Obtaining a Practical Model for Estimating Stock Performance on an Emerging Market Using Logistic Regression Analysis

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Abstract

Having at their disposal information from different sources, investors should have the ability to identify the main factors which can affect the stock performance for making their decisions. The purpose of this study is to obtain a deterministic model with financial factors that estimates the probability that a company is performant on capital market. The target population is represented by companies listed on Bucharest Stock Exchange during 2007-2011. The research results were obtained using logistic regression analysis and show a significant and differential impact of financial ratios on the probability of a company to be performant on stock market.

Keywords: Stock Performance, Financial Ratios, Stock Market Ratios, Logistic Regression Analysis;

1. Introduction

The information offered to investors, regardless of its origin (financial statements and reports, macroeconomic indicators, companies’ or financial websites, news), represent a fundamental support in making investments decisions on a capital market. Due to the variety and multitude of existing information characteristic to the financial market and to the existence of information asymmetry, investors must prove they are able to decrypt and analyze the information provided when making decisions.

Mainly, on a capital market, the potential investors that make long-term placements are not interested in the size of the dividends distributed by a company, but in the capital gains yield by conservation of dividends and profit reinvestments (Mironiuc, 2006), thus determining an increase of the stock performance. For making the most appropriate investment decisions, in terms of performance on the capital market, the investors must use the best methods, techniques and tools, as well as all available information in the form of financial or non-financial factors.

The purpose of the present study is to obtain a deterministic model in order to estimate the probability that a firm is performant on a capital market (to have a positive variation of the stock price relative to a threshold), depending on a number of accounting or traditional factors or stock market factors.

The utility of the study is given by the use of the model in practice, by investors, for selecting those stocks that offer a high stock performance. In order to achieve this goal a sample was created and analyzed, sample consisting of firms listed at the Bucharest Stock Exchange (BSE) between 2007 and 2011. The statistical method used was the logistic regression analysis.

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2. Determinants of stock performance

Starting from the investors’ main objective regarding the increase of the market value of a company and stock return, they have searched for a way to accurately predict stock price and capital gains yield by using the technical analysis of time series, the multiple regression analysis (Kendall and Ord, 1990), the artificial neural networks (Baba and Kozaki, 1992), the fuzzy neural networks and the genetic algorithms (Kuo et al., 2001).

The use of these methods was performed using, as variables a series of qualitative factors, such as the effects of the political system or the investor’s psychology (Kuo et al., 2001), and quantitative factors like macroeconomic variables - money supply (Homa and Jaffee, 1971; Mookerjee and Yu, 1997), inflation rate (Chen et al., 1986; Fama, 1981), industrial production (Chen et al., 1986; Schwert, 1990), interest rate (Léon, 2008), or financial variables characteristic to each firm. These last variables are acquired from financial statements prepared according to the rules and regulations in force. Compliant to the requirements imposed by the law, especially for listed firms, the financial statements must offer all the information needed to satisfy the investors’ demands.

2.1. The importance of financial factors in determining stock performance

The financial information offered by the financial statements (traditional accounting ratios, cash flow ratios, or ratios concerning creating value for shareholders) are considered to be the main means of communication with investors. Moreover, specialists have tried to find the most important and significant ratios, with influence on stock performance, measured by changes in the price or by total stock return.

The connection between the information provided by the financial statements and stock price was proved ever since 1968 by Ball and Brown (1968). As regards to the influence of a rate detrimental to another, Chen and Dodd (1997) stated that, even though ratios concerning value creation offer more information than traditional ratios in explaining the overall performance of a stock, they must not replace traditional ratios such as Earnings Per Share (EPS), Return On Assets (ROA) or Return On Equity (ROE). Maditions et al. (2009) targeted in their study the same connection between stock return and ratios concerning creating value, respectively traditional ratios such as Return On Investments (ROI), ROE and EPS for the Athens Stock Exchange. The test results showed that there is a greater association between stock return and EPS than ratios concerning creating value.

ArabSalehi and Mahmoodi (2011) have analyzed the link between the Economic Value Added (EVA), as a ratio concerning value creation for shareholders, traditional accounting ratios and their capacity to explain stock return. They have concluded that ROA has the highest explanatory power concerning this return, followed by ROE and EPS. The relationship between the stock return and the traditional ratios is much stronger than compared to relation between return - EVA.

In addition to the past information provided by the financial statements, further studies have extended the research area to stock variables where the numerator is the price and the denominator is a financial value: Market – to – Book Ratio (M/B Ratio), Price-Earnings Ratio (P/E Ratio), Dividend Yield. Because each one of these ratios uses the price as numerator, the connection with the capital gains yield should be positive (Lewellen, 2004). The importance of P/E Ratio was analyzed by Basu (1977) who showed that firms with low P/E presented higher returns than firms with great P/E ratios. The M/B Ratio is considered to be one of the main determinants of stock performance for a company and, based on numerous studies, has proven to have a significant explanatory power on the stock return (Ruthenberg et al., 2011). Rosenberg et al. (1985) and Chan et al. (1991) used in their studies the inverse of this ratio (Book – to – Market Ratio - B/M Ratio) showing the existence of a direct and positive relationship with stock returns.

In addition, some authors have taken into account the influence of the beta coefficient on the stock return. Pettengill et al. (1995) state that the relationship between the two becomes significant only when the analyzed sample is divided in bull and bear markets.

As regards to Romania, perceived as an emerging economy, the studies considering the link between the performance criteria and their impact on creating value for shareholders are insufficient. Nevertheless, numerous authors have focused on analyzing theoretical studies on these criteria and on applying them on different firms.
3. Research methodology

The study aims at point estimation of the occurrence probability for stock performance status, calculated via capital gains yield, based on the analysis of financial factors. Thus, the research objective is the parameters estimation for a deterministic model used to identify the odds ratio between the incidence or not of a stock performance status.

Starting from a positivist approach and an inductive and deductive process, the article proposes to develop and test the following work hypothesis:

\[ H: \text{For firms listed at BSE, by aggregating certain financial ratios (traditional and stock ratios) in an econometric model, the estimation of the odds ratio for a firm to be performant or not in the stock market can be obtained.} \]

3.1. The studied population, extraction of analyzed sample, variables used and data source

The target population concerns the 79 firms listed at BSE, categories I, II and III, between 2008 and 2011. Out of this population, 11 firms are eliminated because they are financial intermediaries, monetary intermediaries, mutual funds and other financial entities, as well as 21 other firms, that were listed starting from 2008 but were eliminated from trading until 2011 or they do not offer financial information for the analysis. The final sample was constructed based on the principle of rational choice (Jaba, 2002) and it is comprised of 47 firms, out of which 12 are form the I\textsuperscript{st} category and 35 from the II\textsuperscript{nd} category.

The study variables are presented in Table 1.

| Variables                      | Formula                                         |
|--------------------------------|-------------------------------------------------|
| ROA - Return On Assets         | Operating Profit / Total Assets                  |
| ROE - Return On Equity         | Net Profit / Total Equity                        |
| NM - Net Margin Ratio          | Net Profit / Turnover                            |
| OCF/share - Operating Cash Flow Per Share | Operating Cash Flow / Number of Shares          |
| EPS - Earnings Per Share       | Net Profit / Number of Shares                    |
| DIVa - Dividend Per Share      | Dividends / Number of Shares                     |
| P/B - Price to Book Ratio      | Stock Price / Book Value Per Share               |
| P/E - Price-Earnings Ratio     | Stock Price / Earnings Per Share                 |
| DIVY - Dividend Yield          | Dividend / Stock Price                           |
| Beta - Beta Coefficient        | Covariance of Market Return with Stock Return / Variance of Market Return |

As regards to the beta coefficient, as a result of the inexistence of its historical information for 2008-2010, it was necessary to calculate it for all the firms in the sample and for every fiscal year taken into account. In terms of market return, the BET-C Index was chosen to illustrate the price evolution for all listed companies at BSE, categories I and II, except the Financial Investment Companies (FICs).

The data needed of the proposed variables were taken from the financial statements of the sample firms, found on the Romanian National Securities Commission website (www.cnvm.ro) and from the information presented on the BSE website (www.bvb.ro).

3.2. Data analysis method

For calculating the research results the study used the Logistic Regression Analysis (LRA), which employs regression models with alternative dependent variable (Robu, 2012), as follows:

\[ Y = a_0 + a_1X_1 + \ldots + a_jX_j + \ldots + a_mX_m + \varepsilon \]

\( (1) \)

with \( j = 1, \ldots, m \), where \( Y = 0 \) when the firm has stock performance and \( Y = 1 \) when the firms does not have stock performance, \( X_j \) being the factor variables, and \( a_j \) the model parameters.

The Logistic model is defined by the following equation:
Y = ln(p_i/(1-p_i)) = \alpha_0 + \alpha_1X_{i1} + ... + \alpha_jX_{ij} + ... + \alpha_mX_{mi} + \varepsilon_i \tag{2},

with i = 1,...,n \text{ and } j = 1,...,m.

Thus,

p_i/(1-p_i) = e^{\alpha_0 + \alpha_1X_{i1} + ... + \alpha_jX_{ij} + ... + \alpha_mX_{mi} + \varepsilon_i} = e^{\alpha_0} \cdot e^{\alpha_1X_{i1}} \cdot ... \cdot e^{\alpha_jX_{ij}} \cdot ... \cdot e^{\alpha_mX_{mi}} \cdot e^{\varepsilon_i} \tag{3},

where

\begin{align*}
p_i &= \text{probability that the firm } i \text{ is in difficulty}, \\
\alpha_0 &= \text{constant}, \\
\alpha_{i, j=1,..., m} &= \text{weighting coefficients}, \\
X_{i, j=1,..., m} &= \text{independent variables}, \\
\varepsilon_i &= \text{error}.
\end{align*}

Estimation of model parameters was performed using SPSS 19.0.

4. Results and discussion

When using the logistic regression analysis a number of steps are involved. The first one is to create an initial classification of the firms in the sample, based on capital gains yield, calculated as a ratio between the price at the end of the fiscal year and the price at the beginning of the fiscal year minus 1 unit. Thus, based on this ratio, three classifications emerge. The first one targets a yield bigger than 0, the second one a yield bigger then 0.50 and the third a yield bigger then 0.75.

The next step aims to create three categorical variables that can be equal to 0 (the return is below the set limits of 0, 0.50 or 0.75) or 1 (the return is over the set limits of 0, 0.50 or 0.75).

After processing the data in SPSS using the LRA, weighting coefficients for the three models are obtained (one model for each considered condition). These coefficients are presented in Table 2.

Table 2. Weighting coefficients for the three models

| Condition                        | Variables | B   | S.E. | Wald  | Sig.  | Exp(B) |
|----------------------------------|-----------|-----|------|-------|-------|--------|
| Capital gains yield > 0         | ROE       | 0.959 | 0.461 | 4.318 | 0.038 | 2.608  |
|                                  | P/B       | 0.502 | 0.244 | 4.234 | 0.040 | 1.652  |
|                                  | Constant  | -0.776 | 0.215 | 12.977 | 0.000 | 0.460  |
| Capital gains yield > 0.50      | Beta      | 1.094 | 0.623 | 3.087 | 0.079 | 2.987  |
|                                  | ROE       | 1.341 | 0.683 | 3.854 | 0.050 | 3.821  |
|                                  | P/B       | 0.648 | 0.338 | 6.684 | 0.055 | 1.912  |
|                                  | Constant  | -0.131 | 0.697 | 20.160 | 0.000 | 0.444  |
| Capital gains yield > 0.75      | Beta      | 1.998 | 0.829 | 5.802 | 0.016 | 7.372  |
|                                  | Constant  | -4.147 | 0.900 | 21.223 | 0.000 | 0.016  |

The first model aims to estimate the odds ratio regarding the existence of stock performance, taking into account 0 as the limit value. Thus, the most significant variables that determine this ratio are ROE and P/B, the model being:

Y_0 = 0.959ROE + 0.502P/B - 0.776 \tag{4}

or

p/(1-p) = e^{0.959ROE} \cdot e^{0.502P/B} \cdot e^{-0.776} \tag{5}.

With a 90% degree of confidence a 1% increase of ROE determines increase of the odds ratio for a firm to have a stock performance with 160.8%. P/B has the same positive influence, causing an increase for the ratio of 65.2%.

The second model estimates the odds ratio regarding stock performance, expressed by the increasing in the capital gains yield with 50%. The model has the following form:

Y_{0.50} = 1.094Beta + 1.341ROE + 0.648P/B - 0.131 \tag{6}

or

p/(1-p) = e^{1.094Beta} \cdot e^{1.341ROE} \cdot e^{0.648P/B} \cdot e^{-0.131} \tag{7}.

The third model represents the estimation of the odds ratio concerning the increasing in the capital gains yield with 75%. Thus, the model variables are:

\[ Y_{0.70} = 1.998\beta - 4.147 \] (8)

or

\[ \frac{p}{1-p} = e^{1.998\beta} \frac{1}{e^{-4.147}} \] (9).

According to the first two models, ROE has the biggest influence on the capital gains yield, on the stock performance, shareholders being interested more in the managers’ capabilities to maximize returns on the capital entrusted to manage. Of significant importance is the high value of this coefficient who shows the objectives of the minority shareholders (immediate return in form of dividends), as well as the objectives of the controlling shareholders, who are interested in a rate of self-financing to increase the company value. The P/B ratios shows the stock price related to the net assets per share or the market capitalization to net assets and it illustrates investors’ concern for undervaluation or overvaluation of stocks, in order to know exactly when to buy or when to sell a stock. A higher value for this indicator will imply the probability that a firm will have a positive value or a value higher than 0.50 of the capital gains yield.

Out of the variables comprising the third model, the only one that shows the difference between firms with a capital gains yield higher or lower than 0.75 is the Beta, found also in the second model. Therefore, the high value of this coefficient indicates the investors’ interest in this particular coefficient. The investors are not interested only in a positive stock return, but also in a return higher than the market return. Nonetheless, this variable shows the degree of risk and volatility associated with a stock that has a superior return (if the stock return can increase, so can the degree of risk and stock sensitiveness related to the current economic situation). According to the model, investors are not directly interested in financial results obtained via the financial statements, but indirectly, through the Beta coefficient that include this information, in addition to information provided by other sources.

5. Conclusions

The model results validate the work hypothesis regarding the odds ratio for a firm to be performant or not on the stock market, by aggregating certain financial ratios (traditional and stock ratios), for firms listed at BSE. The probability has values in the range \([0; 1]\). Thus, out of the 10 considered variables, the most significant are ROE, P/B and Beta because they have a positive influence on the odds ratios. These variables have also showed the importance and the impact that traditional return variables, acquired from financial statements, have on stock price and on capital gains yield. Furthermore, the link between the price and the financial information expressed by the P/B ratio is considered to be significant. In addition, investors do not take into account just the evolution of a single firm, based on the financial or stock ratios, but also the financial market evolution expressed by the Beta coefficient. This situation can be supported by the impact that a firm’s bankruptcy has (especially the ones listed in the first categories) on the economy.

The utility of the study is provided by the ability to identify the determinants of stock performance, thus offering to investors good information.

The limits of the study are the small number of firms listed at BSE, which had stock traded between 2008 and 2011, and also not taking into account others financial determinants that show the liquidity or solvency of the company, non-financial and macroeconomic determinants. The future research directions aim to eliminate these limits.

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