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# Do Financial Ratios Affect Stock Returns in the Athens Stock Exchange?[1]

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## Summary

This study examines whether selected financial ratios can be used to explain stock price movement in the Athens stock exchange (ASE) for the period between 2005 and 2014. Information about potential driving factors of stock returns can be useful to capital market analysts and investors when trying to predict stock price movements and also to the managers of the underlying companies when they are planning their strategies. The financial ratios selected are the return on equity, the net profit margin, the assets turnover ratio, the assets to equity ratio, the current ratio and the dividend payout ratio. The empirical results of our study showed that during the examined period a statistically significant relation was not in generally observed between stock returns and the examined ratios. This was also the case when the periods from 2005 to 2009 and from 2010 to 2014 were examined separately. Only the return on equity was found to be significant for the overall period, as well as for the period from 2010 to 2014. Opposite to what we expected, the ROE coefficient was found to be negatively related to stock returns.

**Key words**: financial ratios, stock prices
**JEL classification**: G30, G39

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## 1. INTRODUCTION

The issue of stock prices predictability has been examined for long both by academics and professionals involved in capital markets and various theories on the subject have been developed. A number of empirical studies have tried to examine the power of finance-related information, mainly in the form of ratios, to predict stock returns. These studies focus on particular stock exchanges in developed and developing economies but little research has been carried out for the Athens stock exchange. So, this study focuses on the latter. However, the empirical results regarding the relation between financial ratios and stock returns are not consistent in the literature and there is no universal conclusion regarding the explanatory power of financial ratios on the stock prices and returns.

The objective of this study is to examine whether there is a significant relation between a firm's accounting related information, which is made publicly available, with its stock returns in the Athens stock exchange.

For this purpose, this paper is structured as follows: the next section discusses the main studies of the related literature. The third section presents the data, the testable hypotheses and the methodology. The fourth section depicts and analyses the results. The final section contains a summary, limitations and conclusions as well as suggestions for further research.

## 2. REVIEW OF LITERATURE

Martikainen (1989) examined the relation between financial ratios and stocks' behavior in the Finnish Stock Exchange. The sample

consisted of 26 firms listed on the Finland stock exchange, apart from financial firms and covered the period from 1974 to 1986. The study examined the relationship between 12 financial ratios and three variables: a) stock price, b) stock return and c) risk measured by the variance in the stock returns. He found that, in general, high profitability ratios and low financial leverage ratios were positively related with stock prices and returns. There seemed to be no relation between the above dependent variables and growth ratios. When examining the relationship of stocks' total risk to the financial ratios, profitability and growth ratios were found to be significant in explaining the risk, while operating leverage ratios were not found to be significant. From the financial leverage group of ratios, equity to invested capital and debt to sales were found to be significantly related to risk.

Chan, Hamao and Lakonishok (1991) examined the relation between expected stock returns and four fundamental variables in the Japanese stock market. Their sample consisted of firms listed on the Tokyo stock exchange and covered a period from 1971 to 1988. The authors found that the book to market ratio had the most statistically significant positive relation with stock returns and that there was also a statistically significant positive relation between returns and cash yield. Regarding the relation between stock returns and size, the study showed a negative relation between them, but the significance of this relation was found to be highly dependent on the model used to predict the relation. The study showed contradictory results regarding the explanatory role of the earnings yield ratio. When this variable was examined in isolation, a significant positive relation existed between stock returns and the variable.

Fama and French (1992) examined the role of ratios deriving from financial statements coupled with market data in explaining average stock returns for the USA market and covered the period from 1963 to 1990. They found that there was not a significant positive relation between stocks' market β estimates and average stock returns during the examined period, unlike to what is stated by the CAPM equation. The study showed a statistically significant relation between earnings to price ratio and stock returns. "Market leverage" was found to be positively related to returns, whereas "book leverage" was found to be negatively related to returns. The study showed that the firms' size and the book to market ratio were the most significant variables in explaining variations in the average stock returns, with the size being negatively related with stock returns and the book to market ratio positively related.

Abarbanell and Bushee (1997) examined the relation between fundamental signals and cumulative abnormal (excess) stock returns compounded over a 13-month period. Monthly excess returns were estimated using the same model with that of Lev and Thiagarajan (1993). Their analysis showed that gross profit margin change, S&A expenses change, effective tax rate change and inventory change signals were significant in predicting excess returns. The audit qualification, earnings quality, accounts receivable change, capital expenditure change and labor force change variables were insignificant in explaining them. Furthermore, Abarbanell and Bushee (1997) carried out a contextual analysis and found that the macroeconomic developments had, in general, little effect on the explanatory power of the examined fundamental signals.

Dhatt, Kim and Mukherji (1999) examined the relation between financial ratios and stock returns in the Korean stock market. The sample consisted of firms listed on the Korean stock exchange, apart from financial firms and covered the period from 1982 to 1992. The results showed that the book to market ratio had the higher explanatory power regarding stock returns among the examined ratios.

Bagella, Becchetti and Carpentieri (2000) examined whether investment strategies based on the size and value of firms (S&V strategies) yielded excess returns. Their

sample consisted of firms listed on the London stock exchange and covered the period from July 1971 to June 1997. They found that there was a negative relation between the four examined variables and the mean monthly returns. Namely, they found that the returns of portfolios with low EPS, ROE, MV and MTBV were higher than those with high values of these variables and that they outperformed the returns yielded by the index. They named these portfolios as "successful portfolios". They also examined whether the excess returns of successful portfolios were still significant when risk was taken into account and found that excess returns of successful portfolios were not explained by higher risk.

Lewellen (2004) examined the relation between three financial ratios and monthly stock returns equally weighted and value weighted based on NYSE index. The ratio values was estimated monthly and weighted based on the monthly level of the NYSE index. The author found that dividend yield had the most significant positive relation with both equally and value weighted returns during the whole examined period. He found that, in general, book to market ratio and earnings to price ratio have limited explanatory power compared to dividend yield. For the period from 1995 to 2000, the author observed that the relationship between returns and explanatory variables were opposite to the expected one. While a positive relation was generally expected between any of the above three ratios and the expected returns, in this period, dividend yields for example, had been reduced, whereas the value weighted index was almost doubled. Nevertheless, this opposite relation affected the explanatory power of book to market and earnings to price ratios, but did not impair in total that of the dividend yield.

Turk (2006) examined the relation between financial ratios and short term stock performance. For a sample of 50 firms he examined the relation between stock price change (from end of June to end of September 2005) and the change during the same period in the following ratios: cash ratio, measured as total cash divided by total assets, inventory turnover ratio, P/E ratio and the dividend payout ratio, measured as total dividends divided by net income. A positive relationship was expected between the change in each of the above ratios and the change in the stock returns. He found that, opposite to what expected, almost none of the above variables was statistically significant in predicting stock returns. Statistically significant variables (i.e., inventory turnover ratio and dividend payout ratio) had unexpected negative coefficients with stock price change.

Naïmy (2008) examined the relation between stock prices and financial ratios of firms listed on the NYSE and on the Dubai Financial Market. The author selected two samples of firms operating in the same sectors (i.e., Banking, Insurance and Real Estate), one for the NYSE and one for the Dubai Financial Market, in order to see whether the same relations existed between stock prices and financial ratios in both markets. 19 firms were included in the sample from NYSE and 15 firms in the sample from the Dubai Financial Market. The period covered was from 2001 to 2005. He found that there was no statistically significant relation between the financial ratios and the stock prices of firms listed in the Dubai Financial Market. Regarding the sample from the NYSE firms, statistically significant relations were found for the following variables: liability to equity, debt ratio and the total assets turnover ratio.

Alexakis, Patra and Poshakwale (2010) examined the predictability of stock returns and the probability of achieving excess (or above the average) returns using accounting information. They examined whether a semi-strong form of efficient market hypothesis was present at the Athens stock exchange, by exploiting whether financial ratios could support investment strategies that would lead to excess returns. The sample consisted of 47 firms listed on the Athens stock exchange

and the period covered was from 1993 to 2006. The sample period was divided into three sub-periods 1993-2003, 1993-2004 and 1993-2005, to accommodate for "bull" and "bear" periods that were observed in the stock market. They found that the operating profit margin, the return on equity, the assets turnover ratio and the current ratio were statistically significant and positively related to stock returns in all three examined sub-periods. The debt to equity ratio, the P/E ratio and the price to book ratio were found to be significant and negatively related to stock returns in all examined periods. Finally, the variables net profit margin, return on assets and debt ratio were not found significant in explaining the stock returns.

Kheradyar, Ibrahim and Mat Nor (2011) examined whether three specific financial ratios can be used to predict stock returns. The study concerned a sample of firms listed on the Malaysia stock exchange and covered the period from 2000 to 2009. The examined financial ratios were: dividend yield, earnings yield, book to market ratio. The authors found that all three ratios were significantly positively related to stock returns for both samples, with the book to market ratio having the highest explanatory power.

Dzikevicious and Saranda (2011) examined the relation between financial ratios and stock returns in the Lithuanian stock market. The study examined the correlations between selected financial ratios and stock returns and between the selected financial ratios and risk measured by the standard deviation of the firms' profitability. The sample consisted of firms listed on the official Baltic equity list and covered the period from 2007 to 2010. They examined twenty financial ratios. Their analysis showed that the relationship between the financial ratios and stock returns was not as high as expected (i.e., well below |0.9| in most cases). Similar results were observed for the relationship between the financial ratios and risk.

Goslin, Chai and Gunasekarage (2012) examined whether an investment strategy can be built to earn stock returns in excess of a market index. Their sample consisted of firms listed on the New Zealand stock exchange and the investigation covered the period from 1995 to 2006. Under the "indirect approach" (expressed by EPS change), they found 5 variables, out of 54 considered, to be statistically significant in predicting a year ahead earnings change. These were: the change in current ratio, the change in quick ratio, the return on total assets ratio, the pre-tax income to sales ratio, the sales to inventory ratio. Under the "direct approach" (one year return by compounding monthly returns), 9 variables out of the 54 examined were found to be significant in predicting future stock return direction. These were: the change in sales, the change in depreciation, the return on opening equity, the lag of change in capital expenditure to total assets, the return on closing equity, the pre-tax income to sales ratio, the sales to inventory ratio, the operating income to total assets ratio and the change in operating income to total assets.

Muhammad and Scrimgeour (2014) examined the relation between firms' fundamental ratios and their stocks returns. Their sample consisted of firms listed on the Australian Securities Exchange and more specifically on the ASX 200 index and covered the period from 2001 to 2010. They found that regarding the accounting based variables, only the return on assets was statistically significant in explaining stock returns under all models used and its relation to returns was positive. The following ratios were found to be statistically significant in explaining stock returns in some models, whereas not in others: a) the dividend payout ratio, with a negative relation to stock returns, b) the earnings per share, with a positive relation. Return on equity and free cash flows found to be insignificant in explaining stock returns. The authors found that regarding the market based variables, only the market to book ratio was statistically significant in explaining stock returns under all models and had a positive

relation to stock returns. The following ratios were found to be statistically significant in explaining stock returns in some models, whereas not in others: a) the price to earnings ratio, with a positive relation to returns, b) the Tobin's Q, with a positive relation, c) the cash flow return on investment, with a positive relation. The MVA found to be insignificant in explaining stock returns. Based on the above findings Muhammad and Scrimgeour (2014) concluded that market based performance ratios better explained stock returns than accounting based ones.

Petcharabul and Romprasert (2014) examined the relation between stock returns and financial ratios in the technology industry, using a sample of technology firms listed on the Thailand stock exchange. The study covered the period from 1997 to 2011. They found that there was a statistically significant positive relation between quarterly stock returns and the following ratios: the return on equity and the price to earnings ratio, with the return on equity having higher explanatory power than the price to earnings. Furthermore, they found that there was not a significant relation between stock returns and the current ratio, the inventory turnover ratio and the debt to equity ratio.

Talebian and Daghbandan (2015) examined the relation between financial ratios and the economic performance of firms listed on the Tehran stock exchange. The sample included the firms from all sectors, apart from the financial one and covered the period from 2009 to 2014. In order to estimate the economic performance of firms, the authors used Q-Tobin ratio, measured as the sum of market value of stocks and the book value of debt divided by the book value of firms' assets. They examined the relationship between the firm's performance, as stated above, with the following financial ratios: current ratio, leverage ratio, measured as total debt divided by total assets, assets turnover ratio, profitability ratio, measured as net profit over total assets. They found that all the examined variables were significant in explaining the economic performance of firms. They found there was a positive relation between the current ratio, the assets turnover ratio, the profitability ratio and the firms' economic performance. The relation between economic performance and the leverage ratio was found to be negative.

Trejo-Pech, Noguera and White (2015) examined the relation between financial ratios most preferred by equity analysts in Mexico and stock returns. The sample consisted of firms listed on the Mexican stock exchange, and more specifically from firms constituting the Mexican Stock Exchange (MSE) index, apart from financial ones, and covered the period from 1995 to 2011. Their results indicated that all examined variables were statistically significant in explaining one year ahead stock returns. The firm value to EBITDA, the dividend yield and the free cash flows yield were found to be negatively related to stock returns. The following ratios were found to have a positive relation to stock returns: a) the EBITDA margin, b) the return on investment, c) the net debt to equity ratio, d) the growth in earnings per share and e) the growth in sales. Finally, the authors found that the predictive power of the examined variables was lost when the two years ahead stock returns were considered.

Based on the pertinent literature, we observe that there is not an obvious, unanimous and conclusive relation associating firms' financial ratios, with the prediction or explanation of the firms' performance measured in terms of stock returns. Therefore, it is necessary to undertake further research so this paper attempts to cover this aspect to an extent.

## 3. DATA, TESTABLE HYPOTHESES AND METHODOLOGY

### 3.1. Data

A sample of 43 firms listed on the Athens Stock Exchange (ASE) was selected for the purposes of this study. The sample included

43 firms out of the 60 composing the ASE Composite Index (General index) at the end of 2014. The Composite Index is considered representative of the general activity of the ASE and for this reason the sample of firms was taken from this index, as was the case for the selection of the sample in the study of Trejo-Pech, Noguera and White (2015). To be included in the sample, a firm must have at least three years of listing in the ASE, a fiscal year ending in December and must not operate in particular sectors. Firms excluded from the sample mainly concern financial institutions (e.g., credit institutions, insurance firms), holding firms, specialized Real Estate Investment firms and firms with less than three years of listing, i.e., date of listing after 31.12.2011. Also one company with fiscal year ending in June was excluded from the sample.

In order to determine the timeframe of data included in the examined sample the following was taken into consideration. According to the article 25 of the Law 2190/1920, the general annual shareholders meeting of a firm must be held within 6 months after the end of the firm's fiscal year. According to the article 43b of the Law 2190/1920, the firm's Board must publish the annual financial statements at least 20 days before the date of the general annual shareholders meeting. According to the article 4 of the Law 3556/30.04.2007, listed firms are required to make their annual financial reports publicly available within 3 months from the end of the respective fiscal year and the annual report should include the firm's audited financial statements. The sample of firms showed that financial statements were authorized throughout the 6 month period after the fiscal yearend of December.

To be included in the sample, the firms' financial statements of each fiscal year should have been made publicly available until the end of June, after the December yearend. The date of the authorization of the financial statements by the Board had been used as the indicator of the time of their public release. Therefore, cases of financial statements with authorization date after the end of June were excluded from the sample. Also, when trade in a firm's stock was suspended within the period used for the calculation of stock returns, the respective observation was removed from the sample.

The sample covered the fiscal years from the end of December, 2005 until the end of December, 2014. The respective financial ratios for this ten-year period were calculated by the yearend financial statements. Quarterly stock returns were calculated each year for a 3-month period (i.e., based on the returns of April, May and June) from 2006 to 2015. The above initially led to an estimated sample of 430 observations (i.e., 43 firms for 10 years). Since 3 out of the 43 firms were listed in 2007, there were no observations for these firms in the sample for Y/E 2006 and 2005. This reduced the sample from 430 to 424 cases. Trading in a firm's shares was suspended in 2008. The respective case was also removed from the sample. Finally, a firm had not its financial statements for the Y/E 2006 authorized in time and the respective case was removed from the sample. As a result of the above, the sample contained 422 observations.

Especially for the dividend payout ratio, 359 observations were used when examining its relation to stock returns, instead of 422, because 44 cases of DPS were not found in the financial statements and were excluded as well as 19 cases, where the reported DPS exceeded EPS. The dividend in these cases was paid out of the accumulated profits, or other firm's reserves, whether explicitly stated in the financial statements or not. As it is mentioned below in the sub-section regarding the calculation of the selected financial ratios, dividends deriving from the current year's net profit were used in the dividend payout ratio.

In summary, the data necessary for the study were: data for the calculation of the stock returns, including dividend payments; data for the calculation of the financial ratios; dates of firms' listing; dates of suspension in stocks trading; financial statement

authorization dates. The data about the stock returns, the declared dividends and the ex-dividend dates, were taken from the monthly statistical bulletins of the ASE, which are published on its websites (helex.gr and ase.gr). Data used in the calculation of the firms' financial ratios were taken from the firms' annual reports. Concise financial statements had been supplementary used in case of information not found in the annual reports (mainly for cases of reported dividend per share). The annual reports were retrieved from the websites of the ASE and in two cases the financial statements were retrieved from the websites of the respective firms. The dates of the firms listing were retrieved from the ASE websites. Information about the suspension of trading in a firm's stock was taken from the monthly statistical bulletins of the ASE.. The authorization dates of the financial statements were retrieved from their annual reports. The data was manually typed and then processed in Excel. The statistical analysis on our data was performed in SPSS and Excel was used complementarily. Figures used in data analysis are expressed in percentages.

### 3.2. Methodology and Testable Hypotheses

#### *3.2.1. Selection of financial ratios to be examined*

The relation between stock returns and the following six financial ratios was examined: return on (common) equity (ROE), net profit margin, assets turnover ratio, leverage ratio (or assets to equity ratio), current ratio and dividend payout ratio.

The study primarily examined the relation of ROE to stock returns. Alternatively, the study went further to examine the relation of ROE constituent ratios, i.e., a profitability ratio (net profit margin), an activity ratio (assets turnover) and a leverage ratio (the equity multiplier), to stock returns. After the examination of the relation between the above financial ratios and stock returns, two additional ratios, one from the category of the liquidity ratios (the current ratio) and one from the category of the market ratios (the dividend payout ratio) were examined. The focus on ROE is due to its significance in the valuation of stocks, as defined both by the "earnings multiplier approach" and the "present value approach". (Vasiliou, 2005). So, a positive relation is expected to exist between stock returns and the examined ROE constituent ratios, i.e., the net profit margin, the assets turnover ratio and the assets to equity ratio (leverage ratio).

The relation between stock returns and the current ratio is expected to be positive, though this is not absolute and unconditional. A high current ratio is an indication of a sound liquidity position of the firm, whereas a low ratio and especially one below the unit (1) is an indication of possible serious liquidity problems, though this is not always the case. For example, a firm holding a considerable amount of highly liquid non-current assets, such as tradable debentures may not face liquidity problems. On the other hand, a very high current ratio may exhibit ineffective working capital management, with long term funds being invested in current assets. Alexakis, Patra and Poshakwale (2010) found a positive relation of the current ratio and the stock returns. Talebian and Daghbandan (2015) also found a positive relation between this ratio and the firm's performance. Dzikevicious and Saranda (2011) and Petcharabul and Romprasert (2014) found no significant relation between the current ratio and the stock returns.

Regarding the relation between stock returns and the dividend payout ratio, again a clear, definite prediction about the direction of the relation cannot be given. This ratio reveals the dividend policy of the company and the level of profit that is reinvested to finance growth and for this reason the reinvestment ratio is defined as the dividend payout ratio. To this end, controversial theories have been developed regarding the right dividend policy, as it was called the "dividend puzzle" by Black

(1976), but this is beyond the scope of this study. We can say that the favorable value for this ratio is subject to a great extent to the type of investors involved. For example, investors such as insurance firms may prefer a steady flow of cash from dividends in order to pay insurance claims and other benefits to their clients, whereas other investors may favor the reinvestment of profits and the benefit from increased capital gains from the future sale of stocks. Therefore, the perceived favorable value of this ratio by the investors is somehow subjective. Turk (2006) found a negative relation between stock returns and the dividend payout ratio. Muhammad and Scrimgeour (2014) also found in some models used in their study a significant negative relation between stock returns and the dividend payout ratio.

The selected financial ratios were calculated from accounting data retrieved from the firms' financial statements. Where averages are mentioned in the calculation of ratios, namely in the denominator, these refer to the average value of the respective item based on its value at the beginning and at the end of the accounting period.

For the calculation of the return on equity the following formula was used:

$$ROE = \frac{\text{Net profit after tax - Preference dividend}}{\text{Average common equity}} \quad (1)$$

Profit concerns that from continuing activities, excluding profit from discontinued operations. Common equity was calculated as common equity minus treasury stocks (i.e., common equity stocks held by the firm, as presented on the Balance Sheet). For the calculation of the net profit margin the following formula was used:

$$\text{Net profit margin} = \frac{\text{Net profit after tax – Preference dividend}}{\text{Sales}} \quad (2)$$

For the calculation of the assets turnover ratio the following formula was used:

$$\text{Assets turnover} = \frac{\text{Sales}}{\text{Average total assets}} \quad (3)$$

For the calculation of the assets to equity ratio the following formula was used:

$$\text{Assets to equity} = \frac{\text{Average total assets}}{\text{Average common equity}} \quad (4)$$

For the calculation of the current ratio the following formula was used:

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Short term liabilities}} \quad (5)$$

"Non-current assets held for sale" and/or "discontinued operations", together with any associated liabilities, were treated as current assets and short term liabilities and were included in the ratio. The sale or disposal of such type of assets is expected to be completed within one year from the date of classification in this asset category.

For the calculation of the dividend payout ratio the following formula was used:

$$\text{Dividend payout ratio} = \frac{\text{Cash dividends per share (DPS)}}{\text{Earnings per share (EPS)}} \quad (6)$$

The reported basic EPS was used in the calculation of this ratio. Where basic EPS was not stated in the financial statements this was calculated as follows:

$$\text{Basic EPS} = (\text{Net profit after tax} - \text{preference dividends for the period}) / \text{Weighted average number of outstanding ordinary shares during the accounting period.} \quad (7)$$

Stock returns were calculated using the monthly price changes of April, May and June of each year and also any declared dividend, on the condition that the ex-dividend date was within this 3-month period. A time lag of 3 months after the regulatory deadline for the public release of financial statements was used, in order to ensure that the necessary information was publicly available and processed. This approach is similar to the one followed by Alexakis, Patra and Poshakwale (2010) where a six month lag after the fiscal yearend of December was used. The following formula was used to calculate stock returns:

$$Stock\ return = Monthly\ stock\ price\ change\ of\ April \times \times Monthly\ price\ change\ of\ May \times \times Monthly\ price\ change\ of\ June + + \frac{Dividend\ declared}{End\ of\ March\ closing\ price\ of\ stock} \quad (8)$$

The monthly stock price change, which is stated in the ASE monthly statistical bulletin, incorporates the effect of corporate actions on the stock price. As stated in the ASE bulletins, the monthly price change (mΔP) is estimated based on the following formula:

$$m\triangle P = \frac{(\text{Closing price of the stock at the end of the month - adjusted price at the end of the previous month})}{\text{Adjusted price at the end of the previous month}} \times 100 \quad (9)$$

The adjusted stock price (Pa) referred to in Formula/model 9, in general is estimated as a function of the historical stock price and an adjustment coefficient, mathematically:

$$Adjusted\ stock\ price = = f\ (Historical\ closing\ price,\ Adjustment\ coefficient\ ) \quad (10)$$

Following a corporate action, like the 15 actions/cases reported in the Appendix, an appropriate adjustment is made to the firm's stock price ($P_0$) before the corporate action and we get the adjusted stock price, ($P_a$). This is done in general by multiplying the historical price ($P_o$) with a fixed adjustment coefficient, which differs depending on the corporate action.

As stated in the ASE monthly statistical bulletins, the adjustment coefficient is estimated as a function of the following:

*Adjustment coefficient = f [Historical stock price before the action (Po), closing price on the day of realization of the share capital change due to the corporate action ($P_y$), the number of stocks before the capital issue ($N_o$), the number of new stocks from the corporate action ($N_y$)].* (11)

The adjustments made to the closing price of a stock, before the realization of the share capital change, are differentiated according to the type of the corporate action. For more information, one may refer to the decision No. 26/17.7.2008 of the Board of Directors of the ASE. The more usually occurred types of corporate actions and their adjustments on the stock price are presented in the Appendix, at the end of the paper, as prescribed in the ASE decision mentioned above.

### 3.2.2. Models and Testable Hypotheses and Data Analysis

In order to examine whether a statistically significant relation exists between the stock returns and the selected financial ratios we used the Least Squares method (OLS). After identifying and removing potential outliers, univariate and multivariate regression models were carried out. The general regression equation can be expressed as follows:

$$Y_i = b_0 + b_i X_i + e_i \quad (12)$$

Where,

$Y_i$ is the value of the stock return (dependent variable),

$b_0$ is the constant coefficient (i.e., the intercept of the regression line with the y-axis),

$b_i$ is the regression coefficient for the variable $X_i$,

$X_i$ is the value of the financial ratio (independent variable),

$e_i$ is the error term, from the fitted Yi against the actual ones, with the assumption that $e_i \sim N(0, \sigma^2_\varepsilon)$ for every price of X.

The testable hypotheses are:

Null hypothesis (H0): Stock returns and financial ratios are expected to be independent of each other. In this case $b_i = 0$

Alternative hypotheses: There is expected to be a dependence between the stock returns and the financial ratios. In this case $b_i \neq 0$ and more specifically:

H1: Stock return is expected to be dependent on the return on equity ratio.

H2: Stock return is expected to be dependent on the net profit margin.

H3: Stock return is expected to be dependent on the assets turnover ratio.

H4: Stock return is expected to be dependent on the assets to equity ratio.

H5: Stock return is expected to be dependent on the current ratio.

H6: Stock return is expected to be dependent on the dividend payout ratio.

The following models will be analyzed:

$$\textbf{Model 1: } R_{it'} = b_0 + b_i\, ROE_{it} + e_{it} \quad (13)$$

Where,

$R_{it'}$ is the stock return of the firm i in the period t', with t' concerning the period from the end of March to the end of June,

$ROE_{it}$ is the return on equity of the firm i in the period t,

i = 1, 2, …, 43 and t = 1, 2, …, 10.

$$\textbf{Model 2: } R_{it'} = b_0 + b_i\, Profit\ Margin_{it} + b_i\, Assets\ Turnover_{it} + b_i\, Leverage_{it} + e_{it} \quad (14)$$

Where,

$R_{it'}$ is the stock return of the firm i in the period t', with t' concerning the period from the end of March to the end of June,

$Profit\ Margin_{it}$ is the net profit margin of the firm i in the period t,

$Assets\ Turnover_{it}$ is the assets turnover ratio of the firm i in the period t,

$Leverage_{it}$ is the assets to equity ratio of the firm i in the period t,

i = 1, 2, …, 43 and t = 1, 2, …, 10.

$$\textbf{Model 3: } R_{it'} = b_0 + b_i\, Profit\ Margin_{it} + b_i\, Assets\ Turnover_{it} + b_i\, Leverage_{it} + b_i\, Current_{it} + e_{it} \quad (15)$$

Where,

$R_{it'}$ is the stock return of the firm i in the period t', with t' concerning the period from the end of March to the end of June,

$Profit\ Margin_{it}$ is the net profit margin of the firm i in the period t,

$Assets\ Turnover_{it}$ is the assets turnover ratio of the firm i in the period t,

$Leverage_{it}$ is the assets to equity ratio of the firm i in the period t,

$Current_{it}$ is the current ratio of the firm i in the period t,

i = 1, 2, …, 43 and t = 1, 2, …, 10.

$$\textbf{Model 4: } R_{it'} = b_0 + b_i\, Profit\ Margin_{it} + b_i\, Assets\ Turnover_{it} + b_i\, Leverage_{it} + b_i\, Current_{it} + b_i\, Payout_{it} + e_{it} \quad (16)$$

Where,

$R_{it'}$ is the stock return of the firm i in the period t', with t' concerning the period from the end of March to the end of June,

$Profit\ Margin_{it}$ is the net profit margin of the firm i in the period t,

$Assets\ Turnover_{it}$ is the assets turnover ratio of the firm i in the period t,

$Leverage_{it}$ is the assets to equity ratio of the firm i in the period t,

$Current_{it}$ is the current ratio of the firm i in the period t,

$Payout_{it}$ is the dividend payout ratio of the firm i in the period t,

i = 1, 2, …, 43 and t = 1, 2, …, 10.

In order to proceed with the linear regression analyses we first estimated the Pearson's correlation coefficients between the dependent variable (i.e., the stock returns) and each of the independent variables (i.e., the selected financial ratios) to see whether a significant linear relationship exists between them. In case no significant correlations are observed then, instead of using simple linear regression analysis, the multiplicative model was used to examine whether a significant non-linear relation exists between the dependent variable and the independent variables. We identified and removed extreme values from the independent variables datasets, which could obscure the analysis (i.e., outliers).

## 4. ANALYSIS OF RESULTS

The Table 1 below summarizes the descriptive statistics of the dependent and the independent variables after the removal of outliers. We see that the degree of skewness is within ±2 for all variables. Based on the central limit theorem, as the sample size consists of

well above 30 cases (Kavussanos, 2005), we can say that the data are normally distributed, irrespective of the type of distribution of the population of the variables.

**Table 1:** *Descriptive Statistics of the variables (Figures are expressed in percentage)*

| | | RETURN | ROE | PROFIT MARGIN | ASSETS TURNOVER | LEVERAGE | CURRENT | PAYOUT |
|---|---|---|---|---|---|---|---|---|
| n | Valid | 422 | 409 | 380 | 402 | 418 | 405 | 359 |
| | Missing | 0 | 13 | 42 | 20 | 4 | 17 | 63 |
| Mean | | 3.224 | 5.549 | 5.196 | 53.293 | 215.255 | 180.401 | 28.703 |
| Median | | -.528 | 4.337 | 5.302 | 43.198 | 191.581 | 146.150 | 31.25 |
| Std. Deviation | | 26.821 | 12.537 | 11.901 | 42.436 | 89.41 | 119.05 | 30.216 |
| Minimum | | -49.40 | -28.76 | -35.32 | .00 | 67.69 | 9.49 | .00 |
| Maximum | | 182.37 | 49.25 | 46.96 | 234.28 | 559.02 | 618.60 | 100.00 |
| Skewness | | 1.888 | .616 | -.158 | 1.423 | 1.181 | 1.59 | .673 |

In order to check the existence of multicolinearity, the Pearson's coefficients of correlation between the independent variables used in the multivariate regression equations were estimated and are depicted in Table 2. As presented in Table 2, though some correlation coefficients are significantly different from zero, based on the estimated p-values, weak correlations exist among the independent variables, well below 0.7, with the highest one being between the net profit margin and the dividend payout ratio (0.383). Therefore, the independent variables used in the multivariate analysis might not be linearly related.

**Table 2:** *Correlation matrix between the independent variables*

| | Assets turnover | | LEVERAGE | | Current | | PAYOUT | |
|---|---|---|---|---|---|---|---|---|
| | Pearson correlation | Sig. (2-tailed) | Pearson correlation | Sig. (2-tailed) | Pearson correlation | Sig. (2-tailed) | Pearson correlation | Sig. (2-tailed) |
| PRofit margin | .054 | .310 | -.269* | .000 | .261* | .000 | .383* | .000 |
| Assets turnover | | | .213* | .000 | .037 | .466 | .187* | .000 |
| LEVERAGE | | | | | -.256* | .000 | .017 | .755 |
| Current | | | | | | | .062 | .249 |

** Denotes significance at the 1% level of a two tailed test.*

We also examined whether a linear relationship existed between the dependent and the independent variables based on the Pearson's correlation coefficients, whereby the results are presented in Table 3.

Based on the correlation coefficients in Table 3 and the estimated p-values for these coefficients, which range from 0.294 to 0.884, there was not any evidence of a statistically significant strong linear relationship between: The stock returns and the return on equity (r = 0.038); The stock returns and the net profit margin (r = 0.035); The stock returns and the assets turnover ratio (r = 0.017); The stock returns and the assets to equity ratio (r = -0.051); The stock returns and the current ratio (r = -0.007) and the stock returns and the dividend payout ratio (r = -0.038).

**Table 3:** *Pearson's correlation coefficients*

| | | ROE | PROFIT MARGIN | ASSETS TURNOVER | LEVERAGE | CURRENT | PAYOUT |
|---|---|---|---|---|---|---|---|
| RETURN | Pearson correlation | .038 | .035 | .017 | -.051 | -.007 | -.038 |
| | Sig. (2-tailed) | .441 | .490 | .733 | .294 | .884 | .474 |
| | Cases | 409 | 380 | 402 | 418 | 405 | 359 |

Since some firms presented net losses during some fiscal years and consequently negative returns, we divided the sample into two sub-samples, one for the firms with negative ROE and one for those with positive ROE. We then examined whether a linear relationship existed between the dependent and the independent variables for each of the two sub-samples and again no significant correlations were observed. (these results can be given upon request).

Additionally, we examined the Spearman's correlation coefficients between the stock returns and the selected financial ratios, which is a non-parametric correlation test that does not presuppose the normal distribution for the variables. The results are presented in Table 4.

As it can be seen from the results in Table 4, there were observed no statistically significant correlations between stock returns and the independent variables at the 1% or 5% levels of significance, similarly to the Pearson correlation coefficient analysis.

**Table 4:** *Spearman's correlation coefficients*

| | | ROE | PROFIT MARGIN | ASSETS TURNOVER | LEVERAGE | CURRENT | PAYOUT |
|---|---|---|---|---|---|---|---|
| RETURN | Spearman correlation | .083* | .063 | .072 | -.060 | .057 | .004 |
| | Sig. (2-tailed) | .093 | .224 | .148 | .224 | .251 | .945 |
| | Cases | 409 | 380 | 402 | 418 | 405 | 359 |

** Denotes significance at the 10% level of a two tailed test.*

The only difference that we note is that the Spearman rho coefficient between stock returns and ROE was statistically significant at the 10% level of significance (p-value = 0.093), which probably means that one of the two examined variables' distributions does not follow the normal distribution and we have a positive relationship. This positive relation between ROE and stock returns is consistent with the results of Alexakis, Patra and Poshakwale (2010), Goslin, Chai and Gunasekarage (2012) and Petcharabul and Romprasert (2014). Anyway, the results regarding the relation of the returns with the ROE ratio were tested with other tests to verify it, such as regression analysis.

Since no significant linear relationships between the dependent variable and the selected independent variables was observed, as it can be seen in Table 3, we proceeded to estimate whether other, non linear form of relationship existed. In order to be able to use the Least Squares method to calculate the regression estimators and derive conclusions about their significance, we transformed the variables using natural logarithms according to Halikias (2010). The model used in the analysis is the multiplicative (non-linear) regression model and the equation is:

$$Return_{it'} = e^{b_0} * X_{it}^{b_i} \quad (17)$$

or otherwise stated:

$$ln(Return_{it'}) = ln(b_0) + b_i ln(X_{it}) \quad (18)$$

Where,

$Return_{it'}$ is the stock return of the firm i in the period t', with t' concerning the period from the end of March to the end of June,

$X_{it}$ is one of the six selected financial ratios as explanatory variables of the stock return of the firm i in the period t.

We ran multiplicative regression equations in SPSS for the 4 models stated in the methodology section. The results of the multiplicative regression analyses are presented in Table 5.

**Table 5:** *Summary of regression results for the period 2005 to 2014*

| Model | Cases | $R^2$ | F | Sig. | Variable | Coefficient | *t* | p-value | D-W |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 145 | .022 | 3.241 | .074** | Constant | 2.924 | 11.714 | .000* | 1.658 |
| | | | | | ln_ROE | -.203 | -1.800 | .074** | |
| 2 | 133 | .015 | .649 | .585 | Constant | 2.790 | 1.312 | .192 | 1.609 |
| | | | | | ln_Profit | -.169 | -1.246 | .215 | |
| | | | | | ln_Turnover | -.009 | -.052 | .958 | |
| | | | | | ln_Leverage | .028 | .076 | .940 | |
| 3 | 128 | .021 | .673 | .612 | Constant | 2.143 | .755 | .452 | 1.543 |
| | | | | | ln_Profit | -.200 | -1.416 | .159 | |
| | | | | | ln_Turnover | -.005 | -.026 | .980 | |
| | | | | | ln_Leverage | .122 | .300 | .765 | |
| | | | | | ln_Current | .034 | .137 | .891 | |
| 4 | 86 | .015 | .250 | .939 | Constant | 1.867 | .458 | .648 | 2.016 |
| | | | | | ln_Profit | -.036 | -.188 | .851 | |
| | | | | | ln_Turnover | .215 | .833 | .407 | |
| | | | | | ln_Leverage | .159 | .281 | .779 | |
| | | | | | ln_Current | -.037 | -.118 | .906 | |
| | | | | | ln_Payout | -.220 | -.568 | .572 | |

* : statistical significance at the 5% level, ** : statistical significance at the 10% level

ln_ROE = the natural logarithm of the return on equity variable, ln_Profit = the natural logarithm of the net profit margin variable, ln_Turnover = the natural logarithm of the assets turnover ratio variable, ln_Leverage = the natural logarithm of the assets to equity ratio variable, ln_Current = the natural logarithm of the current ratio variable, ln_Payout = the natural logarithm of the dividend payout ratio variable

Based on Table 5 the observations included in the models were reduced as a result of the removal of negative values. From the estimated very low coefficients of determination ($R^2$), we see that the independent variables used in all models failed to adequately explain the variations in the stock returns during the examined period. Only model 1 has an F statistic value which is significant at the 10% level of significance (p-value = 0.074). The F statistic values of the other models showed that they fail to explain variations of the dependent variable. We see that apart from the return on equity (ROE), which can explain stock returns at the 10% level of significance (p-value = 0.074), all other financial ratios failed to significantly explain stock returns. The autocorrelation of the error term for model 1 was measured with the use of the Durbin-Watson statistic and it was found to be 1.658 (close to 2), so we do not have to worry about autocorrelation.

Taking into account the fact that the Greek Government entered in May 2010 into a set of finance agreements with its EU partners and the IMF, known as "Memorandum", we divided the examined period in two sub-periods, one from 2005 to 2009 and one from 2010 to 2014. The reason was to examine separately the relations between stock returns and financial ratios for the two sub-periods, before and after the memorandum and, as a result, to indirectly

see whether this macroeconomic development actually affected them. The results for these two sub-periods are presented in Table 6 and Table 7 respectively.

**Table 6:** *Summary of regression results for the period 2005 to 2009*

| Model | Cases | $R^2$ | F | Sig. | Variable | Coefficient | *t* | p-value | D-W |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 93 | .023 | 2.111 | .150 | Constant | 3.153 | 8.843 | .000* | 1.151 |
| | | | | | ln_ROE | -.222 | -1.453 | .150 | |
| 2 | 84 | .008 | .209 | .890 | Constant | 3.050 | 1.070 | .288 | 1.085 |
| | | | | | ln_Profit | -.130 | -.670 | .505 | |
| | | | | | ln_Turnover | .072 | .248 | .805 | |
| | | | | | ln_Leverage | -.071 | -.135 | .893 | |
| 3 | 83 | .008 | .165 | .955 | Constant | 2.777 | .695 | .489 | 1.054 |
| | | | | | ln_Profit | -.135 | -.681 | .498 | |
| | | | | | ln_Turnover | .079 | .261 | .795 | |
| | | | | | ln_Leverage | -.050 | -.086 | .932 | |
| | | | | | ln_Current | .027 | .076 | .939 | |
| 4 | 64 | .042 | .509 | .768 | Constant | 3.872 | .763 | .448 | 1.490 |
| | | | | | ln_Profit | .023 | .090 | .929 | |
| | | | | | ln_Turnover | .212 | .598 | .552 | |
| | | | | | ln_Leverage | .193 | .246 | .807 | |
| | | | | | ln_Current | -.064 | -.141 | .888 | |
| | | | | | ln_Payout | -.743 | -1.357 | .180 | |

* : statistical significance at the 5% level, ** : statistical significance at the 10% level

ln_ROE = the natural logarithm of the return on equity variable, ln_Profit = the natural logarithm of the net profit margin variable, ln_Turnover = the natural logarithm of the assets turnover ratio variable, ln_Leverage = the natural logarithm of the assets to equity ratio variable, ln_Current = the natural logarithm of the current ratio variable, ln_Payout = the natural logarithm of the dividend payout ratio variable

Table 6 once again shows that the financial ratios failed to significantly explain stock returns. In this case even the return on equity was found to be statistically insignificant in predicting stock returns at the 10% level of significance for the period before the memorandum.

As the results presented in Table 7 reveal, for the fiscal years from 2010 to 2014, the stock returns were significantly related to the return on equity variable (p-value = 0.055). Model 1 has an F statistic value which is significant at the 10% level of significance (p-value = 0.055). The F statistic of the other models showed that they failed to explain variations of the dependent variable. The autocorrelation of the error term for model 1 was measured with the use of the Durbin-Watson statistic and it was found to be 2.373 (close to 2), so we do not have to worry about autocorrelation.

**Table 7:** *Summary of regression results for the period 2010 to 2014*

| Model | Cases | $R^2$ | F | Sig. | Variable | Coefficient | *t* | p-value | D-W |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 52 | .072 | 3.859 | .055** | Constant | 2.774 | 8.848 | .000* | 2.373 |
| | | | | | ln_ROE | -.309 | -1.964 | .055** | |
| 2 | 49 | .085 | 1.391 | .258 | Constant | 4.538 | 1.474 | .147 | 2.338 |
| | | | | | ln_Profit | -.329 | -1.852 | .071** | |
| | | | | | ln_Turnover | -.217 | -1.064 | .293 | |
| | | | | | ln_Leverage | -.142 | -.286 | .776 | |
| 3 | 45 | .164 | 1.956 | .120 | Constant | 2.613 | .730 | .469 | 2.150 |
| | | | | | ln_Profit | -.451 | -2.411 | .021* | |
| | | | | | ln_Turnover | -.232 | -1.091 | .282 | |
| | | | | | ln_Leverage | .163 | .315 | .754 | |
| | | | | | ln_Current | .099 | .330 | .743 | |
| 4 | 22 | .160 | .610 | .694 | Constant | -3.881 | -.490 | .631 | 2.043 |
| | | | | | ln_Profit | -.245 | -.785 | .444 | |
| | | | | | ln_Turnover | -.035 | -.073 | .943 | |
| | | | | | ln_Leverage | .584 | .521 | .610 | |
| | | | | | ln_Current | .306 | .653 | .523 | |
| | | | | | ln_Payout | .518 | .810 | .430 | |

* : statistical significance at the 5% level, ** : statistical significance at the 10% level

ln_ROE = the natural logarithm of the return on equity variable, ln_Profit = the natural logarithm of the net profit margin variable, ln_Turnover = the natural logarithm of the assets turnover ratio variable, ln_Leverage = the natural logarithm of the assets to equity ratio variable, ln_Current = the natural logarithm of the current ratio variable, ln_Payout = the natural logarithm of the dividend payout ratio variable

The results in Table 7 show that, except for the ROE, the other financial ratios were not found to be significant in explaining stock returns both for the overall period and the two sub-periods, with the exception of the net profit margin variable which was found to be significant in models 2 and 3 during the crisis period (from 2010 to 2014), but the respective models are not statistically significant in explaining stock returns based on their F statistics.

Due to the above, we performed regression analysis, using as explanatory variable only the net profit margin ratio, for the period from 2010 to 2014. The results of the analysis are presented in Table 8.

As it can be seen from Table 8, there was not a statistically significant relation between the stock returns and the net profit margin ratio during this period.

**Table 8:** *Regression results for the "net profit margin" variable (period 2010 to 2014)*

| Cases | $R^2$ | F | Sig. | Variable | Coefficient | *t* | p-value | D-W |
|---|---|---|---|---|---|---|---|---|
| 51 | .012 | .591 | .446 | Constant | 2.493 | 7.622 | .000* | 2.261 |
| | | | | ln_Profit | -.116 | -.769 | .446 | |

* : statistical significance at the 5% level, ** : statistical significance at the 10% level

ln_Profit = the natural logarithm of the net profit margin variable

As stated in many studies, such as those of Alexakis, Patra and Poshakwale (2010), Goslin, Chai and Gunasekarage (2012) and Petcharabul and Romprasert (2014) a positive relation was observed between the ROE and the stock returns. Nevertheless, other studies such as that of Bagella, Becchetti and Carpentieri (2000) found a negative relation between the ROE and the stock returns. Other studies, such as those of Naïmy (2008), Dzikevicious and Saranda (2011) and Muhammad and Scrimgeour (2014) found no significant relation between stock returns and the ROE. It appears that our results are consistent with these latter studies.

Regarding the net profit margin, Martikainen (1989) found a positive relation between this ratio and stock returns. Naïmy (2008), Alexakis, Patra and Poshakwale (2010) and Dzikevicious and Saranda (2011) found no significant relation between stock returns and the net profit margin, so our study is consistent with these studies.

Regarding the assets turnover ratio, Alexakis, Patra and Poshakwale (2010) found a positive relation between this ratio and stock returns. Talebian and Daghbandan (2015) also found a positive relation between assets turnover and the firm's performance. Dzikevicious and Saranda (2011) found no significant relation between assets turnover and stock returns.

Alexakis, Patra and Poshakwale (2010) found a positive relation of the current ratio and the stock returns. Talebian and Daghbandan (2015) also found a positive relation between this ratio and the firm's performance. Dzikevicious and Saranda (2011) and Petcharabul and Romprasert (2014) found no significant relation between the current ratio and the stock returns. And our results are in line with these findings.

Regarding the financial leverage ratios, Martikainen (1989) found a negative relation between these ratios and stock returns. Alexakis, Patra and Poshakwale (2010) established a negative relation of the debt to equity ratio with stock returns. Talebian and Daghbandan (2015) also found a negative relation between leverage and the firm's performance. Interestingly the study carried out by Fama and French (1992) established a negative relation between leverage and stock returns when the equity was measured based on its book value, but a positive relation when the equity was measured based on its market value.

Dzikevicious and Saranda (2011) and Petcharabul and Romprasert (2014) found no significant relation between the total assets to equity ratio or the debt to equity ratio and the stock returns and we confirm this latter result.

Turk (2006) found a negative relation between stock returns and the dividend payout ratio. Muhammad and Scrimgeour (2014) also found in some models used in their study a significant negative relation between stock returns and the dividend payout ratio.

Perhaps a different outcome, as a whole, would be reached, if market-based financial ratios were used instead of accounting-based ones, as was the result in the study of Muhammad and Scrimgeour (2014). This test is beyond the scope of the present study but is an interesting proposal for future research.

In summary, the literature findings that are similar to these established in the present study, we note that Bagella, Becchetti and Carpentieri (2000), also found a negative relation between ROE and stock returns. Regarding the results for the other ratios, Naïmy (2008), Alexakis, Patra and Poshakwale (2010) and Dzikevicious and Saranda (2011) also found no significant relation between the stock returns and the net profit margin ratio. Dzikevicious and Saranda (2011) also found no significant relation between the assets turnover ratio and the stock returns. Finally, similar results about the explanatory power of the leverage and the current ratios were established by Dzikevicious and Saranda (2011) and Petcharabul and Romprasert (2014). They found that the total assets to equity ratio, or the debt to equity ratio and the current ratio were not significantly related with the stock returns.

## 5. SUMMARY AND CONCLUDING REMARKS

The aim of this study was to examine whether firms' fundamentals, in the form of financial ratios, can be used in explaining stock returns in the Athens Stock Exchange. We examined six selected ratios as explanatory variables of the stock returns by using univariate and multivariate regression analysis: the return on common equity, the net profit margin, the assets turnover ratio, the assets to equity ratio, the current ratio and the dividend payout ratio.

The empirical results of our study showed that during the examined period (2005 to 2014)

in general a statistically significant relation was not observed between stock returns and the examined ratios. This was also the case when the periods from 2005 to 2009 and from 2010 to 2014 were examined separately. Only the return on equity was found to be significant for the overall period, as well as for the period from 2010 to 2014 and at the 10% level of significance. Contrary to expectations, the ROE coefficient was found to be negatively related to stock returns, as was also found in the study of Bagella, Becchetti and Carpentieri (2000) for the London stock exchange.

A relevant limitation of the present and similar studies regarding the Greek listed and non-listed companies, is the non-availability of the pertinent data in electronic, publicly available form. The data were manually collected and this takes considerable time. As it has already been mentioned in other studies, such as that of Goslin, Chai and Gunasekarage (2012), another significant limitation in this type of research is the absence of a sound, unique theoretical framework for the selection of the fundamentals to be examined.

Future research can elaborate on the findings of the current study to examine the significance of other financial variables in explaining stock returns, or to examine the significance of non-firm specific variables, such as GDP and other macroeconomic factors or to use market based ratios. Research can also focus on developed markets such as the US, or other developing markets, to examine the same factors as the present study and even extend to make comparisons between the selected markets. The pertinent literature as well as our study have not found what factors make the difference for the variety of relations or no relations we get between financial ratios and stock returns, so more in depth research is needed.

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## APPENDIX

This Appendix presents the most often occurred types of corporate actions and their adjustments on the stock price, as prescribed in the ASE decision Nr. 26/17.7.2008 of the Board of Directors of the ASE. There are 15 cases of corporate actions that we take into consideration:

**Case 1:** Share capital issue with cash. The adjusted stock price (Pa) is calculated with the following formula:

$$P_a = [(P_0 * N_0) + (P_1 * N_1)] / (N_0 + N_1) \quad \text{(A.1)}$$

Where,

$P_0$ = the closing price before the capital issue,

$P_1$ = the offer price for the new stocks,

$N_0$ = the number of stocks before the capital issue,
$N_1$ = the number of new stocks from the capital issue.

**In case Pa > $P_0$, then $P_0$ is used as Pa.**

**Case 2:** Bonus issue. In case of issuing stocks to existing shareholders or other parties such as staff, as a result of capitalization of reserves, the adjusted stock price (Pa) is calculated with the following formula:

$$P_a = (P_0 * N_0) / (N_0 + N_1) \quad \text{(A.2)}$$

Where,
$P_0$ = the closing price before the bonus issue,
$N_0$ = the number of stocks before the bonus issue,
$N_1$ = the number of new stocks from the bonus issue.

**Case 3:** Issue of convertible debentures. The adjusted stock price (Pa) is calculated with the following formula:

$$P_a = [(P_0 * N_0) + (P_1 * N_1)] / (N_0 + N_1) \quad \text{(A.3)}$$

Where,
$P_0$ = the closing price before the issue,
$P_1$ = the price of conversion of a debenture into stock,
$N_0$ = the number of stocks before the issue,
$N_1$ = the number of new stocks that will derive from the conversion of debentures.

**In case Pa > $P_0$, then $P_0$ is used as Pa.**

**Case 4:** Dividend distribution in the form of new stocks. In case of issuing stocks to pay dividends to shareholders, the adjusted stock price (Pa) is calculated with the following formula:

$$P_a = (P_0 * N_0) / (N_0 + N_1) \quad \text{(A.4)}$$

Where,
$P_0$ = the closing price before the issue of the stocks,
$N_0$ = the number of stocks before the issue,
$N_1$ = the number of new stocks from the stocks issue.

**Case 5:** Stock split. In case of issuing new stocks proportionally to the reduction of the nominal value of stocks, the adjusted stock price (Pa) is calculated with the following formula:

$$P_a = (P_0 * N_0) / (N_0 + N_1) \quad \text{(A.5)}$$

Where,
$P_0$ = the closing price before the stock split,
$N_0$ = the number of stocks before the stock split,
$N_1$ = the number of new stocks from the stock split.

**Case 6:** Reverse stock split. In case of reducing the number of stocks proportionally to the increase of the nominal value of stocks, the adjusted stock price (Pa) is calculated with the following formula:

$$P_a = (P_0 * N_0) / N_n \quad \text{(A.6)}$$

Where,
$P_0$ = the closing price before the reverse stock split,
$N_0$ = the number of stocks before the reverse stock split,
$N_n$ = the total number of stocks after the reverse stock split.

**Case 7:** Reinvestment of dividends. In case of reinvesting part or the total amount of dividend and issuing new stocks at a predefined price, the adjusted stock price (Pa) is calculated with the following formula:

$$P_a = [(P_0 * N_0) + (P_1 * N_1)] / (N_0 + N_1) \quad \text{(A.7)}$$

Where,
$P_0$ = the closing price before the issue of stocks,
$P_1$ = the offer price of new stocks,
$N_0$ = the number of stocks before the issue,
$N_1$ = the number of new stocks to be issued due to the reinvestment of dividends.

**In case Pa > $P_0$, then $P_0$ is used as Pa.**

**Case 8:** Share capital distribution in cash. In case of distributing share capital to the shareholders in the form of cash, the adjusted

stock price (Pa) is calculated with the following formula:

$$P_a = P_0 - C \quad (A.8)$$

Where,
$P_0$ = the closing price before the distribution,
C = the amount per stock of distributed capital.

**Case 9:** Acquisition/merger of a listed firm by another listed firm. The adjusted stock price (Pa) of the acquirer firm is calculated with the following formula:

$$P_a = [(P_0 * N_0) + (P_1 * N_1)] / N_c \quad (A.9)$$

Where,
$P_0$ = the closing price of the stock of the acquirer firm before the acquisition/merger,
$P_1$ = the closing price of the stock of the acquiree firm before the acquisition/merger,
$N_0$ = the number of stocks of the acquirer firm before the acquisition/merger,
$N_1$ = the number of stocks of the acquiree firm before the acquisition/merger,
$N_c$ = the number of stocks of the acquirer firm after the acquisition/merger.

**Case 10:** Acquisition of an unlisted firm by a listed firm, where the shareholders of the listed firm maintain their original number of stocks. No adjustment is made to the stock price of the listed firm (i.e., the acquirer).

**Case 11:** Acquisition of an unlisted firm by a listed firm, where the shareholders of the listed firm receive new bonus stocks (i.e., at no cost) as a result of the acquisition/merger. The adjusted stock price (Pa) of the listed firm is calculated with the following formula:

$$P_a = (P_0 * N_0) / (N_0 + N_1) \quad (A.11)$$

Where,
$P_0$ = the closing price of the stock of the listed firm before the acquisition/merger,
$N_0$ = the number of stocks of the listed firm before the acquisition/merger,
$N_1$ = the number of bonus stocks distributed to the shareholders of the listed firm.

**Case 12:** Acquisition of an unlisted firm by a listed one, where the shareholders of the listed firm receive fewer stocks of the new firm in exchange of the old ones. The adjusted stock price (Pa) of the listed firm is calculated with the following formula:

$$P_a = (P_0 * N_0) / N_1 \quad (A.12)$$

Where,
$P_0$ = the closing price of the stock of the listed firm before the acquisition/merger,
$N_0$ = the number of stocks of the listed firm before the acquisition/merger,
$N_1$ = the number of shares of the new firm, after the acquisition/merger, issued to the shareholders of the listed firm.

**Case 13:** Issue stocks as a result of a stock option plan. No adjustment is made to the historical stock price.

**Cases 14:** Changes in the share capital without issuing new shares. In cases of changing the nominal amount of the share capital without issuing new shares, either by increasing the nominal value of the existing shares due to the capitalization of reserves, or by reducing the nominal value of the existing shares, no adjustment is made to the historical stock price.

**Case 15:** Cancellation of treasury stocks. In case of cancellation of own stocks held by the firm no adjustment is made to the historical stock price.