attracting a high investment flow need to make efforts for increasing their trade’s openness and for diminishing external debt and the imbalances on the internal and external markets.

Kiat’s (2007) study, which analyzed FDI’s evolution in 30 countries between 1981 and 2007, concluded that inflation does not directly affect FDIs. It influences the unemployment, population’s wages and the economic growth, factors considered to be important in the investment decision making process. Also, the study shows that high inflation rates have a negative effect on FDIs.

Duasa (2007) examined FDI and GDP in Malaysia and it proved to be no clear evidence of a relation between them. Consequently, FDI does not influence country’s economic growth. It only contributes to its stability.

Abbas (2011) realized a study on the countries forming the South Asian Association for Regional Cooperation on the period 2001-2010, whose conclusions were that there is a positive and significant relation between GDP and FDI and an insignificant relation between the inflation rate and FDI.

Tapsoba’s empirical study (2012) realized between 1980 and 2007 on 53 developing countries shows that central banks’ monetary policy of inflation targeting determines a high level of FDIs. Why this? Because it increases country’s credibility and economic environment stability.

A recent paper of Saleem, Zahid, Shaoib, Mahmood and Nayab (2013) on Pakistan economy in the period 1990-201 argues that FDIs are in a direct and positive relation with inflation rate and GDP. Another paper of Shahzad and Al-Swidi (2013) analyzed Pakistan between 1991 and 2011, and it concluded that political stability, GDP, exchange rate and exports positively influence FDIs, while inflation rate has no significant impact on FDIs.

If at global level there is a series of studies analyzing FDI's drivers, in Romania, the subject was not enough "exploited", even if it is of a real interest. This explains the reduced number of studies debating this issue.

A study of Pirtea and Miloș (2009) analyzed FDI's influence on the economic growth in Romania between 2000 and 2007, using the simple linear regression. The dependent variable was considered to be GDP's real growth rate, while the independent variable was FDI's growth rate. Study's conclusions were that FDI variation has a moderate impact on the economic growth.

Bakos, Sisak, Vlad and Voica (2010) realized in their paper a number of correlations: GDP-FDI, inflation-FDI, unemployment-FDI, exports-FDI and imports-FDI. The conclusion was, on one hand, that there is a strong correlation between GDP, exports and imports and the FDI growth. On the other hand, there is a low correlation between inflation rate, unemployment and GDP.

Other factors that foreign investors take into consideration when they take the investment decision in Romania include the relative low cost of workforce and resources, as well as a high educational preparation level of the workforce.

Ludoșean (2012) shows, with the help of Value at Risk (VaR) model, that between Romanian economic growth and FDI level, there is a negative relation. Consequently, FDI level does not determine economic growth in Romania. However, it represents an important factor in attracting FDI's in Romania.

### 3. Study motivation

Observing the existence of numerous studies at international level regarding FDI's drivers, we concluded that the specifics of each country make different factors influence the foreign investment flow. The present study aims at identifying, using the multiple regression, the factors which determine the foreign investment flow in Romania.

The paper's objective is to analyze and test new hypothesis. Also, as it took into consideration macroeconomic coordinates from 2000 to 2012, it allows highlighting some conclusions to date.

### 4. Methodology and data used

Prediction is the process of forecasting the value of one variable using a variable whose value is known. Although there are no perfect relations in the real world, such forecasts can be done using regression. Regression refers to a quantitative estimation of the causality relations between economic variables. It is mainly based on probability theory and statistics inference.

First regression models date from 1877, the method being introduced by Francis Galton, who tried to determine to what extent children's height is influenced by parents' height. Even if he did not apply the method in economy, regression was rapidly embraced by economists. George Udny Yule in 1895 and Reginald Hawthorn Hooker in 1901 were among the first to use correlation to analyze the relation between economic variables.

The relation between variables is described by a linear equation, the regression equation, which has as geometric correspondent the regression line. Depending on the number of factors involved, the regression can be:

- Single/simple factor regression, which can be linear or curved;
- Multi factor regression, with the two alternatives: linear and curved.

The objective of multiple regression is to highlight the relation between a dependent variable (explained, endogen, resultant) and a variety of independent variables (predictors, explicative, exogenous). Linear multiple regression was first used in economy in 1901, by the Italian statistician Rodolfo Benini.

The usage of the regression function in prediction involves several phases: choosing the shape of the function, determining the parameters, validating the function through statistical tests and in the end, establishing the prediction. Also, the partial determination coefficients need to be computed, as they show each independent variable contribution to the dependent variable.

The equation of the multiple linear regression is practically an extension of the simple linear regression, with the following format:

$$\hat{y}_t = a + b_1x_{1t} + b_2x_{2t} + \dots + b_kx_{kt}$$

where:  $\hat{y}$  – estimated value for the dependent variable

$a$  – origin of the line (constant)

$b_k$  – parameters for the  $k$  predictor variables

$x_k$  – independent variables

t – time variable, t = 1, n

Real observed values will know a deviation from the theoretical values, expressed as:  $Y_t = \bar{Y}_t + \varepsilon_t$   
Where  $\varepsilon_t$  – estimation error represented by a random variable normally distributed from average, 0 and the constant variable.

For computing the parameters a and b, the following equation system is used:

$$\begin{aligned} n * a + b \sum x_1 + c \sum x_2 + d \sum x_3 &= \sum y \\ a \sum x_1 + b \sum x_1^2 + c \sum x_2 x_1 + d \sum x_3 x_1 &= \sum y x_1 \\ a \sum x_2 + b \sum x_1 x_2 + c \sum x_2^2 + d \sum x_3 x_2 &= \sum y x_2 \\ a \sum x_3 + b \sum x_1 x_3 + c \sum x_3 x_2 + d \sum x_3^2 &= \sum y x_3 \end{aligned}$$

For the easiness of calculations, the two parameters can be automatically computed using Excel, Eviews, Spss or other similar software. Interpreting such variables represents the second stage from the regression process. The coefficient “a” shows the value Y has when X is zero. The coefficient “b” (regression slope) shows the extent to which Y is influenced when X increases with a unit.

The prediction for the period n+1, if we consider n to be the present moment, is realized:

$$\hat{y}_{n+1} = a + b_1 x_{1, n+1} + b_2 x_{2, n+1} + \dots + b_k x_{k, n+1}$$

To determine the prediction threshold, maximum and minimum limits will be computed, as follows:

$$\text{Inferior limit: } \hat{y}_{n+1}^l = \hat{y}_{n+1} - \Delta y$$

$$\text{Superior limit: } \hat{y}_{n+1}^s = \hat{y}_{n+1} + \Delta y$$

where:  $\Delta y$  - admitted deviation compared to the predicted level of the dependent variable. Its level is computed:

$$\Delta y = t_{q/2}^s \sqrt{\frac{\sum_{t=1}^n (y_t - \hat{y}_t)^2}{n - (k + 1)} \sqrt{1 + C(X'X)^{-1} C}}$$

y – admitted deviation compared to the predicted level of the dependent variable

$t_{\alpha/2}^s$  – statistics t value with Student distribution related to a level of significance  $\alpha/2$

n – number of historical observations

C – coefficient's matrix

X' - transposed matrix of independent variables

q – significance level (risk, the probability for the real value to be outside the thresholds),  $q = 1 - p$

P – confidence level (the probability for the real value to be in the predicted threshold). The higher the P value, the wider the prediction threshold. Most used values are: 0.90; 0.95; 0.99.

## 5. Results

To develop the regression equation, a number of 16 variables was used, including: GDP (m lei), Minimum wage (euro), Exports (b euro), Tax revenues to the state budget (b euro), Short, medium and long term public and private external debt (b euro), Inflation rate (%), BET (leu), Official exchange rate leu-dollar (annual average), Unemployment rate (%), International reserve (b lei), Real interest rate (%), Electricity consumption (b kWh), Budgetary deficit (%), Budgetary expenses (b lei), Market capitalization (b lei) and Workforce with tertiary education (according to the World's Bank methodology, tertiary education includes the faculty) (%).

The period considered was between 2000 and 2012. The selection of the independent variables introduced in the model was done through the regressive method, as follows:

- the linear multiple regression equation was generated including all the 16 independent variables;

- taking into consideration the results of the statistics significance test, variables with a  $p > 0.05$  were eliminated, beginning with the maximum value;
- this procedure was repeated for the variables left in the model;
- in the end, in the model were only left three variables: capital market index BET, international reserves and the short, medium and long term public and private external debt, each of them with a  $p > 0.05$ .

BET is the reference index of the capital market in Romania, being the first index developed by the Bucharest Stock Exchange. It is a free float weighted capitalization index of the most liquid 10 companies listed on the Bucharest regulated market. The Romanian international reserve is formed from gold and foreign currencies, being administered by NBR. The short, medium and long term public and private external debt indicates Romanian indebtedness on the international market.

These three variables were afterwards analyzed in terms of descriptive statistics, whose results are presented in the table below:

*Table 1. Descriptive Statistics*

Foreign Direct Investments (b euro) (y)		BET (leu)		International reserves (b euro)		The short, medium and long term public and private external debt (b euro)	
Mean	3.787923077	Mean	4330.998462	Mean	20.90007692	Mean	40.34615385
Standard Error	0.613727738	Standard Error	766.9521451	Standard Error	3.486639925	Standard Error	7.96965089
Median	5.183	Median	4364.71	Median	22.935	Median	28.6
Standard Deviation	2.212826829	Standard Deviation	2765.285285	Standard Deviation	12.57125903	Standard Deviation	28.73498493
Sample Variance	4.896602577	Sample Variance	7646802.707	Sample Variance	158.0365536	Sample Variance	825.699359
Kurtosis	-1.650952875	Kurtosis	-0.211412705	Kurtosis	-1.705944062	Kurtosis	-0.663690822
Skewness	0.057271811	Skewness	0.45684352	Skewness	-0.105865067	Skewness	0.779399767
Range	6.353	Range	9281.38	Range	33.608	Range	86.2
Minimum	1.147	Minimum	544	Minimum	3.643	Minimum	11.7
Maximum	7.5	Maximum	9825.38	Maximum	37.251	Maximum	97.9
Sum	49.243	Sum	56302.98	Sum	271.701	Sum	524.5
Count	13	Count	13	Count	13	Count	13
Confidence Level (95.0%)	1.337197868	Confidence Level (95.0%)	1671.045172	Confidence Level (95.0%)	7.596735793	Confidence Level (95.0%)	17.36437759

Source: Own calculations

The **mean** indicates the average of each indicator values. The **median** divides the series in two equal parts. If the mean were equal to the median, the distribution would be a normal one. However, there are differences between the two indicators, which express an abnormal distribution. FDI's mean is 3.79b euro, while the median is 5.18b euro. BET has a mean of 4330.90 lei and a median of 4363.71 lei. The international reserve is of 20.9 b euro and the median of 22.93 b euro, while the external debt has a mean of 40.34b euro and the median of 28.6b euro.

The fact that the distribution is not a normal one is also expressed by the two indicators **Kurtosis** and **Skewness**, which show the flattening and the inclination of the distribution. A normal level for the two indicators would have been 3 for Kurtosis and 0 for Skewness. The four factors have a flat distribution, as Kurtosis has levels of -1.65, -0.21, -1.70 and -0.66. In what concerns the inclination, the distribution is inclined to the left in the case of the international reserve, as Skewness has a negative value (-0.105). For the other factors, the distribution is inclined to the right, Skewness having positive values (0.057 for FDIs, 0.456 for BET and 0.77 for the external debt).

**Standard error** refers to the average of each factor's errors, the so called "ε" in the model. FDIs have a level of 0.613, BET – 766.95, international reserve – 3.486 and the external debt – 28.74. The quite high level of this indicator can be explained by the high variation of the variables in the observed period.

In what concerns the indicators for measuring dispersion, **sample variance** indicates the relative spread of the data and **standard deviation** shows the values' distribution around the mean. Standard deviation is the square root of the variance, and its levels are of 2.21b euro for FDIs, of 2765.28 lei for BET, of 12.571 b euro for the international reserve and of 28.73 b euro for the external debt.

The **range** is the difference between the **minimum** and the **maximum** levels for each observation. FDIs have a range of 6.353b euro, BET - 9281.38 lei, the international reserve - 33.61b euro and the external debt - 86.2b euro.

The **confidence level** shows with a probability of 95%, that FDIs can deviate from the mean with  $\pm 1.34$ b euro, BET with  $\pm 1671.04$  lei, international reserve with  $\pm 7.59$  euro and the external debt with  $\pm 16.36$ b euro.

The next step was to obtain the results of the regression analysis, results that are presented in the table below:

*Table 2. Regression Analysis*

SUMMARY OUTPUT								
<i>Regression Statistics</i>								
<b>Multiple R</b>	<b>0.924199</b>							
	<b>957</b>							
<b>R Square</b>	<b>0.854145</b>							
	<b>56</b>							
<b>Adjusted R Square</b>	<b>0.805527</b>							
	<b>414</b>							
<b>Standard Error</b>	<b>0.673842</b>							
	<b>839</b>							
Observations	13							
ANOVA								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	3	50.188	16.72	17.56	<b>0.0004</b>			
Residual	9	8.570	0.95					
Total	12	58.759						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
<b>Intercept</b>	<b>1.0771</b>	0.6493	3.077	<b>0.0131</b>	0.2854	1.8687	0.2854	1.8687
<b>BET</b>	<b>0.0003</b>	0.0001	2.784	<b>0.0212</b>	0.0001	0.0006	0.0001	0.0006
<b>International reserve (b euro)</b>	<b>0.2037</b>	0.0401	5.073	<b>0.0006</b>	0.1128	0.2945	0.1128	0.2945
<b>Short, medium and long term external public and private debt (b euro)</b>	<b>-0.0831</b>	0.0137	4.773	<b>0.0010</b>	-0.1667	-0.0595	-0.1667	-0.0595

**Multiple R** represents the correlation coefficient between the dependent variable observed (y, effective FDIs in the period 2000-2012) and the dependent variable calculated ( $\hat{y}$ , FDIs computed based on the regression equation). In this case, the indicator has a level of 92.41%, which expresses a strong correlation between effective FDIs and the calculated FDIs, computed with the help of the regression equation.

**R Square** represents the variance percentage in the dependent variable (criteria) determined by the simultaneous variation of the independent variables (predictors). The analysis indicates a level of 85.41% for  $R^2$ , which translates into the fact that FDIs' variation in Romania is influenced by 85.41% by BET, international reserve and external debt variations.

**Adjusted R Square** is practically R Square corrected for the number of predictors. In this case (13 observations) to compute this indicator, the division is done by 12. The obtained value, 80.55%, higher than the



minimum level considered compulsory for a strong relation between variables (75%) reveals a 80.55% FDIs' dependency on the independent variables. **Standard Error** represents the errors' average and it has a level of 0.67.

R statistics significance is computed with a variance test (F), which in this case has a value lower than 0.0004. This emphasizes the validity of the regression model, as it is below 0.05.

As aforementioned, **P-value** has for each variable, levels below 0.05, the highest level being 0.021 for BET. The international reserve has a P-value of 0.00067 and the external debt of 0.0010.

Thus, the regression function has the following format:

$$Y' = 1.077106526 + 0.000342628 * X_1 + 0.203726121 * X_2 - 0.083153003 * X_3$$

where  $Y'$  – estimated value for FDIs

$X_1$  – BET

$X_2$  – international reserve

$X_3$  – short, medium and long term public and private external debt

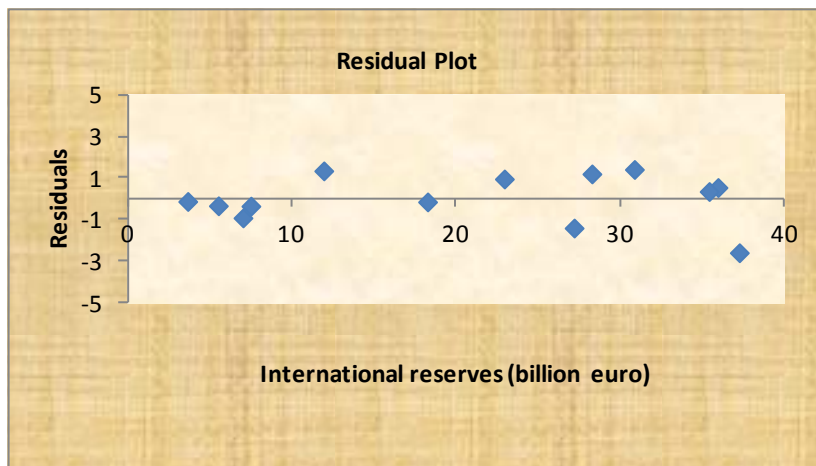
Computing FDIs' values in the period 2000-2012, based on the regression equation, leads to the following results:

*Table 3. Residual Output*

Observation	Predicted Foreign Direct Investments (billion euro) (y)	Residuals
1	1.032780174	0.114219826
2	1.335500783	-0.041500783
3	1.84279855	-0.63079855
4	2.041863231	-0.095863231
5	4.539944765	0.643055235
6	5.007357996	0.200642004
7	6.729604746	0.770395254
8	6.580662639	-0.880662639
9	4.664272307	0.835727693
10	4.632384072	0.767615928
11	4.219216632	0.980783368
12	2.89064678	-1.07564678
13	1.915159353	0.222840647

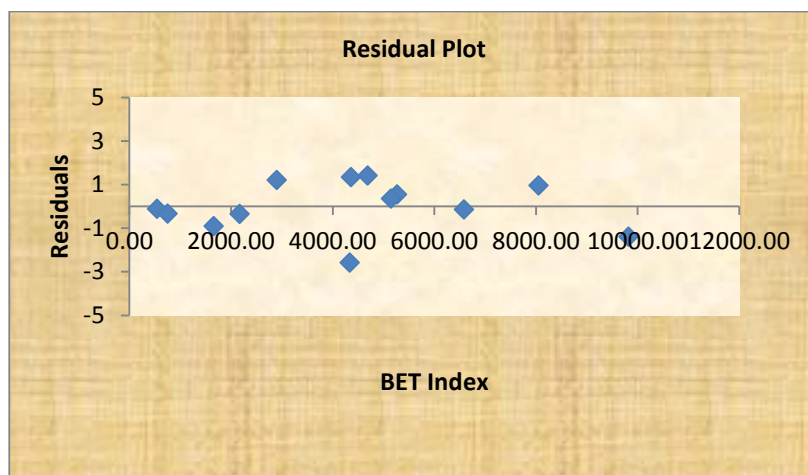
Source: Authors' calculations

The quality of the model is facilitated by the Residual Plot graphs for each of the independent variables, presented as follows:

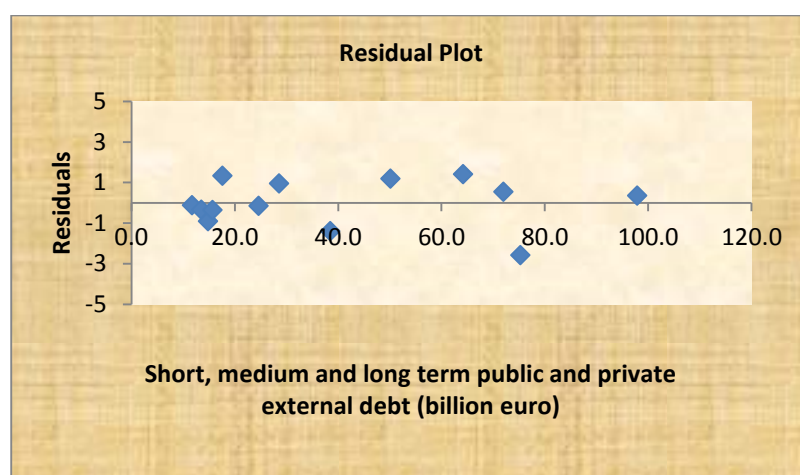


*Figure 1. Residual Plot – International reserves*

Source: Authors' calculations



**Figure 2.** Residual Plot – BET Index  
Source: authors’ calculations



**Figure 3.** Residual Plot –Short, medium and long term public and private external debt (billion euro)  
Source: authors’ calculations

It can be observed that for each independent variable, residuals’ graphic representation can be translated into a horizontal line that does not contradict the hypothesis of the errors’ normality. The uniform line reflects the constant dispersion of the residuals all over the independent variable domain.

## 6. Conclusions

Thus, we can assert that there is a direct and positive relation between FDIs, the capital market index BET and the international reserves. This is indicated by the positive coefficients of 0.00034 and 0.203726 that exist between these variables. On the other hand, FDIs are negatively influenced by external debt level, the coefficient related to this variable being -0.08315.

What do these numbers indicate? That in order to attract a higher level of the foreign investment flow in Romania, the external debt level should be a reduced one, corroborated with high levels of the capital market index BET and of the international reserves. A reduced level of the external debt reflects a better asset management and it expresses the country’s ability of auto finance. A high level of the international reserves indicates prudence and the capacity of facing crisis, while a high BET level reflects a financial market in expansion.

All this data in nothing else but signals regarding the country’s economic stability, its capacity of overcoming crisis, as well as the financial market maturity level.

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