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DYNAMICS OF THE MARKET MODEL IN THE CONTEXT OF GLOBAL FINANCIAL CRISIS: THE CASE OF BUCHAREST STOCK EXCHANGE

The purpose of this paper was to conclude whether the market return in Romania is an important factor with a great impact on returns for the stocks listed at the Bucharest Stock Exchange. Based on the sample of 28 stocks listed on BSE, it shows that the market rate of return is not important in explaining the variation in stock returns, while the market model considers market return the only factor with a systematic impact. Furthermore, the stability of the market model coefficients from period to period can be seen as questionable.

Keywords: *stock return, market return, global financial crisis, market model.*

JEL Code: *G12.*

Драгош Штефан Опреа

ДИНАМІКА РИНКОВОЇ МОДЕЛІ В КОНТЕКСТІ ГЛОБАЛЬНОЇ ФІНАНСОВОЇ КРИЗИ (НА ПРИКЛАДІ ФОНДОВОЇ БІРЖІ БУХАРЕСТУ)

У статті показано, чи є для Румунії ринковий прибуток важливим чинником, що впливає на прибуток по акціях на фондовій біржі Бухаресту. На основі вибірки 28 пакетів акцій, що котируються на фондовій біржі Бухаресту, показано, що ринковий прибуток не є головним чинником змін у прибутковості акцій, а ринкова модель вважає ринковий прибуток єдиним фактором із систематичною дією. Крім того, стабільність коефіцієнтів ринкової моделі від періоду до періоду можна вважати сумнівною.

Ключові слова: *прибутковість акцій, ринкова прибутковість, світова фінансова криза, ринкова модель.*

Драгош Штефан Опреа

ДИНАМИКА РЫНОЧНОЙ МОДЕЛИ В КОНТЕКСТЕ ГЛОБАЛЬНОГО ФИНАНСОВОГО КРИЗИСА (НА ПРИМЕРЕ ФОНДОВОЙ БИРЖИ БУХАРЕСТА)

В статье показано, является ли в Румынии рыночная прибыль важным фактором, влияющим на прибыль по акциям на фондовой бирже Бухареста. На основе выборки 28 пакетов акций, котирующихся на фондовой бирже Бухареста, показано, что рыночная прибыль не является главным фактором изменений в доходности акций, а рыночная модель считает рыночную прибыль единственным фактором с систематическим воздействием. Кроме того, стабильность коэффициентов рыночной модели от периода к периоду можно считать сомнительной.

Ключевые слова: *доходность акций, рыночная доходность, мировой финансовый кризис, рыночная модель.*

1. Introduction. A major challenge in financial research that has been addressed in multiple studies is the understanding of the behavior of stock returns and in particular the factors that help explain their variation. A recent study by Subrahmanyam

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(2010) compiles a number of factors that were found to be significant in explaining the variation in stock returns. The research focuses only on the determinants of stock returns at the US capital markets, often considered efficient in terms of information. Compared to developed capital markets, on emerging capital markets the informational efficiency is questionable (Dragota and Mitrica (2004), Pele and Voineagu (2008), Dragota et al. (2009a) in the case of Romanian capital market, Dragota and Tilica (2012) on capital markets for ex-communist countries in Eastern Europe). The capital market in Romania is characterized by low liquidity (Dragota and Mitrica (2004), Geambasu and Stancu (2010)), and the education of investors that place their capital at Romanian market is relatively limited, the investment being mostly speculative (Dragota and Serbanescu (2010)).

In the context of the capital market in Romania the first purpose of this paper is to test the market model proposed by Sharpe (1963), which considers the market return as being the single and the unique factor with a systematic impact on stock returns. In other words, the study will conclude if the market rate of return in Romania is an important factor in explaining the variation in stock returns, for the case of the Bucharest Stock Exchange (BSE).

Given the 2008 global financial crisis that rocked the whole world, financial markets being contained by panic that led to profound decreases in trading volume and important corrections in stock prices, this research subsequently aims to test the power of market rate of return in explaining changes in stock returns over different periods: before the financial crisis, during the financial crisis and immediately following the financial crisis. Also in this context the evolution of the market model coefficients is analyzed for the periods established by this study, because under the philosophy of the model the coefficients are constant over time.

Further, the paper is structured as follows: in Section 2 the literature review is presented, Section 3 presents the data and methodology used, Section 4 states the results and in Section 5 the study is concluded.

2. Literature review. Some problems in the applicability of the market model are given by the classical assumptions for residuals in the market model equation. Thus, heteroscedastic errors and autocorrelated errors could lead to misinterpretation of tests in terms of statistical significance for the market model coefficients (Brooks, 2008). In terms of studies, Fama et al. (1969), Martin and Klemkosky (1975), Brenner and Smidt (1977) concluded that heteroscedasticity is not a serious problem in estimating the market model. On the other hand, studies by Belkaoui (1977), Bey and Pinches (1980), Karathanassis and Philippas (1993), Diebold et al. (1993) concluded that heteroscedasticity is widely present in the market model.

The problem regarding the autocorrelation of errors in the market model is as important as the hereroscedastic errors. Schwartz and Withcomb (1977) concluded the existence of autocorrelation coefficients in errors that are statistically significant. Based on these results they investigated different causes of this phenomenon. The so-called Fisher effect[2] is responsible for the existence of autocorrelated errors. Over time this effect was mainly attributed to the thin trading phenomenon. Thus, a number of studies have concluded that thin trading could bias the volatility coefficient

[2] See Fisher, L. (1966). Some New Stock Market Indexes. Journal of Business, Vol. 39, No. 1, p. 191-225.

estimates suggesting different methods for correcting this bias. In this respect, studies by Scholes and Williams (1977), Dimson (1979) and Cohen et al. (1983) may be mentioned. However, many other studies (Bartholdy and Riding (1994)) in the case of New Zealand capital market, Beer (1997) on the case of Belgian capital market and Diacogiannis and Makri (2008) in the case of Greek capital market) have refuted the results of the proposed correction techniques, the method of least squares being considered most appropriate for estimating the volatility coefficient.

Another problem in estimating the market model coefficients is the length of the return interval used (daily, weekly, monthly etc.) to estimate it. Interesting results are provided by Pogue and Solnik (1974). They estimated equation of the market model using series on daily, weekly, biweekly and monthly returns and found that on average the volatility coefficient estimates in monthly returns are higher to those estimated in daily returns. The sensitivity of the volatility coefficient estimates according to the length of the return interval used is reported by many other studies (Handa et al. (1989), Corhay (1992), Frankfurter et al. (1994) and Diacogiannis and Makri (2008)). A possible explanation of the volatility coefficient instability attributed to the length of the return interval used is given by the impact of new information on stock prices which are not immediately incorporated due to lack of continuous trading (see Scholes and Williams (1977), Cohen et al. (1983)). Recommendations on choice of return interval to estimate the volatility coefficient arise from the study of Daves et al. (2000) which suggests using daily return series because they produce the lowest standard error for the volatility coefficient estimates. Furthermore, the length of the return interval used has impact on the coefficient of determination associated with the market model. Pogue and Solnik (1974), Dimson (1979), Brailsford and Josev (1997) and Diacogiannis and Makri (2008) reported an increased coefficient of determination if the length of the return rises.

For a proper application of the market model the assumption is made that its parameters are stable over time. A number of studies have questioned the stability of the volatility coefficient, a plausible hypothesis being that it varies over time. The variation may be due to microeconomic and macroeconomic influences (Rosenberg and Guy (1976a, 1976b), Jagannathan and Wang (1996)). This hypothesis is further supported by several case studies of developed capital markets (Jacob (1971), Blume (1975) and Fabozzi and Francis (1978)) and for emerging capital markets (Dragota and Filip (2005) for the capital market in Romania).

3. Database and methodology. The database used in this study consists of historical returns of 28 stocks listed at BSE. Stocks were selected based on the number of days that were traded during the period analyzed. The source for the data series is the official site of the SSIF Broker (www.tranzactiibursiere.ro). The period for the analysis was 21.11.2005 - 30.12.2011 corresponding to the maximum time frame for which all the relevant stock information could be retrieved. A selection statistics was built as the ratio between the number of days in which a stock traded and the total number of trading days in the period analyzed. After calculating the selection statistics for each stock in the initial sample of 45 companies, the average of selection statistics was determined. On average the stocks in the sample were traded in about 73% of the days of the period. In other words, on average stocks traded in about 3.7 days in the five

days of the week. Further, individual statistics were compared to the average in the sample. The 28 stocks selected are those for which the selection statistics are greater than or equal to the average sample. Using such selection criteria the most liquid stocks listed at BSE were selected, as lack of liquidity may distort the results of econometric tests used in assessing various hypotheses (Dragota and Mitrica, 2004). Since the series of prices registered days in which the stocks were not traded, attributing the previous day's price for the nontrading day was chosen as a method to correct[3].

In this study, the market portfolio was proxied by the BET-Composite index (BET-C). The problem with empirical investigations is that in practice we cannot see this theoretical market portfolio (Roll, 1977) and therefore the author employed different stock indices as a proxy for the true market portfolio. The general idea is that these market indices employed as proxies for the market should include many stocks. For Romanian stock market, the current work chose the BET-C index to represent the market portfolio, as BET-C includes all the stocks traded at the BSE and is, therefore, more suitable to proxy the true market portfolio in comparison to the official index BET (which only includes the 10 most liquid stocks from the BSE).

After selecting the stocks that will be used in the analysis and establishing the index that is supposed to highlight the overall return of Romanian market, the daily returns series were calculated:
where :

$$R_{i,t} = \ln(P_{i,t}) - \ln(P_{i,t-1}),$$

$R_{i,t}$ — denotes the continuously compounded return for the common stock i at time t;

$P_{i,t}$ — denotes the natural logarithm of the price for the common stock i at time t.

For daily returns to be comparable over time, in the case of each company in the sample, corporate actions (stocks issue to pay dividends, splits, consolidations etc.)[4] that have occurred over time were identified. Therefore, these corrections were made to avoid the presence of extreme values (outliers) in the data sets that lead to distortions of econometric results (Brooks, 2008).

After building the series of daily returns for the period 21.11.2005 - 30.12.2011, in order to focus on the importance of the market rate of return in explaining the variation of stock returns, the initial time frame is divided into 3 periods: the pre-crisis period (21.11.2005 - 24.07.2007), the crisis period (25.07.2007 - 25.02.2009) and the instability period (26.02.2009 - 30.12.2011). The dates corresponding to 24.07.2007[5] and 25.02.2009[6] were chosen as thresholds to split the database because they represented important moments in the BET-C index evolution. After these dates the relationship between stocks returns and the market return may suffer significant changes.

[3] See Bartholdy, J., Olson, D. and Peare, P. 2007. Conducting event studies on a small stock exchange. The European Journal of Finance, Vol. 13, No. 3, p. 227-252.
[6] Data on corporate actions were taken from the official site of the Bucharest Stock Exchange — http://www.bvb.ro.
[7] The moment when BET-C showed maximum historical quotation (see Appendix).
[8] The moment when BET-C showed minimal historical quotation (see Appendix).

Next, with the series of daily returns for each period, the study will estimate the market model equation using the method of least squares:

$$R_{i,t} = \alpha_i + \beta_i * R_{M,t} + \varepsilon_{i,t}, \quad (1)$$

where:

α_i = the intercept of stock i, which shows the impact of all stable factors of the returns with the exception of the market return;

β_i = volatility coefficient of stock i, which shows the sensitivity of stock return to market return;

$R_{M,t}$ = denotes the continuously compounded return for the market at time t;

$\varepsilon_{i,t}$ = error term at time t quantifying the influence of random factors characterized by zero mean, no correlation with an error term at any time, lack of correlation with the explanatory variable ($R_{M,t}$) and constant variance (homoscedasticity).

If the errors do not have constant variance, the paper will apply the correction proposed by White (1980) and if errors are autocorelated it will apply the correction proposed by Newey and West (1987).

The study follows the evolution of the coefficient of determination, the intercept, and the volatility coefficient from one period to another. Concerning the evolution of the coefficient of determination this study follows the 3 periods analyzing the size of the estimates.

Regarding the evolution of the intercept and the volatility coefficient, the study will test their stability. First, the study determines the periods for which testing will be done. After, these periods will be divided into 2 subperiods. For this approach, the first period is 21.11.2005 - 25.02.2009 (T) which was divided in 2 subperiods: 21.11.2005 - 24.07.2007 (T_2) and 25.07.2007 - 25.02.2009 (T_1). The date 24.07.2007 was chosen to split the first period because after this moment the BET-C index has seen a downward trend, this threshold marking the end of a period of strong growth (see Appendix). Thus, the major change given by the influence of the global financial crisis could lead to structural changes in the market model coefficients. The second period is 25.07.2007 - 30.12.2011 (T) which was divided in two subperiods like in the first case: 25.07.2007 - 25.02.2009 (T_1) and 26.02.2009 - 30.12.2011 (T_2). For this case 25.02.2009 was chosen to split the second period because after this point there is a return to the upward trend in the index evolution (see Appendix). As in the first case the recovery could lead to structural changes in the market model coefficients.

In the second phase it will estimate equation (2) which is a modification of equation (1) built in order to test the stability of the market model coefficients for the periods analyzed (Fabozzi and Francis, 1977; Brooks, 2008):

$$R_{i,t} = \alpha_{1,i} + \beta_{1,i} * R_{M,t} + \alpha_{2,i} * D_t + \beta_{2,i} * D_t * R_{M,t} + u_{i,t}, \quad (2)$$

where:

D_t = dummy variable which takes value 1 for $t \in T_1$ and 0 for $t \in T_2$.

The coefficients attached to dummy variables $\alpha_{2,i}$ and $\beta_{2,i}$ measure the differential impacts of the global financial crisis on coefficients $\alpha_{2,i}$ and $\beta_{2,i}$ of stock i, because the dummy variable takes the value 1 only during the crisis period. Furthermore, if the $\alpha_{2,i}$ is significantly different from zero is can be concluded that the intercept is not

stable from one subperiod to another. For $\beta_{2,i}$ significantly different from zero the conclusion is the same as described above.

Following the presentation of the methodology, the next section presents and discusses the results.

4. Results. This section is divided into 2 parts. The first part presents the results of the market model equation estimates for the 3 periods considered. Concurrently, the study presents the evolution of the correlation coefficients between stock returns and market. In the second part, this paper presents the evolution of the intercept and volatility coefficient estimates previously calculated. The current work follows the stability of the coefficient estimates from one subperiod to another and the global financial crisis influences on the evolution of coefficient estimates.

After estimating the regression equations for each period, it can be observed (Table 1) that the intercept is significantly different from zero for a low percentage of stocks in the sample regardless the period analyzed. The intercept is the coefficient which shows the impact of all stable factors of the stock returns with the exception of market return. The fact that the majority of intercepts are not significantly different from zero can lead to two conclusions. The market return is the only factor with a systematic impact on stock returns or the impact of other factors, not identified by the model, is compensated. Regarding the second conclusion, works such as Ross (1976), Fama and French (1993) suggest several determinants stock returns. Hence, using multifactorial models can better capture the evolution of the stock returns.

Regarding the volatility coefficients, they are significantly different from zero and positive for each stock in part and for all periods analyzed. Furthermore, using the t-Student test we observed that the average of the volatility coefficients of the pre-crisis period is significantly different from that of the crisis, for the significance level of 1%, and the crisis volatility coefficients increased on average by about 33.2%.

The correlation coefficients between stock returns and market return have fluctuated. For the most stocks in the sample, the correlation coefficients increased during the crisis to pre-crisis period and decreased during the instability to the crisis period. In other words, trends in crisis stock returns are more closely related to the market return evolution. Furthermore, the relation is positive for all 28 cases indicating that trends in stock returns and that of market return evolved in the same direction. Moreover, using the t-Student test we observe that the average of the correlation coefficients of the pre-crisis period is significantly different from that of the crisis for the significance level of 1%.

In the first part, the table presents the number of the stocks for which the coefficient estimates ($\hat{\alpha}_i$ and $\hat{\beta}_i$) are significantly different from zero (see columns 2 and 3) and the number of stocks for which the correlation coefficient estimates ($\hat{\rho}_i$) are significantly different from zero (see column 4). Afterwards, the next 4 columns show the estimated coefficient averages.

Moving towards the analysis of the coefficients of determination, we can see that the importance of the market rate of return in explaining the variation in stock return increases with the appearance of the global financial crisis influences. On average, the coefficients of determination from the crisis period are significantly different from those during the pre-crisis period at the significance level of 1%. More than that, on

average the coefficients of determination from the crisis period increased to 140% of those from the pre-crisis period. However, the average coefficient of determination is approximately 32% during the crisis period. The small percentage of stock return variation explained by the market rate of return, suggests the existence of other factors that can have impact on stock returns. In this respect for the capital market in Romania future studies should try to identify new factors that could have a systematic impact on stock returns.

Table 1. **The market model estimates and the correlation coefficient estimates for the three periods analyzed**

Period	$\hat{\alpha}_i$		$\hat{\beta}_i$		$\hat{\rho}_i$		$\bar{\hat{\alpha}}$	$\bar{\hat{\beta}}$	$\bar{\hat{\rho}}$	$\bar{\hat{R}}^{2\,1}$
	$\hat{\alpha}^{+}_{i}{}^{2}$	$\hat{\alpha}^{-}_{i}$	$\hat{\beta}^{+}_{i}$	$\hat{\beta}^{-}_{i}$	$\hat{\rho}^{+}_{i}$	$\hat{\rho}^{-}_{i}$				
Pre-crisis	7	2	28	0	28	0	0.000686*	0.690343*	0.325675*	0.132729*
Crisis	0	4	28	0	28	0	-0.000425**	0.919221*	0.541368*	0.311250*
Instability	1	1	28	0	28	0	0	0.903521*	0.471879*	0.251782*
Number of stocks examined	28									

*** Estimated averages are significantly different from zero at the significance level of 1%
** Estimated averages are significantly different from zero at the significance level of 5%
* Estimated averages are significantly different from zero at the significance level of 10%
[1] Represent the average of the coefficients of determination.
[2] The intercept estimate is significantly different from zero and positive.
Source: Author calculations.

Second, the equation of the market model embodies the implicit assumption that the parameters (α_i and β_i) are constant for the entire sample, both for the data period used to estimate the model, and for any subsequent period used in the construction of forecasts. Thus, testing the stability of the coefficients from one subperiod to another appears to be an important step in evaluating the forecasting characteristic of the market model in the case of Romanian capital market.

Table 2. **The stability of the market model coefficients**

Period	$\hat{\alpha}_{2,i}$	$\hat{\beta}_{2,i}$	$\hat{\alpha}^{+}_{2,i}$	$\hat{\beta}^{+}_{2,i}$
First period	9	16	2	12
Second period	5	13	1	7
Number of stocks examined	28			

Source: Author calculations.

The table presents the number of stocks for which the coefficient estimates ($\hat{\alpha}_i$ and $\hat{\beta}_i$) are significantly different from zero (see columns 2 and 3) and for which the estimated coefficients are significantly different from zero and positive (see columns 4 and 5).

Studying the results in Table 2, the first conclusion that can be drawn is that the stability of volatility coefficients is much lower than the stability of intercepts regardless the period analyzed. What is interesting to note is the sign of coefficient estimates.

A positive sign suggests that the coefficients have been raised over the subperiods analyzed, and a negative sign indicates their downward trend. For the first period analyzed, what is important to note is the upturn in the volatility coefficients for 75% of stocks characterized by an unstable volatility coefficient. This result is supported by the observation made in the first part of this section, where the study found that the average of volatility coefficients of the crisis are significantly different from those of pre-crisis period, and they have increased on average by 33.2%. These results have great significance for portfolio managers, as in times of crisis when the general market trend is down, good management involves identifying those stocks that are less sensitive to changes in the market return[7]. In the second period, the volatility coefficients record an unstable evolution from one subperiod to another. However, in this case the study could not identify a general evolution of the volatility coefficients, rather being two clusters[8].

In conclusion, the lack of stability coefficients rises many questions on the market model applicability to forecast stock returns in the case of Romanian capital market. A possible improvement of this deficiency of the market model can be achieved through a dynamic portfolio management, consistent with the time at which the transactions are made[9].

5. Conclusions. Since the average daily market capitalization of the sample used is about 69%[10] of the overall capitalization of the Bucharest Stock Exchange for the period 21.11.2005 - 30.12.2011, basing on the results presented throughout the paper we can draw some general conclusions.

The market rate of return is not important in explaining the variation of stock returns although the market model considers market return the only factor with a systematic impact. The analysis performed on different periods (the pre-crisis, the crisis and the instability period) showed that the market return had the greatest impact on stock returns in the same time with the global financial crisis influences. However, on average, only 32% of the variability of stock returns is explained by the market rate of return during the crisis period. In other words, the remaining 68% of stock return variances is attributed to random factors represented by the residual variable in the model. According to these results, it seems unlikely that the market return can be the only factor with a systematic impact on stock returns in the case of Romanian capital market. Identification of other factors in the case of Romanian capital market is an important issue for future studies.

Second, the stability of the market model coefficients from period to period raised questions. For the first period under analysis (21.11.2005 - 25.02.2009), what is important to note is the upturn in the volatility coefficients for approximately 75% of stocks characterized by an unstable volatility coefficient. The volatility coefficients increased on average by about 33.2% during the crisis to pre-crisis period. This last result has great significance for portfolio managers as in times of crisis when the gen-

[7] Financial practice emphasized the existence of volatility coefficients generally positive, rarely identifying negative volatility coefficients.
[8] 21.4% of the volatility coefficients have a downward trend, while 25% have an upward trend.
[9] For more details see Dragota et al (2009b), p. 59 -60.
[10] Calculated on the basis of data from http://www.bvb.ro site.

eral market trend is down, good management involves identifying those stocks that are less sensitive to changes in market return.

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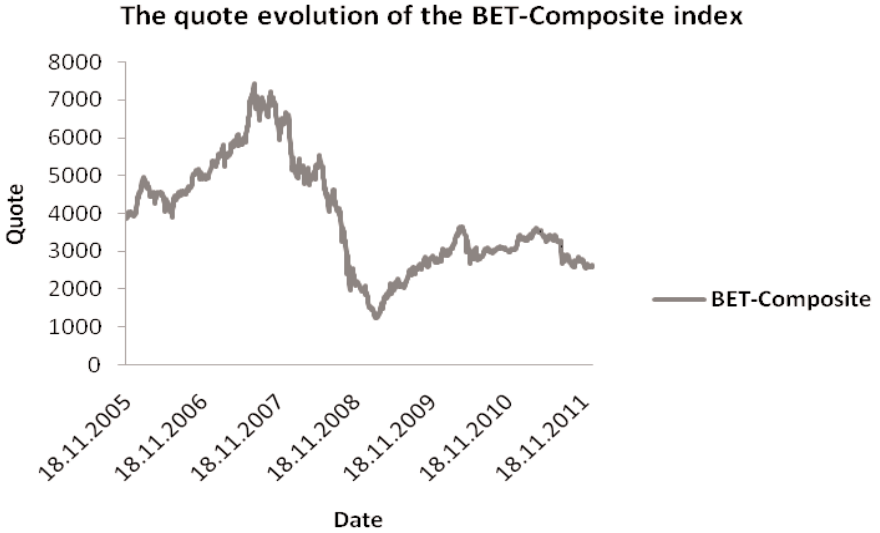
Appendix. The appendix presents the quote evolution of the BET-Composite index for the period 18.11.2005 - 30.12.2011, according to data from http://www.tranzactiibursiere.ro.



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