CHARLES UNIVERSITY
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Significance of different financial ratios in predicting stock returns: NYSE - cross-industry analysis

Bachelor's thesis

Author: Matěj Coufal
Study program: Economics and Finance
Supervisor: prof. Ing. Michal Mejstřík, CSc.
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Declaration of Authorship

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Havlíčkův Brod, April 25, 2020

Matěj Coufal

Abstract

The goal of this research is to investigate the power of following seven variables to predict stock returns on the New York Stock Exchange: price to earnings ratio (P/E), dividend yield (DY), debt to equity ratio (D/E), book to market ratio (B/M), return on assets (ROA), return on equity (ROE) and market capitalization (MC). Companies selected for the analysis are divided into five industries (airlines, computers and software, financial services, food and beverages, energy) which enables to observe the difference between the sectors as far as the statistical significance of regressors is concerned. The ability of six financial ratios and MC to forecast stock returns is examined between February 2010 and February 2020, whereas three investment horizons are considered: three months, one year, three years. Panel data regression models reveal different significant variables for each industry and show that the strength of the relationship between these regressors and expected stock returns increases with a longer investment horizon.

Keywords

financial ratio, predicted stock return, statistical significance, regression model, ceteris paribus (c.p.)

Abstrakt

Tato studie si klade za cíl vyzkoumat schopnost následujících sedmi proměnných předpovídat akciové výnosy na New York Stock Exchange: P/E poměr, dividendový výnos (DY), poměr dluhů a vlastního kapitálu (D/E), poměr účetní hodnoty a tržní ceny (B/M), výnosnost aktiv (ROA), výnosnost vlastního kapitálu (ROE), tržní kapitalizace (MC). Firmy vybrané pro analýzu jsou rozděleny do pěti odvětví (letecké, počítače a software, finanční služby, jídlo a nápoje, energie), což umožňuje pozorovat rozdíly mezi sektory co se týče statistické významnosti jednotlivých regresorů. Schopnost šesti poměrových ukazatelů a tržní kapitalizace předpovídat akciové výnosy je zkoumána v období únor 2010 – únor 2020, přičemž jsou zohledněny tři investiční období: tři měsíce, jeden rok, tři roky. Regresní modely panelových dat odhalují odlišné signifikantní proměnné pro každé odvětví a ukazují, že síla vztahu mezi těmito regresory a očekávaným výnosem akcie roste s delším investičním horizontem.

Klíčová slova

poměrový ukazatel, předpovídaný akciový výnos, statistická významnost, regresní model, ceteris paribus (c.p.)

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Bachelor's Thesis Proposal

Author	Matěj Coufal
Supervisor	prof. Ing. Michal Mejstřík, CSc.
Proposed topic	Significance of different financial ratios in predicting stock returns: NYSE - cross-industry analysis

Research question and motivation

The research question I am going to study is the significance of certain financial ratios in predicting stock returns on the New York Stock Exchange (NYSE) across selected industries. I will perform an analysis covering three time horizons: 3 months, one year, 3 years.

Comparing stock prices from markedly different sectors might not be appropriate. Thus, when investors decide on which stock to buy, they need to make sure they compare stocks of companies operating in similar industry. Sectors differ in many ways and so do the strategies and behavior of companies. Therefore, some of the income statement and the balance sheet items may have different importance across the industries. It implies that for each sector, certain financial ratios are more relevant when making investment decisions.

Efficient Market Hypothesis (Fama and Samuelson, 1960s) suggests that securities traded on the markets are fairly priced provided that all investors possess equal information. As an implication, no arbitrage opportunity exists and thus there are neither undervalued nor overvalued stocks available. Moreover, the hypothesis states that it is impossible to beat the market by technical or fundamental analysis.

By contrast, according to the Arbitrage Pricing Theory (Ross 1976), an arbitrage opportunity might exist in the financial markets, meaning that an undervalued stock can be purchased. In addition, Pontiff & Schall (1998) showed that stock returns can be predicted using financial ratios. It is due to the inefficiencies in the stock market.

In my thesis, I would like to examine what financial ratios are most relevant for forecasting stock returns in the following industries: airlines, computers/software, financial services, food & beverage, energy. Presumably, P/E ratio, Dividend Yield (DY) and Book-to-Market ratio (B/M) have some power in predicting stock returns because their calculations include the stock price. However, some other important ratios such as inventory turnover, current ratio or debt ratio may indicate the future moves of a stock price with respect to the industry in which the particular company operates.

Another fact influencing the earnings of an entity, and thus the stock price, is the capital structure of a firm. It deals with the division of the company's capital into debt and equity. Debt-Equity ratio, defined as total debt over total equity, shows the firm's leverage. Since the interest expenses decrease the corporate taxes, companies are inspired to increase the debt. The goal of the financial managers is to determine such capital structure which minimizes the weighted average cost of capital (WACC). Therefore, the Debt-Equity ratio should be also taken into account when forecasting stock returns.

Contribution

Undoubtedly, each industry has different requirements on the companies, various strength of the competition and other aspects making it impossible to compare stocks from different sectors. Therefore, I decided to analyze stock returns in five entirely distinct industries.

The main goal of my thesis is to determine for each of the selected industries the significance of different financial ratios in predicting the stock returns on the New York Stock Exchange. Based on the results of the regression models, investors will be able to calculate predicted stock returns in selected industries given the values of financial ratios used in the models.

In addition, I will state various strategies for investing in stocks for examined sectors. As the analysis covers three time horizons, the suggested investment strategies will supposedly differ for both industry type and the length of the time period.

To sum it up, my thesis should help investors make decisions when buying stocks from investigated sectors. Thanks to the results of my analysis, it will be easier for traders to assess whether a purchase of a specific share would be a reasonable investment or not.

Methodology

For each of the selected industries, I will download historical balance sheets, income statements and statements of cash flows for a sample of at least ten companies listed on the NYSE. This data is publicly available at financial websites of Yahoo Finance or CNBC.

Then I will build a model with the stock return as the dependent variable and certain financial ratios as independent variables. I intend to run a panel data regression for each industry, based on which I will test the significance of independent variables with respect to a specific time horizon.

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- suggestions for further research

List of academic literature

Hodrick, R. (1992). "Dividend yields and expected stock returns: alternative procedures for inference and measurement." *Review of Financial Studies* **5(3)**: pp. 357 - 386.

Ang, A. & Bekaert, G. (2006). "Stock return predictability: Is it there?" *Review of Financial Studies* **20(3)**: pp. 651 - 707.

Holthausen, R. W. & Larcker, D. F. (1992). "The prediction of stock returns using financial statement information." *Journal of Accounting and Economics* **15(2)**: pp. 373 - 411.

Kheradyar, S.; Ibrahim, I. & Nor, F. M. (2011). " Stock return predictability with financial ratios." *International Journal of Trade, Economics and Finance* **2(5)**: page 391.

Penman, S. H.; Richardson, S. A. & Tuna, I. (2007). "The Book-to-Price Effect in Stock Returns: Accounting for Leverage." *Journal of Accounting Research* **45(2)**: pp. 427 - 467.

Pontiff, J. & Schall, L. (1998). "Book-to-market ratios as predictors of market returns." *Journal of Financial Economics* **49(2)**: pp. 141 - 160.

Basu, S. (1977). "Investment performance of common stocks in relation to their price-earnings ratios: a test of the efficient market hypothesis." *Journal of Finance* **32(3)**: pp. 663 - 682.

Lewellen, J. (2004). "Predicting returns with financial ratios." *Journal of Financial Economics* **74(2)**: pp. 209 - 235.

Altman, E. (1968). "Financial Ratios Discriminant Analysis and the Prediction of Corporate Bankruptcy." *The Journal of Finance* **23(4)**: pp. 589 - 609.

Author

Supervisor

Acronyms

NYSE New York Stock Exchange

P/E Price to Earnings Ratio

DY Dividend Yield

B/M Book to Market Ratio

D/E Debt to Equity Ratio

ROA Return on Assets

ROE Return on Equity

MC Market Capitalization

EMH Efficient Market Hypothesis

CAPM Capital Asset Pricing Model

APT Arbitrage Pricing Theory

Contents

1. Introduction

1.1 Background of the topic

Stock return - a term every investor is interested in when considering a purchase of a stock. Given a level of risk associated with a security, a rational trader always tries to find an asset with the highest expected return. Alternatively, given an expected return of a stock or a portfolio, the goal of an investor is to minimize the level of risk of that stock or portfolio. The relationship between the risk and expected return of assets became a basis for evolving the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT), tools that help investors estimate the expected return of a security. Since these models are based on strict assumptions that, in reality, are hard to meet, CAPM or APT might be helpful, but certainly not sufficient, for making investment decisions. Therefore, professional portfolio managers and investors spend a considerable amount of time and effort analyzing additional information which could help them better assess the expected return or the level of risk of a particular stock. This, however, clearly contradicts the Efficient Market Hypothesis (EMH) introduced by Eugene Fama in 1965.

The EMH, an important and influential financial theory, asserts that stock returns are unpredictable due to the fact that the stock prices always include all available information relevant to a concrete company.[1] Proponents of this theory suggest that analyzing any information should not bring higher profits. In other words, both the fundamental and technical analysis cannot be tools which would help investors find an asset that will secure an above-average return relative to its level of risk. On the other hand, opponents of the EMH showed some anomalies that represented certain deviations from the definition of this theory. Types of such anomalies are, for example, calendar (January effect, weekend effect), fundamental (P/E, DY, B/M as determinants of future returns) or technical (moving averages as signals for buying/selling).[2]

[1] Fama, E. F. (1965). "The Behavior of Stock-Market Prices." *Journal of Business* **38(1)**: page 90.

[2] Latif, M. et al. (2011). "Market Efficiency, Market Anomalies, Causes, Evidences, and Some Behavioral Aspects of Market Anomalies." *Research Journal of Finance and Accounting* **2(9/10)**: pp. 1 - 13.

Since investors immediately react to new information that enters the financial market, it can be assumed that the EMH is valid as the news is instantly included in the stock prices, implying that there does not exist any arbitrage opportunity. This thesis investigates the validity of the semi-strong form of the EMH according to which the stock prices reflect all publicly available information, and as a consequence, the values of financial ratios are irrelevant for predicting stock returns.[3] The goal of this research is to examine whether the market capitalization and 6 financial ratios play a statistically significant role in forecasting stock returns, and thus the semi-strong form of the EMH is violated.

The topic of financial ratios and their ability to predict stock returns gained in popularity in the last quarter of the 20th century. The economists tried to find out which financial ratios could influence the stock returns and how significant the relationship was. The focus was put mostly on the DY, the P/E and the B/M and the authors used slightly different approaches as far as regression models, investigated time periods or groups of stocks selected for the analysis are concerned. The significance of the DY turned out to increase with a longer investment horizon and this financial ratio was more significant than the P/E as shown by Fama and French (1988). Campbell and Shiller (1988) conducted a survey on the ability of the P/E ratio to forecast future stock returns and concluded that stocks with lower values of the P/E were expected to reach a higher return. Next, Lewellen (2004) found out a significant relationship between stock returns and all three ratios mentioned above, whereas the DY represented the most significant influence on stock returns.

1.2 Contribution of this research

Besides the DY, the P/E and the B/M, this study takes into account also the D/E, ROA, ROE and the MC. These four variables were added to the regression models as well due to the fact that they had rarely been examined in the previous studies, and thus the results about their significance for predicting stock returns might be beneficial. Moreover, contrary to most of the papers that investigated the power of financial ratios to forecast the returns of stock indices or groups of stocks, this research considers five industries: airlines, computers and software, financial services, food and beverages, energy.

[3] Fama, E. F. (1970). "Efficient Capital Markets: A Review of Theory and Empirical Work." *Journal of Finance* **25(2)**: page 383.

In total 106 companies traded on the NYSE were divided into five industries mentioned above and the influence of seven selected variables on stock returns was investigated between February 2010 and February 2020, whereas three possible investment horizons were analyzed: three months, one year, three years. The results confirm findings from the previous research, such as the fact that both the DY and the B/M influence predicted stock returns positively, while the P/E and the MC negatively. Moreover, the strength of the relationship between statistically significant variables and expected stock returns increases with a longer investment horizon which is also in line with published writings.

Nevertheless, whereas the economists in the past mostly examined the power of financial ratios to predict the returns of stock indices or groups of stocks, the major goal of this research is to indicate which financial ratios are significant for a specific industry. For example, Pontiff & Schall (1998) argued that the B/M ratio had predicted the returns on the DJIA from 1926 to 1960. On the other hand, this survey suggests that the B/M ratio is significant only for forecasting the returns in the financial services and food & beverages industries. Next, Lewellen (2004) investigated the power of the DY to predict the returns of both equal- and value-weighted NYSE indices between 1963 and 2000. He concluded that the DY was an important predictor of returns of analyzed indices. However, the results of this study show that the DY is statistically significant only for the financial services industry.

While the previous papers delivered rather general results about the statistical significance of P/E, B/M, DY or MC for predicting stock returns, the division into 5 industries in this research clearly offers an overview of financial ratios that are significant for a particular sector. Hence, instead of considering generally proven statistically significant variables, an investor buying a stock might focus on financial ratios important only for a concrete industry the company is operating in.

Next, most of the influential writings that examined the stock returns predictability with the use of financial ratios analyzed a time period that started around the 1950s or earlier, so the results are now based on relatively old data. Since then, the standards and strategies how the companies operate their businesses have presumably slightly changed which might have an impact on the values of financial ratios as well. As this research considers the last ten years, it offers a more current overview of financial ratios that have been significant for forecasting stock returns in the recent decade.

1.3 Structure of this thesis

This thesis is divided into five sections. The introduction part including also general information on the NYSE as well as its history is followed by the section with the review of existing literature. It starts with presenting some writings from the 19th and 20th century concerning the stock prices behavior. Afterwards, the Efficient Market Hypothesis together with its both critique and support is introduced, followed by the description of the Capital Asset Pricing Model as well as the Arbitrage Pricing Theory. The last part of the literature review section summarizes the results of the previous research on the ability of financial ratios to predict stock returns.

The third section focuses on the definitions and interpretation of financial ratios used in the regression models. The next section is devoted to the empirical part of this study. First, the methodology and selection of regression models is described, followed by a discussion of their results for each of five selected industries. In the end, a cross-industry comparison offers an overview of the difference between the sectors. The last section summarizes the results, achievements and contribution of this research. Outcomes from the RStudio software as well as the list of analyzed companies can be found in the appendix to this thesis.

1.4 New York Stock Exchange (NYSE)

1.4.1 Generally about NYSE

In 2018, the market capitalization of stocks traded on the US stock exchanges amounted to more than 40% of the total world's stock market cap.[4] Therefore, the USA is undoubtedly the most important country for trading securities. The NYSE and Nasdaq, both headquartered in New York City, belong to the most significant trading providers. Besides that, exchanges based in Chicago or Boston

[4] Surz, R. (2nd April 2018). "U.S. Stock Market Is Biggest & Most Expensive In World, But U.S. Economy Is Not The Most Productive." Retrieved from: https://www.nasdaq.com/articles/us-stock-market-biggest-most-expensive-world-us-economy-not-most-productive-2018-04-02

are also considered well known operators of security markets in the USA.[5]

The NYSE is the largest stock exchange in the world as far as the trading volume and the market capitalization of traded securities is concerned. With its trading floor at 11 Wall Street, New York City, the NYSE organizes the marketplace for both electronic and open outcry trading. A wide variety of products, such as securities, bonds, exchange traded funds or options, can be bought and sold on the NYSE by individual investors as well as financial institutions. The markets are open from Monday to Friday between 9:30 am and 4:00 pm ET.[6] However, no trading occurs on federal holidays in the USA or special occasions including natural disasters, wars or a day of mourning when a former or actual American President dies.[7]

The Standard and Poor's 500 Index (S&P 500) and the Dow Jones Industrial Average (DJIA) are popular measures of the performance of the US stock market. The S&P 500 reflects the developement of 505 stocks issued by 500 US publicly traded companies listed on either the NYSE or Nasdaq. Since this index contains stocks of companies with the largest market capitalization, it is considered the most appropriate measure of the US stock market performance. The list of companies included in the S&P 500 is adjusted regularly by a committee following certain criteria that must be fulfilled by the firms. The weight of each stock in the index is determined by the market cap of the company relative to the market cap of the whole index.[8,9,10]

The DJIA, index named after its founder Charles Dow and his business partner Edward Jones, tracks the performance of 30 large companies across several industries traded on the NYSE and Nasdaq. Contrary to the S&P 500, the weight of a company in the DJIA is set by its share price relative to the whole index and

[5] Morah, Ch. (1st February 2018). "What are all of the securities markets in the U.S.A?" Retrieved from: https://www.investopedia.com/ask/answers/08/security-market-usa.asp

[6] https://www.nyse.com/markets/hours-calendars

[7] Rodrigo, Ch. M. (12th January 2018). "Stock markets to close for a day to honor George H.W. Bush." Retrieved from: https://thehill.com/business-a-lobbying/419264-nyse-closing-wednesday-to-honor-george-hw-bush

[8] Kenton, W. (18th May 2019). "S&P 500 Index – Standard & Poor's 500 Index." Retrieved from: https://www.investopedia.com/terms/s/sp500.asp

[9] Langager, Ch. (28th June 2019). "How is the Value of the S&P 500 Calculated?" Retrieved from: https://www.investopedia.com/ask/answers/05/sp500calculation.asp

[10] Amadeo, K. (13th March 2020). "The S&P 500 and How It Works." Retrieved from: https://www.thebalance.com/what-is-the-sandp-500-3305888

not by the total market cap. Therefore, the value of the DJIA can be calculated as the sum of prices of included stocks divided by the Dow divisor, a constant that might be adjusted in case of stock splits or addition of new components so that the value of the DJIA remains consistent.[11] Similarly to the S&P 500, a committee selects the shares to be added or removed from the DJIA.[12] In March 2020, twenty five components of the DJIA were traded on the NYSE.[13]

1.4.2 History of NYSE

"The Buttonwood Agreement" signed by twenty four stockbrokers on Wall Street in 1792 – that is where and how the whole history of the NYSE began.[14] Tontine Coffee House on Wall Street became the place where the securities were traded – at the beginning mostly government bonds and bank stocks. With time, shares from other industries gained in popularity, not only due to the Gold Rush in California in the 1840s and the later discovery of oil in Pennsylvania. In 1864, Open Board of Stock Brokers – a competitor to the NYSE – was founded. Five years later, it merged with the NYSE.[14]

At the end of October 1929, a panic stocks sell-off started, the trading volume rapidly increased and on 29th October 1929, known as Black Tuesday, over 16 million shares were traded.[15] Between 23rd and 29th October 1929, the DJIA lost 24.78% of its value.[16] This period is known as The Wall Street Crash of 1929. The next severe fall in stock prices happened on 19th October 1987, called Black Monday. On this day, the DJIA lost 22,6% which was the biggest one-day percentage drop of this index in history. Due to the terrorist attacks on 11th September 2001, trading on the NYSE was suspended for four days. During the next five trading days, the DJIA lost 14.26% and the NYSE recorded a loss of $1.4 trillion.[17,18]

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[11] Ganti, A. (18th March 2020). "Dow Jones Industrial Average (DJIA)." Retrieved from: https://www.investopedia.com/terms/d/djia.asp

[12] INVESTOPEDIA (12th April 2019). "Dow Jones Industrial Average vs. S&P 500: What's the Difference?" Retrieved from: https://www.investopedia.com/ask/answers/difference-between-dow-jones-industrial-average-and-sp-500/

[13] https://finance.yahoo.com/quote/%5EDJI/components/

[14] "American Stock Exchange – Historical Timeline." Retrieved from: https://www.nyse.com/publicdocs/American_Stock_Exchange_Historical_Timeline.pdf

[15] Osmond, D. C. (1956). "The Great Crash, 1929 by John K. Galbraith." *Case Western Reserve Law Review* **7(2)**: pp. 209 - 212.

[16] https://www.measuringworth.com/datasets/DJA

[17] https://finance.yahoo.com/quote/%5EDJI/history?p=%5EDJI

[18] Kenton, W. (23th March 2020). "New York Stock Exchange (NYSE)." Retrieved from: https://www.investopedia.com/terms/n/nyse.asp

In 2006, NYSE Group, Inc. was formed by a merger of the NYSE and Archipelago Holdings, a provider of electronic trading.[19] In the following year, NYSE Group, Inc. merged with Euronext, N.V., an operator of stock exchanges in Paris, Brussels, Amsterdam and Lisbon to form NYSE Euronext.[20] In 2008, NYSE Euronext acquired American Stock Exchange (AMEX) thanks to which the group extended its offer especially of options and exchange-traded funds.[21] A merger between NYSE Euronext and Deutsche Börse AG was planned. This action would have created the largest security exchange in the world. However, the European Union rejected the merger as there would be a significant loss of competition among the operators of exchanges.[22] In 2013, the Intercontinental Exchange acquired NYSE Euronext and seperated these two companies.[23]

[19] Kenton, W. (25th June 2019). "Archipelago." Retrieved from: https://www.investopedia.com/terms/a/archipelago.asp

[20] Scott, G. (28th June 2019). "Euronext." Retrieved from: https://www.investopedia.com/terms/e/euronext.asp

[21] "American Stock Exchange – Historical Timeline." Retrieved from: https://www.nyse.com/publicdocs/American_Stock_Exchange_Historical_Timeline.pdf

[22] Stafford, P. (8th June 2012). "Deutsche Börse: Failed NYSE/Euronext merger haunts exchange." Retrieved from: https://www.ft.com/content/a2da893c-9f67-11e1-a255-00144feabdc0

[23] Intercontinental Exchange (2016). "The Intercontinental Exchange Story." Retrieved from: https://www.intercontinentalexchange.com/article/intercontinental-exchange-history-part3

2. Literature review

2.1 Efficient Market Hypothesis (EMH)

American economist Eugene Fama came up with the definition of the efficient market in his publication *The Behavior of Stock-Market Prices* issued in 1965. He stated:

A situation where successive price changes are independent is consistent with the existence of an "efficient" market for securities, that is, a market where, given the available information, actual prices at every point in time represent very good estimates of intrinsic value. (Fama 1965, p.90)

The stock prices behavior was, however, researched already in the 19th century. At that time, the economists were interested especially in a fair-game pattern and the conjecture that stock returns followed the random walk theory. As Jovanovic and Le Gall (2001) claimed, French broker Jules Regnault was said to be the founder of the random walk theory. Nonetheless, only little is preserved from Regnault's life. His publication *Calcul des Chances et Philosophie de la Bourse* from 1863 was not found. Although Louis Bachelier did not refer to Regnault's book, he was most likely inspired by it and further developed the theory of the prices behavior in his *Théorie de la Spéculation* issued in 1900.[1]

Keynes (1923) argued that investors who reached a higher return were compensated more for bearing a higher level of risk and not for having access to information that had not been included in the stock price. This conclusion is fully in line with the EMH later defined by Fama, though. Macaulay (1925) as well as Working (1934) similarly reported that the stock returns reminded of a lottery which is undoubtedly a support of the random walk hypothesis.

Kendall (1953) investigated price changes of cotton in New York and wheat in Chicago as well as weekly returns of 19 indices tracking British industrial shares. He pointed out that it appeared as if there had been the Demon of Chance who had randomly determined weekly moves of the prices of examined indices and

[1] Sewell, M. (2011). "History of the efficient market hypothesis." Research Note RN/11/04. University College London, London. 20th January 2011.

commodities. Granger and Morgenstern (1963) conducted a survey on stock returns and found out that short-run price changes had followed the random walk theory, whereas the analysis of long-run movements denied this theory.

Fama was aware of the fact that his definition of the efficient market was very general, and that it would be very difficult, maybe even impossible, to test it. Therefore, he further defined three forms of market efficiency: weak, semi-strong and strong efficiency (Fama 1970). To each of these forms, a different set of information is relevant thanks to which it is easier to determine the criteria for empirical tests. Fama (1970) also specified sufficient assumptions for the EMH: no transaction costs, all investors can obtain all available information without having to pay for it, all traders agree on the influence the new information has on the share price. Undeniably, these conditions are hard to meet in reality. Nonetheless, they are sufficient, not required.

The weak form of efficient markets asserts that current stock prices reflect all information about historical price movements. In other words, there is no correlation between past and future returns. As a consequence, the conditional expectation of tomorrow's stock price given its historical development is equal to today's price. Provided that the weak form of efficiency holds, traders are not able to achieve an excess return using the technical analysis. Nevertheless, Fama (1965) showed a mild positive correlation between day-to-day returns. This relationship was so scant, though, that due to the transaction costs investors could not earn significantly more if they builded up an investment strategy based on these correlations.

According to Fama's definition, a capital market is semi-strongly efficient if the actual prices reflect both their historical developments and all publicly available information relevant to a concrete company, including stock splits, dividend payments or new shares issues. Therefore, assuming this form of market efficiency holds, neither technical nor fundamental analysis can become a tool for achieving excess returns.

Ball and Brown (1968) investigated the influence of annual earning announcements and new stock issues and demonstrated that these events were reflected in the share prices. Next, Fama et al. (1969) argued that the price after the stock split on average fully contained the information about the future dividend payments.

The strong form, as the name indicates, imposes the strictest restrictions on the definition of the efficient market. Therefore, Fama calls a market strong-form efficient if the prices of securities fully reflect both publicly available and insider information. However, Niederhoffer and Osborne (1966) showed that market makers on some exchanges could see the unexecuted limit orders and with the use of this information they were able to generate profits. Further, as mentioned by Fama (1970), Scholes pointed out in his doctoral thesis written in 1969 that insiders had access to information relevant to their companies which helped them achieve excess returns. Nevertheless, Fama considered these two groups the only ones that could obtain insider information, and asserted that there were no other deviations from the strong-efficient market hypothesis throughout the investors.

It is obvious that the EMH implies the random walk theory. Because if the markets are efficient, only new information relevant to a concrete company can cause a move of its share price. The information is completely random, though. Thus, the price move will be random as well. Since the prices on an efficient market indicate fair values of stocks, it is impossible to buy an undervalued or sell an overvalued share. Hence, in order to reach a return that is above the market average, traders need to invest in stocks that are associated with a higher level of risk.

Malkiel issued *A Random Walk Down Wall Street* in 1973 where he stated that shares followed the random walk. Thus, this publication is undoubtedly a support of the EMH. Moreover, Malkiel argued that investors relying on the technical or fundamental analysis could not achieve better results in the long run than by passive investing.

However, as time went on, several evidence against the EMH appeared. Grossman and Stiglitz (1980) highlighted the fact that information is costly. Therefore, investors analyzing information should earn a higher profit than the uninformed traders. As a consequence, the share price cannot reflect all available information.

Shiller (1981) surveyed the causes of stock prices movements and whether new information about upcoming real dividends could explain these price changes. Two datasets were considered – the Standard and Poor's Index between 1871 and 1979 and the Dow Jones Industrial Index from 1928 to 1979. The models showed that the stock price volatility over the examined periods had been five to thirteen times too high to be caused by new information regarding upcoming real dividends. As this strong deviation did not appear to be associated with data errors, price index problems or changes in the tax law, Shiller concluded that the efficient markets model had failed.

Shostak (1997) focused on limitations and implications of the EMH and rejected this theory. Namely, the EMH predicts that all investors have rational expectations about the future. In other words, all market participants have the same forecasts about what will happen on the financial market. As a consequence, no trading should occur since the buyer believes that the stock price will rise and the seller thinks the opposite. Next, Shostak pointed out the investment advisory services which exist as a consequence of a disequilibrium on the market, and highlighted that analyzing historical data, thus relying on fundamental analysis, shall bring higher profits. Shostak concluded that the tests supporting the EMH had wrongly interpreted the probability distribution of stock returns and had not incorporated the assumption of the serial independence of returns.

Similarly, Bernstein (1999) discussed the impossibility of the market to be in the equilibrium and the fact that incomplete or imperfect information made prices move continuously. As there is a considerable part of investors who spend time on evaluating information in order to reach higher returns, Bernstein suggested that marginal benefits of analyzing information must exceed the marginal costs.

The EMH assumes that every market participant has access to all available information regarding company's dividend payments, stock issues, earnings, value of assets, etc. Nevertheless, it is important to distinguish markets based on listing and reporting requirements imposed on the companies that wish to be traded on a specific market. Public companies listed on major stock exchanges are subject to the regulation set by the U.S. Securities and Exchange Commission including the obligation to quarterly report earnings or announce any important event that could influence the investors' interest in the company.[2]

On the other hand, there exist over-the-counter markets (OTC) with limited requirements companies need to meet in order to be listed. Such a provider of an OTC marketplace in the USA is, for example, OTC Market Group which divides

[2] https://www.sec.gov

the traded shares into three tiers (OTCQX, OTCQB, OTC Pink) with different levels of strictness of listing requirements. Whereas OTCQX requires the companies to meet high financial standards and be current in their disclosure, there are no financial standards or disclosure requirements for firms listed on OTC Pink. Due to this fact and reduced liquidity, trading these stocks represents a considerable risk.[3]

Besides markets or stock exchanges with different requirements, there also exist financial instruments, such as American Depositary Receipts (ADR) where various levels of criteria can be observed. ADR – certificates issued by a US bank – represent shares of a foreign company, and thus enable US traders to invest in a business located outside the USA. ADR can be traded on the NYSE, AMEX, Nasdaq or over-the-counter depending on the requirements the foreign company is able to meet.[4] Therefore, stock exchanges and certain financial products are not homogeneous as far as the availability of information about the companies is concerned.

2.2 Capital Asset Pricing Model (CAPM)

Thanks to his publications in 1952 and 1959, Henry Markowitz became known as the pioneer of portfolio theory. He examined the diversification and optimal portfolio selection with the use of the mean-variance analysis. Since finding a variance-covariance matrix of a portfolio containing N assets requires to calculate N(N-1)/2 terms, Markowitz argued that a simpler method, dealing with only one factor, should be introduced.

Next, Modigliani and Miller (1958) investigated the relationship between the firm's capital structure and discount rate. These writings appeared to be an inspiration for the upcoming research of a model that is nowadays known as the Capital Asset Pricing Model.

In the 1960s, Jack Treynor, William Sharpe, John Lintner and Jan Mossin independently of each other developed the thoughts of Markowitz, Modigliani and

[3] https://www.otcmarkets.com

[4] Hayes, A. (27th February 2020). "American Depositary Receipt – ADR." Retrieved from: https://www.investopedia.com/terms/a/adr.asp

Miller and laid the basis for the CAPM.[5] This single-period model shows the existence of a linear relationship between the expected return of a security and its correlation with the market portfolio:

$$E(R_i) = r_f + \beta_i \left[E(R_m) - r_f\right],$$

where $E(R_i)$ is the expected return on security i, r_f is the risk-free rate of return, $E(R_m)$ is the expected return on the market portfolio and β_i, a measure of the volatility of asset i relative to the market portfolio, can be calculated as $\beta_i = \frac{Cov(R_i,R_m)}{Var(R_m)}$.

The β of the market portfolio is equal to 1. Assets with $\beta_i > 1$ are considered more volatile, thus riskier relative to the market. However, they are associated with a higher expected return. The opposite holds for $\beta_i < 1$.

As well as every economic model, the CAPM has also certain assumptions that are in reality not always met. In order for this model to hold, investors are assumed to be rational and risk-averse, they have no influence on market prices and have the same probability distribution of expected future prices. Moreover, trading is not tied with any transaction or taxation costs and securities can be divided into small fractions.[6]

Roll (1977) argued that testing the CAPM was impossible due to the fact that the market portfolio was difficult to create. Proxies such as stock indices were used instead of the market portfolio, and therefore tests based on these proxies did not test the real CAPM but a model with a stock index. Nevertheless, the CAPM has been considered a helpful tool for investors as it offers a simple way to compare different investment opportunities.

2.3 Arbitrage Pricing Theory (APT)

Ross (1976) investigated the arbitrage opportunities, risk premia and factors that could influence the stock returns the result of which was the development of an arbitrage theory of asset pricing as an alternative to the CAPM. He assumed that

[5] E. J. Sullivan (2006). “A Brief History of The Capital Asset Pricing Model”.

[6] French, C. W. (2003). “The Treynor Capital Asset Pricing Model.” *Journal of Investment Management* **1(2)**: pp. 60 - 72.

ex post returns of n assets could be expressed as

$$x_i = E(R_i) + \beta_i \delta + \epsilon_i, \qquad\qquad i = 1, \ldots, n,$$

where x_i is the return on asset i, ϵ_i with $E(\epsilon_i) = 0$ is an error term, $E(R_i)$ stands for a constant of the ex ante expected return of asset i, β_i is the ex ante beta coefficient of asset i related to factor δ.

Ross further developed this equation to the k-factor case assuming that k was significantly lower than the number of assets considered. He showed that

$$E(R_i) - r_f = \beta_{i1}\theta_1 + \cdots + \beta_{ik}\theta_k,$$

where $E(R_i)$ is the expected return on asset i, r_f stands for the risk-free rate and $\beta_{i1}, \ldots, \beta_{ik}$ represent sensitivity coefficients to factors $\theta_1, \ldots, \theta_k$. This equation suggests that the risk premium on asset i depends on certain factors and coefficients related to them. Such factors, if they exist, shall be economic indicators, such as GNP or interest rate (Roll and Ross 1980).

Roll and Ross (1980) examined the empirical evidence of the APT by first estimating the expected returns and factor coefficients and then applying these estimates to test the APT. 1260 stocks divided into 42 groups (each group contained 30 different stocks) were considered to test the significance of individual factors within the period from July 1962 to December 1972. Using t-tests, Roll and Ross under the assumption that $r_f = 6\%$ concluded that at least one factor was significant for 88,1% of groups, at least two factors for 57,1% groups and one third of groups was associated with three or more relevant factors. However, if r_f was estimated and not assumed, the results showed significantly lower percentages than stated above.

Dhrymes et al. (1984) focused on the relevance of the APT tests carried out by Roll and Ross and pointed out the inappropriate method of testing the statistical significance of individual factors. Instead, the usage of the F-test was suggested which enabled to test how many factors were jointly statistically significant for the APT model. Furthermore, Dhrymes et al. argued that the number of factors suitable for the model depended on the amount of stocks considered. Therefore, Roll and Ross' conclusion that there exist at least three and probably four factors that are priced was not precise.

Fama and French (1992) introduced a modified version of the CAPM by adding two factors which appeared to be significant in explaining asset returns. For the analysis, six portfolios based on three different intervals for the value of the B/M ratio and two types of the company size were created. The returns on these portfolios were observed. Fama and French reasoned that besides the excess return of the market portfolio over the risk-free rate, the following two variables also played an important role in the model of asset pricing. First, SMB (small minus big) – the difference between the average monthly return on three portfolios of small-size companies and the average monthly return on three portfolios of big-size firms. Second, HML (high minus low) – the difference between the average monthly return on two portfolios with a high B/M ratio and the average monthly return on two portfolios with a low B/M ratio.

2.4 Predicting stock returns with the use of financial ratios

The topic of stock returns predictability with the use of financial ratios became often a basis for research in the last quarter of the 20th century. Although the authors sometimes used slightly different approaches and calculations of the financial ratios, the results mostly concurred. In this section, the main focus is put on the literature review of papers related to developed markets, especially in the USA.

Fama and French (1988) examined the significance of the DY in predicting the returns of value- and equal-weighted portfolios on the NYSE between 1927 and 1986 by observing the variation of R^2 for the following time horizons: one month, one quarter and one to four years. They argued that for monthly and quarterly horizons the forecastable part of returns represented at most 5% of the respective return variances. On the other hand, for two to four-year time periods, the R^2 of the regression models exceeded 25%. Therefore, the DY became a more important component of the model as the length of the time period increased. Moreover, Fama and French analyzed the effect of the P/E ratio on stock returns and claimed that R^2 of these regression models, similarly as for the DY, grew with a longer time period. T-tests indicated that the P/E ratio played a significant role in the models, its power to predict the stock returns was not as high as that of the DY, though.

Writings of Fama and French (1992), Berk (1995) as well as that of Kothari and Shanken (1997) found a certain power hidden in the B/M ratio to forecast stock returns. These papers were followed by Pontiff and Schall (1998) who surveyed the ability of the B/M ratio to predict returns on US stock markets within the time period 1926 – 1994. The data for the independent variables was collected using the shares contained in the DJIA and the Standard and Poor's Industrial Index (S&P). December book values of the DJIA components were used to calculate the book value of the whole index as the sum of per-share book values of included stocks divided by the DJIA divisor. The monthly B/M ratios were then determined as the DJIA book value at the end of the most recent year divided by the actual DJIA value, analogously for the S&P. Inspired by the previous research, the model examined by Pontiff and Schall included also the DY and three types of variables related to the interest rates: short term rate, the difference between short and long term rates, the excess of the corporate rate over the risk-free rate.

The entire investigated time period was divided into two subperiods – before and after 1960. The authors concluded that the overall US market stock returns could be predicted by the DJIA B/M ratio before 1960. Moreover, Pontiff and Schall argued the B/M ratio was a predictor of small firms excess returns. They claimed that the predictive power of the B/M ratio could be explained by the fact that the book value served well as a proxy for cash flows.

Nonetheless, in the second half of the selected period, there was no significant relationship between the B/M ratio of the DJIA and US stock market returns. A possible explanation appeared to be the fact that the DJIA worse represented the US equity market after 1960 as the number of publicly traded companies was rising and the DJIA included only 30 of them. Since the data for the S&P Index used by Pontiff and Schall started in 1940, the comparison over the whole examined period could not be provided. Nevertheless, the S&P, containing 350 components at that time, showed a better power of the B/M ratio to predict the stock returns after 1960 than did the DJIA. However, the null hypothesis of no statistical significance could not still be rejected.

Lewellen (2004) investigated the power of the DY, the B/M and the Earnings to Price ratio (E/P) to predict the stock returns of both equal- and value-weighted NYSE indices. The primary focus was put on the DY as this financial ratio had been analyzed most often in the previous literature. The B/M ratio was calculated based on the book value from the previous fiscal year and the market capitalization in the last month. Similarly, the E/P ratio depended on the share price from the previous month and operating earnings of the last year which were used instead of the net income. The DY was defined as dividends paid out over the previous year divided by the actual level of the value-weighted NYSE index. For the computation of all variables the data was based on the value-weighted index as it better represented the aggregate measures than did the values of the equal-weighted NYSE index.

Lewellen assumed all variables to be normally distributed and since all of them were ratios, he applied the natural logarithm in the regression models to better approximate the distribution. The following simple regression model was used to estimate the relationship between individual variables and expected returns

$$r_t = \alpha + \beta x_{t-1} + \epsilon_t,$$

where r_t is the return in month t and x_{t-1} represents one of the three selected financial ratios. Moreover, all variables were expected to be positively related to the stock returns. Therefore, $H_0 : \beta = 0$ was tested against $H_1 : \beta > 0$ which led to the usage of one-sided tests.

For the DY, the period $1946 - 2000$ was analyzed. Lewellen argued that this financial ratio turned out to be an important predictor of expected returns as the p-value associated with the t-test was lower than 0.03 for the entire period for both equal- and value-weighted NYSE index returns. As far as the B/M and the E/P are concerned, for both of these ratios the relationship with the expected return between 1963 and 2000 was also significant, less than that of the DY, though.

Ang and Bekaert (2006) focused on the significance of the DY as a predictor of future stock excess returns. Besides the USA, data from Germany, France and the UK was taken as a basis for the research. The authors analyzed the time period $1935 - 2001$ for the US and $1953 - 2001$ for the European countries. A short term rate was part of the regression model as it appeared to have a strong influence on short run expected stock returns. Ang and Bekaert showed that the DY had a statistically significant predictive power for the future excess returns for all horizons if the data until 1990 was considered. Nevertheless, with addition of the last decade of the second millenium, the DY was significant at 5% for the one-year horizon only. The null hypothesis of no significance could not be rejected even at the significance level of 58.7% for longer horizons. Thus, the results of this research suggested that the predictive power of the DY for the long-term stock returns was not significant across analyzed countries.

However, the ability of the DY to forecast stock returns was further discovered on the Chinese market by Wang and Iorio (2007) and on the Canadian market by Deaves et al. (2008).

Muradoglu and Sivaprasad (2008) conducted a research on the relationship between the stock return and the firm's leverage. 792 companies listed on the London Stock Exchange between 1980 and 2004 were divided into the following nine industries: oil & gas, basic materials, industrials, consumer goods, healthcare, consumer services, telecommunications, utilities and technology. In the first step, a simple regression model was used to test the power of just the leverage ratio to forecast stock returns. The examined variable appeared to be significant at the 5% level only for three sectors – Consumer Goods, Consumer Services and Industrials – the relationship was negative. The next model included the company size, the market-to-book ratio and the beta coefficient as additional independent variables. Muradoglu and Sivaprasad found out that in this multivariable regression the leverage ratio was positively significant at 5% for Utilities. Nevertheless, the whole sample as well as three industries mentioned above could be characterized by a negative relationship significant at the 5% level. For the remaining sectors, the leverage ratio did not turn out to be significant.

3. Presentation of various financial ratios

3.1 Price to Earnings Ratio

The Price to Earnings ratio is one of the most frequently used multiples for valuing stocks. It is calculated as

$$P/E = \frac{Market\ Value\ of\ the\ Share}{EPS},$$

where Earnings per Share (EPS) = $\frac{Net\ Income\ -\ Preferred\ Dividends}{Common\ Shares\ Outstanding}$.

The value of the P/E ratio shows how much investors are willing to pay for one unit of earnings of the company. Traders often compare the P/E ratio of a company with a certain benchmark, such as the average of the whole industry, in order to determine whether the concrete stock is overvalued or undervalued. In case of negative or zero earnings, the P/E ratio is expressed as "N/A".

In general, low values of the P/E ratio indicate that the stock price might be undervalued or that the earnings relative to the stock price are better than for the benchmark. The opposite holds for a high P/E ratio.

Two main types of this ratio are commonly stated. First, TTM (trailing 12 months) where the EPS is based on earnings of the last four quarters. Second, the forward P/E ratio where the expectations about future earnings are used in the computation.

Undoubtedly, using the P/E ratio to compare stocks operating in different industries is not appropriate as the way and timing of earning money varies in each sector. Another limitation associated with this financial ratio is the fact that the companies sometimes on purpose manipulate the earnings and, as a consequence, the values of the P/E ratio are not accurate.[1]

[1] Hayes, A. (17th March 2020). "Price-to-Earnings Ratio – P/E Ratio." Retrieved from: https://www.investopedia.com/terms/p/price-earningsratio.asp

3.2 Book to Market Ratio

The Book to Market ratio, another tool for determining the value of a company, represents a proportion of book and market values of the business. The formula for the computation of the ratio is as follows

$$B/M = \frac{Common\ Shareholders'\ Equity}{Market\ Capitalization}.$$

The numerator considers the net value of the firm's assets − total assets less total liabilities, preferred stocks and intangible assets. In other words, the book value shows how much value in assets would be left in case of a firm's bankruptcy. The denominator is determined by multiplying the number of common shares outstanding by the stock price.

The general rule says that if the market value of a company exceeds its book value, the stock is considered overvalued. In that case, B/M $<$ 1 and the stock is traded at a higher price than the firm's book value would indicate. Conversely, companies with the book value higher than the market value are regarded undervalued.

The B/M ratio should be used for comparing stocks of companies located in the same country as the accounting standards may vary across different states. Furthermore, this ratio is less informative for stocks from the IT industry because the companies operating in this sector tend to have significantly higher volume of intangible assets and, as a consequence, the book value is markedly low.[2]

3.3 Dividend Yield

The dividend yield represents a ratio of the annual dividend and the actual stock price

$$DY = \frac{Annual\ Dividend}{Stock\ Price}.$$

The numerator can be determined based on the dividends paid out over the last fiscal year, over the last four quarters or over the last quarter multiplied by four. Hence, it is important to take into account the fact that different sources could provide distinct results of the DYs. Therefore, when comparing stocks of selected

[2] Kenton, W. (1st July 2019). "Book-To-Market Ratio Definition." Retrieved from: https://www.investopedia.com/terms/b/booktomarketratio.asp

companies, traders should make sure that the computations of the DY used the same definition of an annual dividend and the stock price from the same day.

Although high values of the DY might be attractive to investors, one needs to bear in mind that it does not necessarily mean that the particular stock is an outstanding investment opportunity. For example, if a company is in financial difficulties and, as a consequence, its stock price falls, the DY will increase. Next, the higher the DY is, the less the company can invest in some growth opportunities in order to generate more profit. Therefore, it is crucial to investigate what stands behind a high DY and to consider what are possible costs of it.

Similarly as for the previous two financial ratios, it is also not advisable to compare the DY of companies operating in distinct industries as the standards regarding the dividend payments differ. Moreover, not every company pays out dividends.[3]

3.4 Debt to Equity Ratio

The Debt to Equity ratio computed as

$$D/E = \frac{Total\ Liabilities}{Total\ Shareholders'\ Equity}$$

helps investors assess the leverage of a company. It shows in which proportion assets are financed by liabilities and equity, or equivalently, how much the firm owes to its creditors for every unit owned by the shareholders.

A lower D/E ratio indicates that the company is financially quite stable. Nevertheless, it can also mean that the firm does not take the opportunity to increase its profits through the financial leverage.

On the other hand, higher values of the ratio imply a riskier business as assets are financed mostly by debts and less by shareholder's equity. In this case, the company might become unable to fulfill its obligations if a downturn occurs.[4]

[3] Chen, J. (15th November 2019). "Dividend Yield." Retrieved from: https://www.investopedia.com/terms/d/dividendyield.asp
[4] Hayes, A. (13th June 2019). "Debt-To-Equity Ratio – D/E." Retrieved from: https://www.investopedia.com/terms/d/debtequityratio.asp

The D/E ratio is often used in a slightly modified version of the CAPM

$$E(R_i) = r_f + \beta_i \left(1 + \frac{D}{E}\right) [E(R_m) - r_f] .$$

Since this form of the model takes into account the firm's leverage as well, it better assesses the returns investors should require from a company when considering investing in it.[5]

3.5 ROA and ROE

Return on Assets (ROA) and Return on Equity (ROE) are two similar ratios that show the proportion of the net income applicable to common shareholders and total assets or total equity

$$ROA = \frac{Net\ income}{Average\ Total\ Assets}$$

$$ROE = \frac{Net\ income}{Average\ Common\ Shareholders'\ Equity} .$$

ROA and ROE tell the investors how efficient the company is in using its assets and equity to generate profits – higher values of these ratios mean greater efficiency of the business' management.

Similarly as in the previous cases, comparing ROA or ROE of companies from different industries may lead to inaccurate conclusions. Instead, analyzing company's ROA and ROE within the sector or with respect to its historical values shall bring valuable information to investors.[6]

[5] Tarver, E. (27th March 2020). "How Does Debt Affect a Company's Beta?" Retrieved from: https://www.investopedia.com/ask/answers/051315/how-does-debt-affect-companys-beta.asp

[6] Fiorillo, S. (14th August 2019). "Return on Assets (ROA): Definition, Calculation, and Examples." Retrieved from: https://www.thestreet.com/personal-finance/education/what-is-return-on-assets-15055810

4. Regression models

4.1 Methodology

In total 106 firms divided into five industries became a basis for panel regression models the goal of which was to test the statistical significance of the following seven regressors for predicting stock returns on the NYSE: price to earnings ratio (P/E), dividend yield (DY), debt to equity ratio (D/E), book to market ratio (B/M), return on assets (ROA), return on equity (ROE) and market capitalization (MC).

For the time period between October 2008 and September 2019, the quarterly data on balance sheets, income statements and shares outstanding was obtained from the Y Charts webpage, cross-checked and compared with annual reports of selected companies and finance sites, such as Yahoo Finance or CNBC. Dividends and stock prices were gained from the Yahoo Finance webpage, checked and compared with the official websites of companies.

Independent variables were computed at the end of each quarter – TTM definition (trailing twelve months) was applied to P/E, DY, B/M, ROA and ROE, whereas the MC (in millions of USD), calculated as the number of common shares outstanding multiplied by the stock price, and the D/E reflect the numbers of last quarters. In case of a negative P/E, its value was set to 0.

This study takes into account the fact that companies announce quarterly earnings on average more than 30 days after the end of the quarter (Ghai 2016). Therefore, the days on which stocks could be sold or purchased were chosen as follows: 5^{th} May as the buying/selling day after Q1, 5^{th} August (Q2), 5^{th} November (Q3), 5^{th} February (Q4). If the 5^{th} was not a trading day, the next possible trading day was selected.

For each quarter, stock returns for the upcoming 3 months, 1 year and 3 years were calculated using the standard definition

$$R = \frac{P_1 - P_0 + d}{P_0},$$

where R stands for the stock return, P_0 and P_1 represent the stock prices in periods 0 and 1 and d is the dividend paid out between these two periods. The influence of financial ratios and the market capitalization on stock returns was examined within the time period from February 2010 to February 2020.

Companies chosen for the research were required to satisfy the following two criteria. First, the stock was traded on the NYSE without any break during the whole investigation period. Second, the firm paid out dividends at least once a year during the examined period. However, for airline and computer (software) stocks the dividend payment criterion was dropped in order to increase the number of analyzed stocks.

The RStudio software was used for the entire data analysis. First, the Hausman test was applied to determine whether the fixed or random effects model should be used. Since this test suggested the fixed effect model for all three time horizons in each industry, the following type of model was estimated:

$$\begin{aligned} R_{i,t} = {} & \beta_1 PE_{i,t-1} + \beta_2 DY_{i,t-1} + \beta_3 DE_{i,t-1} + \beta_4 BM_{i,t-1} + \beta_5 ROA_{i,t-1} + \\ & + \beta_6 ROE_{i,t-1} + \beta_7 MC_{i,t-1} + \alpha_i + u_{it}, \end{aligned}$$

where $R_{i,t}$ stands for the stock return of the i-th company in time period t. The coefficient α_i is specific for every company in a particular industry and is independent of time. Therefore, it does not contain any time index t. For airline and computer (software) industries, a slightly different model was used:

$$\begin{aligned} R_{it} = {} & \beta_1 PE_{i,t-1} + \beta_2 DIV_{i,t-1} + \beta_3 DE_{i,t-1} + \beta_4 BM_{i,t-1} + \beta_5 ROA_{i,t-1} + \\ & + \beta_6 ROE_{i,t-1} + \beta_7 MC_{i,t-1} + \alpha_i + u_{it}, \end{aligned}$$

where a dummy variable DIV, defined as

$$DIV_{i,t-1} = \begin{cases} 0 & \text{company } i \text{ did not pay dividends in period } t\text{-}1 \\ 1 & \text{company } i \text{ paid dividends in period } t\text{-}1, \end{cases}$$

replaced the DY.

The Wooldridge test was used in order to detect whether the autocorrelation in error terms is present. Next, the Breusch-Pagan test showed whether the assumption of homoscedasticity was violated or not. In case of heteroskedasticity

or/and autocorrelated error terms, appropriate robust standard errors were computed which enabled for each model to test the following hypotheses using the t-test:
$H_{0,i} : \beta_i = 0$ against $H_{1,i} : \beta_i \neq 0 \qquad \forall i = 1, \ldots, 7.$

4.2 Results interpretation

4.2.1 Airlines

Due to a small number of airline stocks traded on the NYSE and the fact that some of them had not been listed for the whole examined time period, only 7 companies (4 US and 3 foreign) were selected for the analysis in this sector. Since the dataset for the airline industry included only 7 stocks and the regression model 7 regressors, the random effect model could not be taken into consideration. Thus, for all three time horizons, without applying the Hausman test, the fixed effect model was estimated.

The results of the three-months returns model indicate that the P/E and ROE are statistically significant at the 0.1% level, both with a negative sign. Therefore, if there is ceteris paribus (c.p.) an increase in the P/E by 1, the predicted stock return is lower by 0.00006. Similarly, c.p. a rise in ROE by 0.1 would shrink the forecasted stock return by 0.0005. Next, the B/M also turns out to be statistically significant, at the 5% level, though. This ratio influences stock returns negatively, c.p. an increase in the B/M by 0.1 reduces the predicted stock return by 0.0032. The sign of $\hat{\beta}_4$ contradicts the results of Lewellen (2004) who, using the OLS regression, found a positive relationship between stock returns and the B/M ratio. Nevertheless, Lewellen analysed the returns of equal- and value-weighted NYSE indices, whereas this study considers 7 airline stocks.

In the one-year returns model, similarly as in the previous case, ROE appears to be statistically significant at 0.1%. C.p. a surge in this ratio by 0.1 would lead to a decrease in the predicted one-year stock return by 0.0009. Hence, the value of $\hat{\beta}_6$ in this model is almost twice as high as the value of $\hat{\beta}_6$ in the previous model. Next, the D/E with $\hat{\beta}_3 \doteq -0.0013$ is also statistically significant at the 0.1% level.

The results of the model for predicting three-years stock returns show the statistical significance of the D/E at the 0.1% level, again with a negative sign.

Since $\hat{\beta}_3 \doteq -0.0029$, the relationship between the D/E and three-years stock returns is more than twice as strong as between the D/E and one-year stock returns. Further, following three independent variables turn out to be statistically significant at the 5% level: P/E, ROA, MC. The coefficients related to these regressors were all negative, with respective values $\hat{\beta}_1 \doteq -0.0033$, $\hat{\beta}_5 = -10.203$ and $\hat{\beta}_7 \doteq -4.29 \cdot 10^{-5}$.

4.2.2 Computers and Software

Since most computer and software companies traded on the NYSE had their IPO during the last ten years, only few fulfilled the first condition to become part of this research. Therefore, the dividend payment criterion was not required in order to include more firms into the dataset. As a result, 13 companies (11 from the USA, one German and one Canadian) operating in this industry were chosen and the same type of model as the one for airline stocks was estimated.

For forecasting three-months returns, the P/E is the most significant financial ratio as the related null hypothesis is associated with p-value $\doteq 5 \cdot 10^{-5}$. Holding other variables fixed, a fall in the P/E by 10 increases the predicted stock return by 0.0005. The MC turns out to be statistically significant at the 1% level, $\hat{\beta}_7$ implies the expected stock return lower by 0.007 if there is c.p. an increase in the market cap by $10 billion. The D/E with p-value $\doteq 0.015$ represents the last significant regressor in this model. Ceteris paribus an increase in the D/E by one decreases the predicted stock return by 0.0033.

The second model revealed that for predicting one-year returns, the MC with $\hat{\beta}_7 \doteq -3.35 \cdot 10^{-6}$ is significant at 0.1%. In other words, a company with c.p. the market cap larger by $10 billion is expected to yield the stock return lower by 0.035. Next, the B/M and the P/E with $\hat{\beta}_1 \doteq -7.1 \cdot 10^{-5}$ result as significant regressors at the 5% level. The relationship between the B/M and one-year stock returns seems to be relatively strong as $\hat{\beta}_4 = 0.2225$.

For predicting three-years returns, only the MC is a significant variable as p-value $\doteq 0.0094$. The results show that for a company with c.p. the market cap higher by $10 billion, the expected stock return will be lower by 0.112. Comparing the coefficients of the MC across the models for three different time horizons, it can be concluded that the strength of the relationship between the MC and the returns on computer and software stocks increases with a longer investment horizon.

4.2.3 Financial services

Thirty four financial institutions (28 with the location in the USA and 6 from the rest of the world) were included in the dataset for this industry.

The results of the three-months stock returns model show two statistically significant financial ratios – the DY and the B/M, both with a positive sign and p-values smaller than 0.1%. Keeping other factors fixed, an increase in the DY by 0.01 implies a rise in the stock return by 0.0158. As far as the second significant ratio is concerned, companies with c.p. the B/M ratio lower by 0.1 are expected to reach the three-months return reduced by 0.0131.

The DY and the B/M turn out to be significant at 0.1% for predicting one-year returns as well. In this case, $\hat{\beta}_2 \doteq 5.22$ indicates more than three times stronger relationship between the DY and one-year returns than between the DY and three-months returns. Compared to the previous model, the B/M is also characterized by a higher predictive power as $\hat{\beta}_4 \doteq 3.855$. Further, the D/E and ROA are considered significant as well because the null hypotheses related to these ratios could be rejected at the 1% significance level. Both the D/E and ROA are positively correlated with expected one-year stock returns, $\hat{\beta}_3 \doteq 9.5 \cdot 10^{-3}$ and $\hat{\beta}_5 = 13.446$.

In the model for three-years returns, only the DY represents a significant relationship with the dependent variable as the corresponding p-value is 0.0011. Nevertheless, $\hat{\beta}_2 = 8.0854$ indicates an increase in predicted stock returns by 0.0809 given c.p. a rise in the DY by 0.01. Comparing the coefficients associated with the DY in all three time horizons models in this industry, it can be observed that the longer the investment period, the stronger the relationship between the DY and the predicted stock return.

4.2.4 Food & Beverages

In this sector, 17 companies were analyzed – 16 headquartered in the USA and one in the Philippines.

In the three-months returns model, the B/M can be considered the most significant variable as the related null hypothesis is associated with p-value $\doteq 0.00135$. The relationship between this ratio and stock returns is positive with $\hat{\beta}_4 \doteq 0.121$. Next, the MC appears to be statistically significant at the 5% level, $\hat{\beta}_7$ shows that a company with c.p. the market cap lower by $10 billion is expected to yield the three-months return higher by 0.0067.

The same two regressors are significant for predicting one-year returns, both associated with a lower p-value, though. The relationship between the B/M, significant at the 0.1% level, and one-year stock returns is four times stronger than in the three-months investment horizon as c.p. a rise in the B/M by 0.01 would lead to an increase in the predicted one-year stock return by 0.0053. The coefficient of the MC, also significant at 0.1%, shows that a firm with c.p. the market cap lower by $10 billion is predicted to reach the one-year return higher by 0.0296.

In the three-years stock returns model, besides the B/M and the MC, the P/E turns out to be statistically significant as well. The B/M with p-value $< 0.1\%$ shows even a stronger influence on stock returns than in the previous two models – if there is c.p. an increase in the B/M by 0.01, the three-years stock return is expected to be higher by 0.0195. The MC, significant at 0.1%, also plays a more meaningful role here – c.p. the market cap lower by $10 billion causes the expected stock return to rise by 0.0899. Last, the P/E with p-value $\doteq 0.0058$ is negatively correlated with three-years returns, $\hat{\beta}_1 \doteq -4.37 \cdot 10^{-4}$.

4.2.5 Energy

Stock returns of thirty five (28 US and 7 foregin) companies from the energy industry were examined.

In the regression model for three-months stock returns, ROE results as a significant financial ratio at the 0.1% level. Its negative correlation with the regressand shows that the predicted stock returns are 0.0005 lower if c.p. ROE increases by 0.1. Next, the MC represents a significant relationship with the stock returns as the corresponding p-value is 0.042. Keeping other factors fixed, a company with $10 billion larger market cap is expected to yield the three-months return lower by 0.007.

As far as the statistical significance is concerned, the model for predicting one-year returns yields similar results as the model for three-months returns – ROE significant at 0.1%, the MC at the 5% level. Nevertheless, the influence of both of these variables on stock returns strengthens. C.p. a rise in ROE by 0.1 would cause a decrease in the predicted stock return by 0.0015 and for a firm with c.p. the market cap higher by \$10 billion, the expectations of the stock return are 0.031 lower.

The MC turns out to be statistically significant at the 5% level for three-years returns as well. In this case, c.p. an increase in the MC by \$10 billion would lead to a fall in the expected stock return by 0.051. The last significant regressor in the model for three-years stock returns is the B/M with p-value $\doteq 0.04$ and $\hat{\beta}_4 \doteq 0.5692$ indicating that stocks of energy companies with c.p. the B/M higher by 0.1 are expected to yield 0.057 larger three-years returns.

4.3 Cross-industry comparison

As far as the search for statistically significant variables is concerned, running the regression models for 5 industries yielded, as expected, slightly different results for each sector. For airline stocks, the P/E, the D/E and ROE show a stronger power to predict stock returns as each of these three ratios turned out to be statistically significant in two out of three models.

The MC resulted as a significant regressor in all three stock returns models for computer and software companies. The sign of $\hat{\beta}_7$ was always negative, supporting the results of Muradoglu and Sivaprasad (2008) who found a negative correlation between the MC and stock returns for all examined industries. Moreover, the relationship between the MC and the predicted stock returns increased with a longer time horizon. Next, the P/E ratio, also negatively related to the stock returns, was statistically significant in both the three-months and one-year stock returns models in this sector.

The DY appeared to be the most reliable determinant of stock returns in the financial services industry as this ratio was statistically significant in all three models. The longer the investment period was, the stronger the positive relationship between the DY and the predicted stock returns. Further, the B/M showed a significant positive relationship with the stock returns of financial institutions in the first two models. These relationships are consistent with the writing of

Lewellen (2004) who also proved right a positive influence of both the DY and the B/M on stock returns.

For predicting stock returns in the food & beverages industry, the B/M and the MC were significant in all three models. The B/M influenced the stock returns positively, the MC negatively and it holds for both regressors that their predictive power strengthened with a longer investment period. These results, contrary to the sign of $\hat{\beta}_4$ from the three-months airline stock returns model, are fully in line with the findings of Pontiff and Schall (1998).

The MC, again with a negative sign, was statistically significant for predicting stock returns of energy companies in all three time horizons. Similarly as for computer and food stocks, the strength of the relationship between the MC and stock returns increased with a longer investment period. Additionally, ROE can also be considered important for predicting stock returns in the energy industry as it resulted as a significant regressor in both the three-months and one-year stock returns models.

5. Conclusion

5.1 Use of the results in practice

The main focus of this research was put on the investigation of the difference between 5 industries as far as the statistical significance of seven selected variables is concerned. The goal was reached since the results had shown different significant regressors for each sector. This might become a handy tool for investors considering stock trades on the NYSE. The division into 5 industries clearly offers an overview of financial ratios an investor should be interested in when buying a stock of a company operating in one of the sectors analyzed in this study. Moreover, examining three types of time horizons indicated that the strength of the relationship between a particular statistically significant regressor and the predicted stock return increased with a longer time period. Therefore, in case an investor plans a longer investment position, the magnitude given to significant financial ratios or market cap should be higher than when investing for a shorter time period.

Although the results might seem to be reliable, one needs to bear in mind that the analysis performed in this study is associated with certain shortcomings. For example, the investigation period is only 10 years. Next, airline as well as computer and software industries include a small number of analyzed companies. Hence, it cannot be guaranteed that these results fully reflect the typicalness of selected industries and that they will still be valid in the future. Therefore, this thesis does not serve as an investment advisory and trading based on its outcomes may not secure future profits.

5.2 Suggestions for further research

Considering the fact that this paper investigated the predictability of stock returns for five industries and a 10-year time period, there undoubtedly exist various possibilities how it could be extended and enhanced. With regard to the time period between February 2010 and February 2020, this era can be characterized as a bull market on the NYSE which can be proven by the development of both the DJIA and the S&P 500. Within the investigation period selected for the analysis, the

DJIA rose by 192.6%, whereas the S&P by 212.8%.[1,2] Thus, it is open for further research whether the results can be the same or at least similar if the examined time period included an era of a bear market as well.

Next, additional sectors could be considered in order to be able to compare more than just five industries in terms of statistically significant variables and the strength of their relationship with predicted stock returns.

5.3 Summary of this thesis

The purpose of this study was to investigate the power of 6 financial ratios and market capitalization to predict stock returns on the NYSE between February 2010 and February 2020. In order to be able to find out certain specificities in different industries, analyzed companies were divided into 5 sectors: airlines, computers and software, financial services, food and beverages, energy. Moreover, three time horizons (three months, one year, three years) were considered which enabled to observe both the statistical significance and strength of the relationships relative to the length of the investment horizon.

The regression models revealed that the P/E, the D/E and ROE, all negatively related to the stock returns, were the most significant financial ratios in the airline industry. For computers and software, the P/E and the MC played the most meaningful role in predicting stock returns − both variables represented a negative relationship with the stock return indicating that companies with ceteris paribus a smaller market capitalization are expected to reach a higher stock return. The DY resulted as a significant variable in the financial services industry only, for all three time horizons, though. Its positive correlation with the regressand suggests that the higher the dividend yield, the higher the expected stock return. Moreover, the strength of the relationship increased with a longer investment horizon. For the food & beverages industry, both the B/M and the MC turned out to be statistically significant in all three time horizon models. The B/M was positively correlated with expected stock returns, the MC negatively. The MC showed a negative relationship with predicted stock returns in the energy industry for all three time horizons. In addition, ROE, statistically significant for two investment horizons, also influenced stock returns negatively in this industry.

[1] https://finance.yahoo.com/quote/%5EDJI/history?p=%5EDJI
[2] https://finance.yahoo.com/quote/%5EGSPC/history?p=%5EGSPC

The results of the regression models showed different outcomes for each of five selected industries. Hence, the major goal of this research was achieved. It also confirmed certain previous writings in a way that the signs of the relationship between the stock returns and a concrete financial ratio or market capitalization go in line with what had already been found out. Further, the correlation between the regressand and statistically significant regressors strengthened with a longer investment horizon. Contrary to the previous research that focused mostly on stock indices or groups of stocks, this paper offers an overview of variables that are statistically significant for predicting stock returns in five distinct industries. The findings of this study suggest that financial ratios might be a helpful tool for predicting stock returns on the NYSE which contradicts the semi-strong form of the EMH.

Bibliography

[1] Ang, A. & Bekaert, G. (2006). "Stock return predictability: Is it there?" *Review of Financial studies* **20(3)**: pp. 651 - 707.

[2] Ball, R. & Brown, P. (1968). "An empirical evaluation of accounting income numbers." *Journal of Accounting Research* **6(2)**: pp. 159 - 178.

[3] Berk, J. (1995). "A critique of size related anomalies." *Review of Financial Studies* **8(2)**: pp. 275 - 286.

[4] Bernstein, P. L. (1999). "A new look at the efficient market hypothesis." *The Journal of Portfolio Management* **25(2)**: pp. 1 - 2.

[5] Campbell, J. Y. & Shiller, R. J. (1988). "Stock Prices, Earnings and Expected Dividend." *Journal of Finance* **43(3)**: pp. 661 - 676.

[6] Deaves, R.; Miu, P. & White, C. B. (2008). "Canadian stock market multiples and their predictive content." *International Review of Economics and Finance* **17(3)**: pp. 457 - 466.

[7] Dhrymes, P. J.; Friend, I. & Gultekin, N. B. (1984). "A Critical Reexamination of the Empirical Evidence on the Arbitrage Pricing Theory." *Journal of Finance* **39(2)**: pp. 323 - 346.

[8] Fama, E. F. (1965). "The Behavior of Stock-Market Prices." *Journal of Business* **38(1)**: pp. 34 - 105.

[9] Fama, E. F. (1970). "Efficient Capital Markets: A Review of Theory and Empirical Work." *Journal of Finance* **25(2)**: pp. 383 - 417.

[10] Fama, E. F.; Fisher, L.; Jensen, M. C. & Roll, R. (1969). "The adjustment of stock prices to new information." *International Economic Review* **10(1)**: pp. 1 - 21.

[11] Fama, E. F. & French, K. (1988). "Dividend yields and expected stock returns." *Journal of Financial Economics* **22(1)**: pp. 3 - 25.

[12] Fama, E. F. & French, K. R. (1992). "Common risk factors in the returns on stocks and bonds." *Journal of Financial Economics* **33(1)**: pp. 3 - 56.

[13] French, C. W. (2003). "The Treynor Capital Asset Pricing Model." *Journal of Investment Management* **1(2)**: pp. 60 - 72.

[14] Ghai, P. (2016). "How Long Does it Take to Announce Earnings?" Accessed on 15th November 2019 at http://www.calcbench.com.

[15] Granger, C. W. J. & Morgenstern, O. (1963). "Spectral analysis of New York stock market prices." *Kyklos* **16(1)**: pp. 1 - 27.

[16] Grossman, S. J. & Stiglitz, J. E. (1980). "On the impossibility of informationally efficient markets." *American Economic Review* **70(3)**: pp. 393 - 408.

[17] Jovanovic, F. & Le Gall, P. (2001). "Does God practice a random walk?" *European Journal of the History of Economic Thought* **8(3)**: pp. 332 - 362.

[18] Kendall, M. G. (1953). "The analysis of economic time-series – Part I: Prices." *Journal of the Royal Statistical Society. Series A (General)* **116(1)**: pp. 11 - 34.

[19] Keynes, J. M. (1923). "Some aspects of commodity markets." *Manchester Guardian Commercial: European Reconstruction Series*: pp. 784 - 786. Section 13. 29th March 1923.

[20] Kothari, S. P. & Shanken, J. (1997). "Book-to-market, dividend yield, and expected market returns: a time-series analysis." *Journal of Financial Economics* **44(2)**: pp. 169 - 203.

[21] Latif, M.; Arshad, S.; Fatima, M. & Farooq, S. (2011). "Market Efficiency, Market Anomalies, Causes, Evidences, and Some Behavioral Aspects of Market Anomalies." *Research Journal of Finance and Accounting* **2(9/10)**: pp. 1 - 13.

[22] Lewellen, J. (2004). "Predicting returns with financial ratios." *Journal of Financial Economics* **74(2)**: pp. 209 - 235.

[23] Macaulay, F. R. (1925). "Forecasting security prices." *Journal of the American Statistical Association* **20(150)**: pp. 244 - 249.

[24] Malkiel, B. G. (2015). "A Random Walk Down Wall Street". 11th ed. New York: W.W. Norton & Company.

[25] Markowitz, H. (1952). "Portfolio Selection." *Journal of Finance* **7(1)**: pp. 77 - 91.

[26] Markowitz, H. M. (1959). "Portfolio Selection: Efficient Diversification of Investments". Yale University Press. Retrieved November 25, 2019, from www.jstor.org/stable/j.ctt1bh4c8h

[27] Modigliani, F. & Miller, M. (1958). "The Cost of Capital, Corporation Finance, and the Theory of Investment." *American Economic Review* **48(3)**: pp. 261 - 297.

[28] Muradoglu, G. & Sivaprasad, S. (2008). "An Empirical Test on Leverage and Stock Returns." Cass Business School.

[29] Niederhoffer, V. & Osborne, M. F. M. (1966). "Market Making and Reversal on the Stock Exchange." *Journal of the American Statistical Association* **61(316)**: pp. 897 - 916.

[30] Osmond, D. C. (1956). "The Great Crash, 1929 by John K. Galbraith." *Case Western Reserve Law Review* **7(2)**: pp. 209 - 212.

[31] Pontiff, J. & Schall, L. D. (1998). "Book-to-market ratios as predictors of market returns." *Journal of Financial Economics* **49(2)**: pp. 141 - 160.

[32] Roll, R. & Ross, S. A. (1980). "An Empirical Investigation of the Arbitrage Pricing Theory." *Journal of Finance* **35(5)**: pp. 1073 - 1103.

[33] Roll, R. (1977). "A critique of the asset pricing theory's tests Part I: On past and potential testability of the theory." *Journal of Financial Economics* **4(2)**: pp. 129 - 176.

[34] Ross, S. A. (1976). "The Arbitrage Theory of Capital Asset Pricing." *Journal of Economic Theory* **13(3)**: pp. 341 - 360.

[35] Samuelson, P. A. (1965). "Proof that properly anticipated prices fluctuate randomly." *Industrial Management Review* **6(2)**: pp. 41 - 49.

[36] Sewell, M. (2011). "History of the efficient market hypothesis." Research Note RN/11/04. University College London, London. 20th January 2011.

[37] Shiller, R. J. (1981). "Do stock prices move too much to be justified by subsequent changes in dividends?" *American Economic Review* **71(3)**: pp. 421 - 436.

[38] Shostak, F. (1997). "In Defense of Fundamental Analysis: A Critique of the Efficient Market Hypothesis." *Review of Austrian Economics* **10(2)**: pp. 27 - 45.

[39] Sullivan, E. J. (2006). "A brief history of the capital asset pricing model." *APUBEF Proceedings* **(Fall 2006)**: pp. 207 - 210.

[40] Wang, Y. & Iorio, A. D. (2007). "The cross-sectional relationship between stock returns and domestic and global factors in the Chinese A-share market." *Review of Quantitative Finance and Accounting* **29(2)**: pp. 181 - 203.

[41] Working, H. (1934). "A random-difference series for use in the analysis of time series." *Journal of the American Statistical Association* **29(185)**: pp. 11 - 24.

[42] https://www.nyse.com

[43] https://www.nasdaq.com

[44] https://www.intercontinentalexchange.com

[45] https://www.finance.yahoo.com

[46] https://www.investopedia.com

[47] https://www.ft.com

[48] https://www.thehill.com

[49] https://www.thebalance.com

[50] https://www.measuringworth.com

[51] https://www.cnbc.com

[52] https://www.ycharts.com

[53] https://www.otcmarkets.com

[54] https://www.sec.gov

A. Appendix

A.1 Results from RStudio

Airlines – 3 months

```
Coefficients:
           Estimate  Std. Error t value  Pr(>|t|)    
TTM.P.E -6.2178e-05  1.2922e-05 -4.8119 2.509e-06 ***
DIV      1.4291e-03  2.9933e-02  0.0477   0.96196    
D.E     -6.5966e-05  3.8665e-05 -1.7061   0.08916 .  
B.M     -3.2182e-02  1.3335e-02 -2.4134   0.01648 *  
ROA     -1.7415e-01  4.3022e-01 -0.4048   0.68596    
ROE     -4.9411e-03  8.3898e-04 -5.8894 1.166e-08 ***
MC      -2.0916e-06  1.9139e-06 -1.0928   0.27546    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    12.801
Residual Sum of Squares: 11.787
R-Squared:      0.079224
Adj. R-Squared: 0.034223
F-statistic: 3.26953 on 7 and 266 DF, p-value: 0.0023844
```

Airlines – 1 year

```
Coefficients:
           Estimate  Std. Error t value  Pr(>|t|)    
TTM.P.E -1.8991e-06  3.8468e-05 -0.0494   0.96067    
DIV     -3.9764e-02  8.5265e-02 -0.4664   0.64138    
D.E     -1.2614e-03  3.0989e-04 -4.0704 6.336e-05 ***
B.M     -9.2078e-02  6.9951e-02 -1.3163   0.18930    
ROA     -2.1954e+00  1.2629e+00 -1.7383   0.08342 .  
ROE     -9.2751e-03  1.7124e-03 -5.4163 1.451e-07 ***
MC      -6.1940e-06  5.8982e-06 -1.0501   0.29469    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    73.642
Residual Sum of Squares: 56.196
R-Squared:      0.2369
Adj. R-Squared: 0.19641
F-statistic: 10.8655 on 7 and 245 DF, p-value: 6.2415e-12
```

Airlines – 3 years

```
Coefficients:
           Estimate  Std. Error t value  Pr(>|t|)    
TTM.P.E -3.2581e-03  1.2638e-03 -2.5779   0.01070 *  
DIV     -1.8741e-01  2.0152e-01 -0.9300   0.35357    
D.E     -2.9198e-03  6.8543e-04 -4.2599 3.222e-05 ***
B.M     -1.0889e-01  1.0777e-01 -1.0104   0.31358    
ROA     -1.0203e+01  4.6015e+00 -2.2174   0.02779 *  
ROE     -1.7069e-03  1.0418e-02 -0.1638   0.87003    
MC      -4.2902e-05  1.7104e-05 -2.5083   0.01297 *  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    561.19
Residual Sum of Squares: 334.92
R-Squared:      0.40319
Adj. R-Squared: 0.36214
F-statistic: 18.2405 on 7 and 189 DF, p-value: < 2.22e-16
```

Computers and Software – 3 months

```
Coefficients:
           Estimate  Std. Error t value  Pr(>|t|)    
TTM.P.E -4.7274e-05  1.1563e-05 -4.0884 5.061e-05 ***
DIV      2.8667e-02  1.9267e-02  1.4879  0.137417    
D.E     -3.2946e-03  1.3487e-03 -2.4429  0.014915 *  
B.M      4.8154e-02  3.5732e-02  1.3477  0.178381    
ROA     -1.7000e-01  9.7922e-02 -1.7361  0.083162 .  
ROE      8.7456e-03  1.4320e-02  0.6107  0.541667    
MC      -6.8492e-07  2.2157e-07 -3.0912  0.002105 ** 
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    11.489
Residual Sum of Squares: 11.109
R-Squared:      0.033087
Adj. R-Squared: -0.0036557
F-statistic: 2.44423 on 7 and 500 DF, p-value: 0.018005
```

Computers and Software – 1 year

```
Coefficients:
           Estimate  Std. Error t value  Pr(>|t|)    
TTM.P.E -7.1345e-05  2.9618e-05 -2.4088   0.01639 *  
DIV      1.1289e-02  4.2967e-02  0.2627   0.79288    
D.E     -1.2061e-02  7.4033e-03 -1.6291   0.10398    
B.M      2.2250e-01  9.0941e-02  2.4467   0.01479 *  
ROA     -1.6897e-01  3.0277e-01 -0.5581   0.57705    
ROE      9.9388e-02  8.5461e-02  1.1630   0.24544    
MC      -3.3493e-06  5.4814e-07 -6.1102 2.119e-09 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    51.705
Residual Sum of Squares: 48.838
R-Squared:      0.055446
Adj. R-Squared: 0.016517
F-statistic: 3.8659 on 7 and 461 DF, p-value: 0.00042041
```

Computers and Software – 3 years

```
Coefficients:
           Estimate  Std. Error t value Pr(>|t|)   
TTM.P.E -1.1072e-04  7.1024e-05 -1.5589 0.119915   
DIV      8.1313e-02  7.7635e-02  1.0474 0.295637   
D.E     -8.2863e-02  7.7658e-02 -1.0670 0.286686   
B.M      1.2861e+00  1.0255e+00  1.2541 0.210619   
ROA      2.0287e+00  1.8826e+00  1.0776 0.281936   
ROE     -1.7634e-01  4.5508e-01 -0.3875 0.698618   
MC      -1.1192e-05  4.2857e-06 -2.6114 0.009398 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    350.63
Residual Sum of Squares: 325.77
R-Squared:      0.070919
Adj. R-Squared: 0.021472
F-statistic: 3.89294 on 7 and 357 DF, p-value: 0.00041962
```

Financial services – 3 months

```
Coefficients:
          Estimate   Std. Error t value  Pr(>|t|)
TTM.P.E -1.1160e-04  1.2320e-04 -0.9059 0.3651550
TTM.DY   1.5792e+00  4.0502e-01  3.8990 0.0001014 ***
D.E      3.8932e-03  2.3302e-03  1.6707 0.0950109 .
B.M      1.3075e-01  1.8351e-02  7.1248  1.71e-12 ***
ROA      1.4347e+00  1.9216e+00  0.7466 0.4554234
ROE      4.9654e-02  1.4750e-01  0.3366 0.7364378
MC       3.4058e-08  1.4774e-07  0.2305 0.8177207
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    17.078
Residual Sum of Squares: 15.855
R-Squared:      0.07158
Adj. R-Squared: 0.043425
F-statistic: 14.5277 on 7 and 1319 DF, p-value: < 2.22e-16
```

Financial services – 1 year

```
Coefficients:
          Estimate   Std. Error t value  Pr(>|t|)
TTM.P.E  2.2262e-05  2.8875e-04  0.0771 0.9385574
TTM.DY   5.2233e+00  1.3480e+00  3.8750 0.0001123 ***
D.E      9.4877e-03  3.3892e-03  2.7994 0.0052011 **
B.M      3.8547e-01  4.6805e-02  8.2357 4.563e-16 ***
ROA      1.3446e+01  4.6368e+00  2.8998 0.0038011 **
ROE     -3.7681e-01  2.8728e-01 -1.3117 0.1898826
MC      -3.8662e-07  5.3260e-07 -0.7259 0.4680304
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    61.828
Residual Sum of Squares: 50.786
R-Squared:      0.17859
Adj. R-Squared: 0.15159
F-statistic: 37.8005 on 7 and 1217 DF, p-value: < 2.22e-16
```

Financial services – 3 years

```
Coefficients:
          Estimate   Std. Error t value Pr(>|t|)
TTM.P.E  6.0526e-04  4.6552e-04  1.3002 0.193851
TTM.DY   8.0854e+00  2.4676e+00  3.2766 0.001089 **
D.E      3.5716e-03  7.8725e-03  0.4537 0.650166
B.M      2.1432e-01  1.1250e-01  1.9050 0.057078 .
ROA      7.5992e+00  6.4966e+00  1.1697 0.242410
ROE     -1.0991e-01  4.0348e-01 -0.2724 0.785364
MC      -3.4267e-06  1.8432e-06 -1.8591 0.063324 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    87.121
Residual Sum of Squares: 75.872
R-Squared:      0.12911
Adj. R-Squared: 0.092252
F-statistic: 20.0147 on 7 and 945 DF, p-value: < 2.22e-16
```

Food & Beverages – 3 months

```
Coefficients:
           Estimate  Std. Error t-value Pr(>|t|)
TTM.P.E -2.6606e-05  5.4385e-05 -0.4892 0.624847
TTM.DY   2.7331e-01  5.9666e-01  0.4581 0.647059
D.E      5.8329e-03  5.9890e-03  0.9739 0.330453
B.M      1.2069e-01  3.7491e-02  3.2191 0.001349 **
ROA     -5.9105e-02  2.7304e-01 -0.2165 0.828686
ROE      3.5111e-02  6.1284e-02  0.5729 0.566888
MC      -6.6838e-07  3.1495e-07 -2.1222 0.034196 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    6.4334
Residual Sum of Squares: 6.2408
R-Squared:      0.029938
Adj. R-Squared: -0.0040733
F-statistic: 2.89221 on 7 and 656 DF, p-value: 0.0055373
```

Food & Beverages – 1 year

```
Coefficients:
           Estimate  Std. Error t value  Pr(>|t|)
TTM.P.E -8.5180e-05  6.5672e-05 -1.2971    0.1951
TTM.DY   2.1988e+00  1.7106e+00  1.2854    0.1991
D.E      1.3051e-02  1.3359e-02  0.9769    0.3290
B.M      5.3032e-01  7.2203e-02  7.3449 6.685e-13 ***
ROA     -7.5329e-01  5.7143e-01 -1.3182    0.1879
ROE      1.2235e-02  1.1747e-01  0.1042    0.9171
MC      -2.9583e-06  5.9060e-07 -5.0089 7.194e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    25.811
Residual Sum of Squares: 22.002
R-Squared:      0.14757
Adj. R-Squared: 0.11516
F-statistic: 14.9623 on 7 and 605 DF, p-value: < 2.22e-16
```

Food & Beverages – 3 years

```
Coefficients:
           Estimate  Std. Error t value  Pr(>|t|)
TTM.P.E -4.3694e-04  1.5768e-04 -2.7711 0.0058095 **
TTM.DY   1.8278e+01  1.0894e+01  1.6779 0.0940352 .
D.E      1.0478e-02  6.1246e-02  0.1711 0.8642331
B.M      1.9498e+00  4.3650e-01  4.4669 9.957e-06 ***
ROA     -2.3551e+00  2.7525e+00 -0.8556 0.3926352
ROE      4.7791e-01  6.9627e-01  0.6864 0.4928042
MC      -8.9935e-06  2.4452e-06 -3.6781 0.0002622 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    84.62
Residual Sum of Squares: 44.923
R-Squared:      0.46912
Adj. R-Squared: 0.44308
F-statistic: 59.205 on 7 and 469 DF, p-value: < 2.22e-16
```

Energy – 3 months

```
Coefficients:
           Estimate  Std. Error t value  Pr(>|t|)
TTM.P.E  8.4777e-06  7.3417e-06  1.1547   0.24840
TTM.DY   1.3713e-01  2.6834e-01  0.5111   0.60940
D.E      5.1423e-05  2.9527e-04  0.1742   0.86177
B.M      3.6794e-04  3.8357e-02  0.0096   0.99235
ROA     -4.0472e-04  1.4812e-02 -0.0273   0.97821
ROE     -4.5673e-03  7.7741e-04 -5.8750 5.312e-09 ***
MC      -7.4176e-07  3.6435e-07 -2.0358   0.04196 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    29.78
Residual Sum of Squares: 29.416
R-Squared:      0.01221
Adj. R-Squared: -0.017612
F-statistic: 2.39811 on 7 and 1358 DF, p-value: 0.019332
```

Energy – 1 year

```
Coefficients:
           Estimate  Std. Error t value  Pr(>|t|)
TTM.P.E -1.5448e-05  2.6137e-05 -0.5911   0.55459
TTM.DY   1.0342e+00  1.0581e+00  0.9773   0.32859
D.E     -4.4330e-06  8.9200e-04 -0.0050   0.99604
B.M      9.4402e-02  1.3525e-01  0.6980   0.48532
ROA     -2.7943e-02  5.0553e-02 -0.5528   0.58053
ROE     -1.4551e-02  3.2558e-03 -4.4694 8.554e-06 ***
MC      -3.0766e-06  1.4374e-06 -2.1405   0.03251 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    106.92
Residual Sum of Squares: 100.5
R-Squared:      0.060054
Adj. R-Squared: 0.029298
F-statistic: 11.4365 on 7 and 1253 DF, p-value: 3.9472e-14
```

Energy – 3 years

```
Coefficients:
           Estimate  Std. Error t value Pr(>|t|)
TTM.P.E  9.9776e-05  2.4235e-04  0.4117  0.68065
TTM.DY   2.8789e+00  2.5095e+00  1.1472  0.25158
D.E      4.3728e-03  2.4722e-03  1.7688  0.07723 .
B.M      5.6919e-01  2.7684e-01  2.0560  0.04005 *
ROA      3.0743e-02  1.4091e-01  0.2182  0.82734
ROE     -1.3293e-02  1.1898e-02 -1.1172  0.26418
MC      -5.1310e-06  2.4997e-06 -2.0526  0.04037 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    218.79
Residual Sum of Squares: 199.91
R-Squared:      0.086264
Adj. R-Squared: 0.047761
F-statistic: 13.1227 on 7 and 973 DF, p-value: 3.1817e-16
```

A.2 List of companies included in the analysis

Airlines

Alaska Air Group, American Airlines Group, Copa Holdings, Delta Air Lines, Gol

Linhas Aéreas, LATAM Airlines, Southwest Airlines

Computers

3D Systems, BlackBerry Limited, FactSet, HP Inc., IBM, Juniper Networks, Oracle Corporation, Salesforce.com, SAP, Teradata, Tyler Technologies, Vmware, Xerox

Financial Services

Associated Banc-Corp, Banc of California, Banco Bilbao Vizcaya Argentaria, Banco Latinoamericano de Comercio Exterior, BancorpSouth, Bank of America, Bank of Hawaii, Berkshire Bank, Capital One, Comerica, Community Bank, Credit Suisse, Cullen/Frost Bankers, F.N.B. Corporation, First Commonwealth Bank, JPMorgan Chase, KeyBank, M&T Bank, Mizuho Financial Group, New York Community Bank, OFG Bancorp, PNC Financial Services, Prosperity Bancshares, Provident Financial Services, Regions Financial Corporation, Scotiabank, State Street Corporation, Sterling Bancorp, Synovus, TCF Financial Corporation, The Bank of New York Mellon, U.S. Bancorp, Webster Financial Corporation, Wells Fargo

Food & Beverages

Archer Daniels Midland, B&G Foods, Bunge, Campbell Soup, Coca-Cola FEMSA, Conagra Brands, General Mills, Ingredion Incorporated, Kellogg's, Kroger, McCormick & Company, Molson Coors Beverage Company, The JM Smucker Company, The Coca-Cola Company, The Hershey Company, Tootsie Roll Industries, Weis Markets

Energy

Apache Corporation, Cabot Oil & Gas Corporation, Canadian Natural Resources, Cimarex Energy, ConocoPhillips, Crescent Point Energy, Cross Timbers Royalty Trust, Devon Energy, Enerplus, EOG Resources, EQT, ExxonMobil, Halliburton, Helmerich & Payne, Chesapeake Utilities, Chevron, Marathon Oil, Murphy Oil, Noble Energy, Occidental Petroleum, Oneok, Ormat Technologies, Panhandle Oil and Gas, Permian Basin Royalty Trust, PetroChina, Pioneer Natural Resources, Range Resources, Sabine Royalty Trust, Schlumberger, Sinopec, SM Energy, Southwest Gas, Statoil, Texas Pacific Land Trust, Total