Tomas Bata University in Zlín
Faculty of Management and Economics

Business Valuation of the Companies Listed on the Prague Stock Exchange and V4 Countries

Oceňování podniků na Burze cenných papírů Praha a zemích V4

Author: **Ing. Florin Aliu**

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Supervisor: doc. Ing. Adriana Knápková, Ph.D.

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Abstract

The work primarily estimates the intrinsic value of the companies listed on the Prague Stock Exchange as an important price signals delivered in the stock market. Determining the estimated intrinsic value of the companies listed in the stock exchanges is essential evidence not just for mergers and acquisition, but also for banks, suppliers, customers, investors, shareholders and employees on the current and future outlook of the company. There are many unclear inputs standing on the general theoretical concepts and practical applications that lie within the valuation of publicly listed companies. The results of the study try to give small indications on an overall complex issue of the valuation process. The first aim of the work determines if the companies listed on the PSE (Prague Stock Exchange) might be undervalued or overvalued. The second aim of work indicates factors affecting deviation of the stock market prices from the intrinsic value to the market prices. The third aim of the work will define the risk level when Prague Stock Exchange join the other stock markets of the Visegrad countries. Results of the work confirm that average stock price of the Czech listed companies in 2017 deviate from their estimated intrinsic value in the range of 58% while international companies in the range of 301%. Moreover, from the 10 selected companies within the Prague Stock Exchange, average deviation within estimated intrinsic value and average market price was 179.8% in 2017. The companies that had very low deviation within estimated intrinsic value and average market price in 2017, were: CEZ, Kofola Ceskoslovensko, Unipetrol Orlen Group, Moneta Bank and Stock Spirit PLC. Results of the third aim show that risk level of the PSE would have been 17.5% lower if it would operate under hypothetical Visegrad Stock Exchange. Moreover, the risk level of the PSE would have declined within the hypothetical Visegrad Stock Exchange from σ=1.28 to

the σ=1.09.However, average risk level from 2009 till 2017 of the individual Visegrad stock exchanges, was as follows: Budapest Stock Exchange contained the lowest risk, followed by Prague Stock Exchange, Warsaw Stock Exchange and Bratislava Stock Exchange.

Abstrakt

Práce se primárně zabývá oceňováním společností obchodovaných na Burze cenných papírů Praha (BCPP), následně se zaměřuje na další visegradské země. Oceňování společností je důležitým prvkem cenových signálů, které jsou trhem poskytovány. Určení vnitřní hodnoty společností je důležitým prvkem nejen pro fúze a akvizice, ale také pro banky, dodavatele, zákazníky a zaměstnance ve vztahu k současnému a budoucímu vývoji společností. V současné době existuje mnoho nejasností v teoretických koncepcích a praktických aplikacích týkajících se oceňování obchodovaných společností. Výsledky předkládané disertační práce jsou zaměřeny na komplexní otázku procesu oceňování společností. První část práce bude zaměřena na vyřešení otázky, zda jsou společnosti obchodované na BCPP podhodnoceny, nadhodnoceny nebo řádně oceněny. Druhým cílem práce bude identifikace faktorů, které ovlivňují odchylku tržních cen na BCPP od jejich vnitřní hodnoty. Třetí cíl práce se zaměřuje na získání odpovědi, zda je výhodnější, aby se BCPP připojila k ostatním akciovým trhům v rámci zemí visegrádské skupiny. Výsledky disertační práce potvrzují, že průměrná cena akcií českých kótovaných společností se v roce 2017 odchyluje od jejich vnitřní hodnoty o 58 %, zatímco u mezinárodních společností činí odchylka 301 %. Průměrná odchylka odhadované vnitřní hodnoty a průměrné tržní ceny u vybraných 10 společností obchodovaných na BCPP činila v roce 2017 180 %. Společnosti, které měly v roce 2017 velmi nízkou odchylku vnitřní ceny od průměrné tržní ceny, byly: Kofola Československo, Unipetrol Orlen Group, Moneta Bank a Stock Spirit PLC. Výsledky třetího cíle ukazují, že úroveň rizika BCPP by byla o 17,5 % nižší, kdyby se připojila k akciovým trhům visegrádských zemí. Úroveň rizika BCPP by navíc poklesla z σ=1.28 naσ=1.09. Průměrná míra rizika od roku 2009 do roku

2017 na jednotlivých burzách V4 byla následující: Burza cenných papírů Budapešť měla nejnižší riziko, následovala Burza cenných papírů Praha, Burza cenných papírů Varšava a nejvyšší riziko vykazovala Burza cenných papírů Bratislava.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

CAPM - Capital Asset Pricing Model

CEZ - České Energetické Závody

CFO – Cash Flow from Operations

CGP - Commisariat Genral Du Plan

CNB - Czech National Bank

CPI - Consumer Price Index

CZK - Czech Crown

DAX - German Stock Index

DCF- Discounted Cash Flow

DIJA - Down Jones Industrial Average

EGB - Erste Group Bank

EMH - Efficient Market Hypothesis

EUCB -European Central Bank

FCE- Free Cash Flow to Equity

FCFF- Free Cash Flow to the Firm

FED - Federal Reserve

GDP -Gross Domestic Product

KB- Komercni Banka

KCS - Kofola CeskoSlovensko

NI – Net Income

NOPA – Net Operating Profit after Taxes

NWC – Net Working Capital

PPE – Property, Plant and Equipment's

PSE - Prague Stock Exchange

SAX - Bratislava Stock Exchange

SDR – Social Discount Rate

SSG - Stock Spirit Group

VIG - Vienna Insurance Group

V4 – Visegrad Countries

WACC - Weighted Average Cost of Capital

WIG -Warsaw Stock Exchange

1. INTRODUCTION

Company valuation is a significant feature of the management performance that reflects underlying settings of the company. Moreover, company value depends on two inputs that are negatively related within them, such as: risk and returns. Returns are detected through cash flows that the company generates. Risk is shown on the cost of equity and cost of debt which are involved within the discount rate (Damodaran, 2005). In addition, higher risk revealed on the discount rate, declines the value of the company and the other way around. Different scholars apply the diverse methodology on the valuation process. Valuation of the company is an important outcome in reflecting the existing situation of the company as far as it delivers information on future and the current prospect of assets, debt, equity, cash flow and so on. The book value of the equity represents historical registrations of the difference between assets and debts. The equity value gained from balance sheet does not reflect the current state of the assets. Market value reveals the truthful company position. Market prices are determined by market forces such as: demand, supply, macro factors, firm specific factors etc. Fama (1968) considers that stock market prices adjust toward the intrinsic value of the company. In contrast, Shiller (2000) confirms that stock markets most of the time are leaded from euphoria, driven by psychological factors. Moreover, Harry Markowitz (1952, 1959), established the first modern concepts that risk exposure within stock markets can be eliminated through diversification.

The intrinsic value of the company reflects the fundamental situation within the company. Risk is a crucial element in a value position of the company, captured through the uncertainties associated with the company returns. The study conducted by Jensen (2005) confirms that firms with overvalued shares engage in a different activity to keep their shares overvalued. Uncertainties are imposed on the beta coefficient,

which captures the overall risk level within and outside the company. Beta coefficient is an integral part of the Capital Asset Pricing Model (CAPM) which is the main element in determining the value of the companies listed on the stock market. The risk level of the public companies is measured through linear relationship within stock market returns and individual security returns, named as beta coefficient (Chen, 2003; Tofallis, 2008). Beta coefficient is an important element within the CAPM. According to Roll (1977), CAPM will never be a testable theory since we do not know the configuration of the market portfolio. There are many uncertainties associated with valuation of companies. Fernandez and Bilan (2015) consider these uncertainties as errors linked to the valuation process. Uncertainties are mainly reflected in the discount rate, company risk, future cash flows, residual values and the like. Moreover, using incorrect inputs in the valuation process, is a central issue for misleading results (Fernandez and Bilan, 2015). Moreover, valuation of firms has always been imprecise science and used for different purposes, such as: capital financing, estate planning, economic damage awards, divorce, initial public offerings, etc. Fundamentally, the company is being valued for its future prospect rather than its current steady state (Damodaran, 2012). Moreover, Kaplan and Ruback (1995) performed a study with 51 highly leveraged companies using discounted cash flow (DCF) and comparable multiple method. However, they did not come up with a concrete suggestion, which of the two methods are more appropriate in the valuation process. However, there is a true intrinsic value which can only be estimated.

The market value of the listed companies depends on the inputs, such as: beta coefficient, volatility of returns, investors' perception of the health of the company, etc. Still there is no accordance among scholars which is the appropriate method to value public companies. Different methods use diverse financial inputs and stand on different assumptions. The financial crisis of 2008 proved that stock prices does

not always reflect the real value of the listed stocks. Moreover, Koeplin et al. (2000) compared the valuation ratios for private and public companies, percentage difference between the two was the discount rate. Their findings show that US companies are acquired at 20-30% lower discount rate relative to public companies, while non-US companies are acquired at 40-50% lower discount rate. Discount rate (cost of equity and cost of debt), starts with the internal risk of the company and ends up with the general risk of the economy. This method has basic assumptions to be followed during the valuation process. Hence, these assumptions will necessarily affect the value of the company (Steiger, 2008). Relying solely on the financial statements is difficult to capture the intrinsic value of the company. The major limitations of traditional financial statements are that they do not give a clear picture of the future outcomes and the exact status of the firm. Balance sheet and income statement represent past data, which are inherently historical. The historical performance of the company is unrelated with its future prospects.

The work intents capturing the estimated intrinsic value of the company not the market price. To the best knowledge, there is no scientific work that measures position of the companies listed in PSE based on the valuation methods. Moreover, it is the first attempt to adjust all the necessary indicators used as financial inputs in the valuation process in the Czech Republic. Moreover, additional dimension of the work tends to observe influential factors that deviate prices from intrinsic value to market prices. Furthermore, the results of the work provide signals for financial investors not only if the shares in the PSE are correctly priced, but also generates outlook on the factors that deviates the prices from intrinsic value. An additional aim of the work tends to observe risk outcomes when PSE joins with the other stock markets of the Visegrad countries.

1.1 Scope of the study

The fundamental microeconomic concepts confirm that prices adjust toward equilibrium. Financial markets operate under diverse rules and conditions where stock prices reflect expectations for the future cash flow. The Prague Stock Market is characterized with low trade volume and small number of listed companies (PSE, 2018). Development of the stock market in the Czech Republic is linked with the overall economic model that the country follows. Moreover, in general Europe Union countries are more oriented in the banking industry to finance economic activities of the companies. Pošta (2008) confirms that PSE stands as a weak-efficient stock exchange. However, his work shows that PSE is less efficient than US, German and Netherland stock exchanges. Weak-efficient concept within the stock markets claims that prices do not comprise entire information's. Fama (1968) confirms that in the long run nobody can beat the stock market. In addition, stock prices that are not in the equilibrium carry distorted signals for the market participants. However, when prices are not close to intrinsic value, they create space for arbitrage. Moreover, literature review claims that larger stock markets comprehend greater efficiency.

The study uses accounting items (secondary data) from the financial statements of the companies listed in PSE in order to determine their equilibrium prices (estimated intrinsic values). The discounted cash flow model is used to generate the intrinsic value of the individual listed companies in the PSE. The study sample concerning the first objective of the work is compounded solely from the Prague Stock Exchange. There are certain other methodologies in place for the valuation, such: dividend discount model, multiple based approach and asset based approach. However, the dividend discount methodology has not used for any of the listed companies do not contain clear and constant dividend policy. Multiple based approach stands on market prices while the previous literature confirms that PSE is not an efficient market. Moreover, the studies focused on the efficiency issues claim

that multiple based approach does not deliver informational results when stock markets are inefficient. The asset based method requires revaluation of each asset item within the balance sheet with market prices and does not consider the future prospect of the company. In addition, the asset based approach requires a higher number of experts to reevaluate asset items and liquid market for each of the items. The asset based approach is mainly used when the company goes into liquidation and needs to sell assets. Moreover, the study identifies the reasons of the deviation from equilibrium prices (intrinsic value) to the market price of the companies listed in PSE. Moreover, the results of the study will also confirm the extent of this deviation. Standing on this theoretical paradigm, stock prices will converge toward equilibrium (intrinsic value) when PSE joins with other stock exchanges of Visegrad countries.

Visegrad countries operate within diverse tax, economic and financial systems. The financial system is mainly controlled from the independent Central Banks of the respective countries. Slovakia is using the euro and is part of the Eurozone monetary system. In contrast, Czech Republic, Poland and Hungary have their national currency and they are independent from the European Central Bank (EUCB). Visegrad countries operate under independent stock exchange with limited market capitalization. The additional purpose of the study is to measure individual risk of the stock exchanges in the Visegrad countries. The supplementary aim of the study is to observe risk benefits for the Visegrad stock exchanges when they pool together. The Markowitz portfolio diversification technique is used to measure the risk level of the: Prague Stock Exchange (PSE), Bratislava Stock Exchange (SAX), Budapest Stock Exchange (BUX) and Warsaw Stock Exchange (WIG20). The portfolio theories confirm that more stocks within a portfolio, reduce the risk level (volatility) of the portfolio. Secondary data on the weekly prices and trade volume are used to capture the risk level of the respective stock exchanges. The

study has intentionally selected the stock exchanges of the Visegrad countries since based on the literature review they are characterized from low efficiency. In addition, the study will confirm if the risk level will decline when Visegrad stock exchanges operate jointly.

1.2 Problem statement

Stock markets stand as a mechanism that helps business to expand their operations and investing activities by issuing stocks. The current paradigm on the stock markets claims that stock prices reflect principal values of the company and economic environment of the country. Prices are important signals for the recourse allocation. Fama (1968) claims that stock prices always adjust toward equilibrium (intrinsic value). Efficient market hypothesis considers that stock prices reflect all available information, public and private. Moreover, efficiency level within stock markets generates confidence on the investors. However, the stock markets of the Eastern Europe are characterized from a small number of the listed companies and inefficiency. Previous works were mainly focused on the factors influencing stock prices in the Prague Stock Market. Earlier studies confirmed that the micro and macroeconomic environment have less influence on the stock prices listed in PSE. However, results of my work confirms the reasons and the magnitude of deviation of the stock prices in the PSE from their intrinsic value (equilibrium).In addition, results from other scholars will identify the reasons of this deviation within the estimated intrinsic value and market prices in the PSE. The work identifies, risk benefits for the PSE when it operates jointly with the stock markets of the other Visegrad countries.

1.3 Objectives of the thesis

Risk is a crucial component linked with the uncertainties of the stock markets. The first objective of the work tends to capture, if the companies listed in the PSE are undervalued overvalued or properly valued. The results of the first objective will identify the current

position of the listed companies in the PSE. Second objective will be based on the factors influencing deviation of stock prices from estimated intrinsic value. Moreover, the third objective identifies overall risk of the PSE based on the portfolio diversification. Based on the results obtained from measuring general risk of the PSE, the results would enable comparing the risk level with other Visegrad countries. Research questions are based on the key and most important inputs used for valuing companies. The study will strive to find answers to the questions listed below. The second part of the research work, will capture factors impacting deviation of the prices from estimated intrinsic value to market value. The supplementary fragment of the research will try to understand if there are diversification benefits when PSE join stock markets of Visegrad countries. Standing on this argument, objectives are set up, such as:

Specification of objectives:

O1: To examine the estimated intrinsic value of the companies listed on the Prague Stock Exchange (PSE). If the companies are undervalued, properly valued or overvalued.

O2: To conduct a critical analysis of factors influencing deviation of estimated prices to market prices.

O3: To examine the general risk level of the PSE based on the portfolio diversification (if the risk level of the PSE would decline when it joins stock markets of the other Visegrad countries).

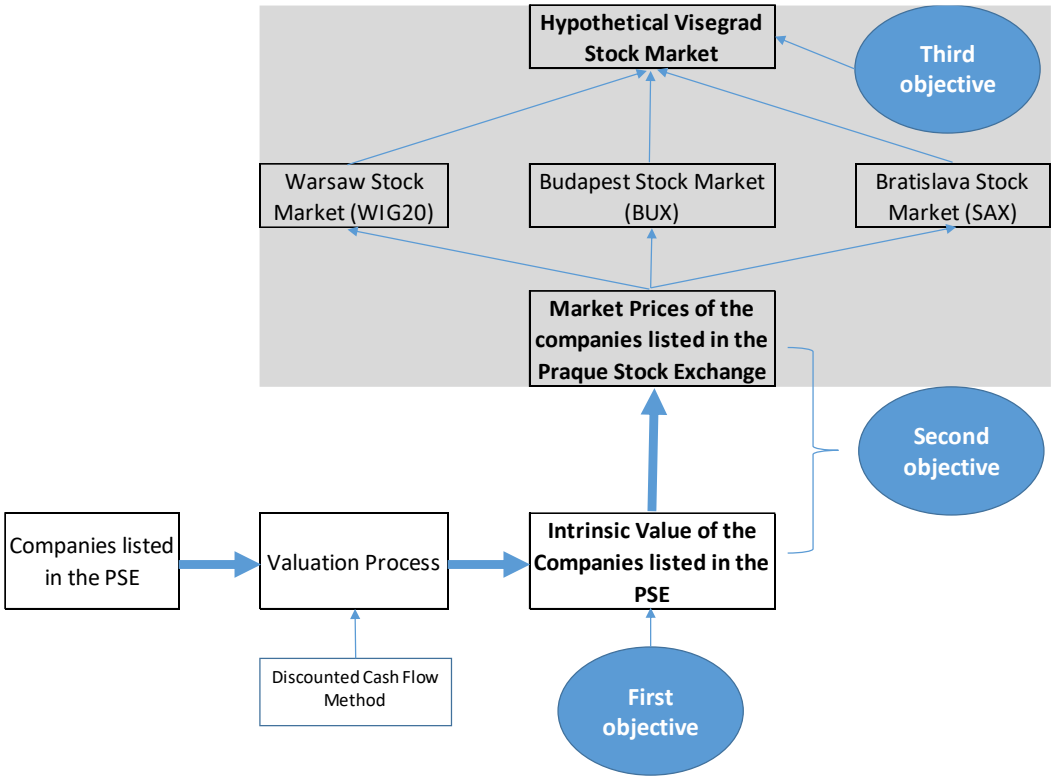

Figure 1 Schematic diagram of the research work
(Source: Authors own elaboration)

Figure 1 shows the research process standing on three objectives. Initial process shows the companies listed on the Prague Stock Exchange (PSE) which is followed by valuation of the listed companies. The second objective detects factors that push prices to deviate from intrinsic value to market prices. Second objective will be completed from the results obtained from valuation and from the literature review of the factors influencing stock prices (market value) of the companies listed in PSE. Moreover, the results of the valuation will enable to compare percentage differences within market value and intrinsic value of the listed companies. However, the literature review will provide information (influential factors) on the difference within market value and intrinsic value. The third objective observes risk benefits of the Prague Stock Exchange (PSE) by joining the other stock markets of the Visegrad countries. Different combinations within stock

exchanges will be conducted to show which of those combinations delivers lowest risk and highest reward.

1.4 Research questions developments

This section indicates developments of the research questions. Standing on the problem identification and the literature review, five main research questions are set up. Moreover, the process of the research questions developments stands on the graphical explanations in the figure 1. The first main research question is linked to the price signals delivered in the PSE. Moreover, the second main research question shows the reasons and the extent of the deviation within market prices and the intrinsic value of the listed companies in the PSE. The third main research question generates an outlook on the diversification risk of the PSE and other Visegrad countries. However, the fourth research question shows diversification risk when PSE operates under hypothetical Visegrad stock market. The fifth main research question shows what will happen to the intrinsic value of the listed companies in the PSE when Visegrad Stock Exchanges operate jointly.

The five main research questions are explained and discussed below.

1.4.1 Research questions regarding the estimated intrinsic value of the listed companies in the PSE

Valuation of the companies listed on the Prague Stock Exchange has been realized through the standard valuation techniques. The previous work confirms that prices in the efficient stock markets tend toward equilibrium. However, PSE stands as a weak efficient market where stock prices might be prone to disequilibrium. These signals lead in generating a research question that stands in line with the first objective of the work.

O1Q1: What is the estimated intrinsic value of the companies listed on the Prague Stock Exchange?

The deviation of the prices from estimated intrinsic value to market prices are generated from various elements. Based on the literature review, factors that influence stock prices are mainly driven by firm specific factors and macroeconomic factors. Results on the second research question are served from the work done from the other scholars. The second research question corresponds with the second objective of the work.

O2Q2: Which are the factors that deviate prices from estimated intrinsic value to market prices?

1.4.2 Research questions regarding the diversification risk of the Visegrad Stock Exchanges

The stock exchanges in the Visegrad countries contains diverse risk level since listed companies are opposed to different risk profiles. Visegrad countries operate under a unique political system, economic arrangement and tax environment. The work considers each stock exchange as an individual portfolio.

Portfolio diversification techniques detect the risk level of the individual portfolios (Visegrad Stock Exchanges). Diversification method is used to generate the results of the third research question. Higher risk level creates more uncertainties for the investors. However, higher risk provides greater returns for the financial investors. Stock exchanges that contain more listed companies provide a lower risk level and the other way around. Standing on this issue, the following research questions are built.

O3Q3: What is the risk level of the individual stock markets, such as: PSE, SAX, BUX and WIG20?

The stock exchanges of the Visegrad countries are characterized from a low turnover level and a small number of listed companies. The portfolio risk theories confirm that more stocks within the portfolio (stock exchange) lower risk level. However, there is traditional

paradigm that higher risk exposure compensates investors with higher returns. This leads to the following research questions that stands for the third objective of the work.

O3Q4: How would change, risk level of the PSE when it joins stock markets of the hypothetical Visegrad countries?

2. THEORETICAL BACKGROUND

The section describes fundamental concepts of the market equilibrium. Moreover, it describes the elements that influence equilibrium in the stock markets. The section also shows the theoretical paradigms of the information asymmetry linked to the stock markets.

2.1 Market equilibrium

Market equilibrium is reached from the interaction within demand and supply which stands as a central mechanism of the capitalist system. In addition, in the free market economy firms maximize profits via competing with each other. However, diverse influential factors drive demand and supply of particular goods. Competition between entrepreneurs drives innovation, lower prices and increase the quality of products. Smith (1817) in his book "Wealth of Nations" set up the foundations of the capitalist system. Moreover, Smiths book considered that markets tend to improve the living standard of society if they are left to operate on their own devices. Adam Smith considers that government intervention creates more harm than market benefits. Moreover, Smith named the enigmatic force that drives markets as" invisible hand". In contrast, Marx (1976) published a book "Capital" which claims that the capitalist system is defective and does not generate benefits for the whole society. Marx claimed capitalist system creates wealth and income mainly for the rich people. Standing on Smith and Marx philosophical groundwork, the countries followed the concept of free market economy or state controlled economic system. Eastern countries followed Karl Marx ideology where the state should control the whole economic processes. In contrast, the western countries were standing in line with the economic concept where the state had limited power in the economy. Stiglitz (2002) on the book "Globalization and its Discontent" shows that sometimes markets fail to carry the outcomes projected. Moreover, the book claims that the

concept of market fundamentalism should be constructed under efficient governmental institutions.

Markets occasionally are characterized from an insufficient number of companies that creates space for cooperative agreements. Markets with one or two players require government intervention to protect customers from unrealistic prices. Highly competitive markets stand for identical products, full information's on prices, low transaction costs and free entry and exit of firms. Competitive markets do not generate space for firms that hold market power and control prices. Moreover, in the highly competitive environments profits are equally distributed among the players. Firms in the perfect competition produce where price equal marginal costs. However, in reality the perfect market competition does not exist. Market structure with one player is named as a monopoly. However, in the case of monopoly, governmental agencies (competition authorities) control prices and position of the firm in the market place. Competition authorities do not permit firms to end up in a cooperative agreement concerning prices or volume.

Prices are essential component in allocation of human, physical and financial resources. Prices in the efficient markets represent the fundamental value of the product. In contrast, financial markets are built under a different framework than tangible markets. Stock prices reflect expectations for the future cash flow of the company. Soros (2008) claims that financial markets are never in the equilibrium, since future outcomes are unknown. Moreover, Soros (2008) question if ever exists any practical case or theoretical concept of the financial market equilibrium.

2.1.1 Stock market equilibrium

Stock prices are driven by fundamental capitalist forces such as supply and demand. Moreover, supply stands on the company's interest to issue stocks while demand from a diverse set of components.

Stock price movements gained the attention of numerous researchers and wide-ranging conclusions are achieved. The demand for stocks is influenced mostly by firm specific factors and macroeconomic context of the country. Stock prices stand in the past and future cash flow of the company. Moreover, financial performance of the economic entity is essential element in moving stock prices. Human recourses leaded through creative management influence investors perception on buying and selling stocks. Moreover, political environment, elections, wars, oil prices tends to influence stock prices. The study by Jones and Kaul (1996) for the UK, Japan, Canada and US stock markets found a positive association within stock prices and oil shocks. The previous studies confirm the relationship within stock prices and oil shocks, generated from oil producing countries. The human element is important in raising the equity value of the business. The literature confirms that motivating people in the workplace tend to increase the overall efficiency of the company. The study by Edmans (2011) shows that satisfied workers generate long run returns for the company. However, the work confirms that stock markets does not fully integrate human elements in determining share prices.

Firm specific factors stand within internal company performance, such as: corporate governance, talent management, financial management, dividend policy, etc. Moreover, company performance that is linked to internal company operations gains strong focus of financial investors. Established corporate governance with the best practices and clear detachment within shareholders and managers increase confidence among investors to buy stocks of the company. Clear arranged dividend policy and good management team are additional elements that make stocks attractive for investors. The profound work of Gordon (1959) considers that stock prices are directly influenced from dividend per share (DPS), growth rate and discount rate. However, Modigliani and Miller (1961) confirms that dividends per share is totally offset from other financial indicators and

it loses the significance within the model. Modigliani and Miller theory stands under the assumption of perfect market conditions. Moreover, the study by Wippern (1966) on 60 companies within four years' time period concludes that growth rate, payout ratio and size have a significant effect on the share prices. However, Uddin (2009) found a significant relationship within stock prices and assets, earnings per share and dividend per share. Uwuigbe et al. (2012) on the study for 30 listed companies detected that leverage indicators and company profitability have a significant effect on the stock prices.

Macroeconomic indicators, such as: government policy, country trade records, market conditions, business environment and so on are supplementary indicators that drive stock prices. An increase in the economic activity (GDP) generates progress in the performance of the overall economy and increase stock prices. Moreover, government actions in terms of business reforms, economic prospect and taxes have immediate influence on the stock prices since it strengthens investors' self-confidence.

Development of the stock markets is also affected from the political parties in power. Conventional parties tend to give more attention to the development of the stock market. They consider that developed stock market, accumulate and distribute income among diverse layouts of the society. However, Piketty (2015) in his book "Capital in the 21st century" confirms with the real historical data that stock markets are one of the components that generates income and wealth inequality. Moreover, the book confirms that stock markets create income that remain solely on the wealthiest people of the society. Blinder and Watson (2016) found that stock markets were performing better in the US when the Democratic Party was leading the country. Moreover, Santa-Clara and Valkanov (2003) have proven that equity markets were generating better performance in the US during the democratic premiership. Naes et al. (2011) confirms higher liquidity in the stock

markets during the democrat's period. However, equity markets remain a controversial topic among economist and scholars that attracts a lot of research.

2.1.2 Factors of stock market equilibrium

Stock markets are an important element of the financial system. Moreover, risk linked with the volatility of the stock markets has always been a major concern for the financial investors. A small number of publicly listed companies tend to increase correlation coefficient and the overall risk level within the stock markets (Demiguel et al. 2013). Current stock prices reflect expectation for the future cash flows that companies tend to generate. In addition, stock prices are unpredictable since depend on the upcoming choice that has not occurred from: investors, governments, international environment, nature, etc. The manufacturing sector is the most important sector, while the financial sector is the fastest growing sector in the Czech Republic and other Visegrad countries (Pražak and Stavarek, 2017). PSE contains limited number of the listed companies and low turnover (PSE, 2017). It is considered that stock markets reflect overall information on the economy when they are strong efficient form. Fama (1968) considers that investors cannot beat the stock markets for a long time since markets have the ability to adjust their own excesses. However, stock price equilibrium is an ideal concept since stock prices reflect expectation for the future cash flow. In contrast, the future is unknown since depends on the decisions that are not made from people, government, companies, environment, etc. Stock markets are the daily mirror of the economies problems and companies underlying settings.

Financial turmoil of 2008-2009 verified that the financial crises are easily transmitted into the real economy. Moreover, financial and economic globalization made countries highly interconnected where financial problems of one country are reflected in the other countries. Financial investors try to find stock markets that are less correlated,

since it enables reducing their investment risk. Furthermore, financial and economic globalization associated with synthetic financial instruments has made risk invisible and to certain extent unmeasurable. However, the 2008 crisis proved that some assets are overvalued for a long period of time. The study conducted by Boulton et al. (2000) within the period 1978-1998 of 10000 US public companies confirmed that the market value of the shares represents 95% of the book value. However, the study conducted by King and Langli (1998) for the Germany, UK and Norway found that the difference between market value and book value is quite low compared to US companies. Moreover, the study completed for Poland from Gornik et al. (2001) showed that the ratio book value to market Price is lower compared to other European countries. The study realized by Hellström (2006) for the period 1994-2001 on the Czech and Swedish companies confirmed that results are diverse within two stock markets. In addition, Hellström (2006) detached his word in two periods (1994-1997 and 1998-2001), the results confirmed that market to book value ratio declined for the Prague Stock Exchange from 0.74 to 0.57 while in Stockholm Stock Market increased from 2.35 to 2.67. The work by Korányi (2008) claimed that companies listed on the Budapest Stock Market were undervalued for 150%. In addition, Juhász (2004) confirmed that public companies within BUX (Budapest Stock Market) were undervalued in the period within 1999 and 2002 (book value to market value was in the range of 1.0). Examples mentioned in the text show that there are differences among countries concerning the deviation within market value and book value. However, in USA difference within book value and market value of the listed companies is quite large. Mezisi (2008) confirms that shares of the A-class companies are bought below their book value which reflects the pessimistic environment within financial investors.

An additional concern for investors is detecting the reasons for this deviation within book value and market value of the listed companies.

Stock prices are mainly driven by firm specific factors and macroeconomic factors. Firm specific factors are linked with internal performance of the company while macro factors might be national or international. Irfan and Nishat (2002) in the case of Pakistan revealed that dividend yield, payout ratio, leverage and size of the company are important elements that affect stock prices. However, Omar and Mutair (2008) in a case of Kuwait found that significant factors that affect stock market prices are book value and earnings per share. Somoye et al. (2009) shows that the Stock Market of Nigeria is influenced from earnings per share, foreign exchange rate, GDP, interest rate. Most of the research concerning the factors influencing stock market prices is conducted in the USA (Fama, 1993, Campbell and Shiller, 1988; Fama and French, 1993; Bulmash and Trivoli, 1991; Abdullah and Hayworth, 1993; Dhakal et al. 1993; Mukherjee and Naka, 1995; Ajayi and Mougoue, 1996; Nieh and Lee, 2001; Chaudhuri and Smiles; 2004, Ratanapakorn and Sharma, 2007). Deev and Kajurová (2004) detected that stock prices in the Prague Stock Exchange (PSE) were mainly affected by German and Polish stock market. However, Hanousek and Filler (2000) argue that import values and capital inflows are the most influential determinants of Czech Stock Market, while the German DAX and US DIJA do not have any descriptive power on the Czech Stock Market. In addition, Grambovas (2003) indicate that short run exchange rate (CZK/DEM) and German stock market (DAX) have a significant effect on PSE, while in the long run this relationship is insignificant. The study realized by Samitas and Kenourgios (2007) for the stock markets of: Slovakia, Czech Republic, Poland and Hungary showed that interest rate imposed by the Czech Central Bank, US interest rate, German interest rate have a negative effect on PSE. Moreover, Moore and Wang (2007) consider that the Czech stock market increased stability by joining the EU, while PSE is highly sensitive toward Russian and Asian financial problems. Horobet and Dumitrescu (2009) argue that the Czech stock market is highly

influenced from GDP, CPI, nominal interest rate and money supply while negatively affected by exchange rate.

2.1.3 CAPM as model for pricing financial assets

Capital asset pricing model (CAPM) indicates relationship within the unsystematic risk of the particular common stock and expected return. CAPM is widely used in the project management, strategic management, company valuation etc. The model stands for pricing financial securities that contain high volatility. Sharpe (1964) developed a CAPM model representing an extended version of the Markowitz (1959) portfolio theory. CAPM stands under the assumption of the efficient stock markets and investors that operate under the rational expectation theory. Systematic risk within CAPM is measured through beta coefficient. Beta coefficient measures the sensitivity of the stock returns with the market proxy. However, beta coefficient does not always represent the true market risk since certain stock indexes are characterized with low efficiency. In contrast, CAPM is built on the ideal financial portfolio and occasionally is not an adequate metric for the risk measurement. Fama (1965) disagrees with the fundamental paradigms of the CAPM model that investors have homogeneous expectations. Moreover, he claims that not all investors contain identical knowledge and perception of the financial reality. In the case CAPM assumption are accurate than entire financial investors must hold an identical quantity of systematic risk. Mülleret al. (1997) confirms that market participants do not contain homogenous expectations, since the stock market is constructed from diverse layouts of investors that possess diverse information on identical issues.

However, many scholars tend to test the CAPM empirically while the results are mixed over time. Fama and French (1993) tested the CAPM results over the fifty years' time period for the companies listed on the US stock exchanges. However, from 1926 till 1968 they confirm a positive relationship within the beta coefficient of the listed

companies and stock returns. In contrast, tested results for the entire period between 1926 and 1990 confirm no significance within two variables. Roll (1977) argues that relationship within the beta coefficient and stock returns exist only if the benchmark stock market stands within the efficient frontier. Moreover, Roll (1977) claims that is impossible to identify efficient frontier since there is no construction of the world portfolio. In addition, he concludes that CAPM is a model that has more practical that scientific grounds. The key problem identified within CAPM stands for the beta coefficient, which is the most arguable indicator. The studies conducted from different scholar claims diverse approach on beta calculation (Black, 1972; Scholes and Williams, 1977; Bekaert and Harvey, 1997). According to Klammer and Walker (1984) in 1970, 40% of investors used the DCF model to appraise projects while in 1980 almost 81% of them used DCF. Moreover, Pike (1988) claims that in 1984, 84% of the decisions realized from investors were based on the internal rate of return and DCF model.

Fama and French (1989) on their study widely explain the anomalies occurring within the stock market. Moreover, they propose a five factor CAPM model that considers profitability and investments and has a deeper explanation than three factor model of Fama and French (1993). Financially distressed firms are characterized from the high possibility of default. In addition, the study conducted by Campbell et al (2008) confirms that firms with financial difficulties are exposed to high volatility and higher market beta where investors require a higher return for their risk investment.

CAPM is broadly used as risk indicator in the strategic management. Moreover, the CAPM model found wide application within the strategic management concepts. Moreover, the model was also extensively discussed in terms of analyzing corporate diversification strategies. Previous studies used diverse metrics of systematic risk and

alpha measure in order to determine independent variable within the model (Montgomery and Singh, 1984; Lubatkin and Oneil, 1988; Chartejee and Lubatkin, 1991). The general intention of these studies tends to show the association within the diversification risk and strategy of the company.

2.1.4 IPO as an input in the price equilibrium

Initial public offering (IPO) is one of the important element of determining equity value of the companies. IPO process stands for the firms that tend to raise funds through stock exchanges. However, existing companies in the stock exchanges might be interested to raise additional capital through shares, named as seasoned equity offering (SEO). The IPO process enables privately held firms going public and to establish market value of their equity.

The initial market prices delivered from the IPO process are characterized with certain loopholes, named as "underpricing anomalies". Underpricing refers to the phenomena when stock prices experience significant increase one or two days after the IPO. Underpricing phenomena indicate that IPO process does not comprise complete information's concerning the company settings. Reilly and Hatfield (1969) confirm IPO underpricing phenomena from 1963 to 1965 for 53 sample companies going public. Moreover, the study shows that first day of the IPO, stocks were underpriced between 18% and 20% lower. Underpricing anomaly might have short term and long term consequences. In addition, incorrect evaluation of the company within the IPO process, effect improper indications in the market place. Numerous scholars found underpriced phenomena in the different countries. Ibbotson et al. (1988) on the sample period from 1960 till 1992 for the US companies detected an underpriced stock in the range of 15.3%. Moreover, Lee et al. (1998) on their study for the Australian companies confirmed an underpriced phenomenon at the level of 11.9%. In addition, Pettway and Kaneko (1994) confirm undervalued

companies in the IPO process for the Japanese companies for 12%. Short run underpriced stocks (undervalued) in the IPO generate arbitrage for the buyers of the stocks. An IPO process might influence long term underperformance of shares. Incorrect pricing on long term generate price distortion for the investors and lack of confidence within the particular stock exchange. Aggarwal and Rivoli (1990) were the first scholars to detect the long run underperformance of the IPO shares in the US market. Their study confirmed negative abnormal returns in the long term in the range of 13.7%. Moreover, financial investors that purchased IPO shares in the first trading days and hold them for more 250 trading days would underperform the stock index of 13.7%. However, mispriced anomaly has controversial results concerning the long run IPO performance. In addition, companies underperformed in the long term IPO for the UK stock markets within -8% to -23% (Levis, 1993). Keloharju (1993) in the case of Finland the underperformance stands in the range of -26.4%.

Ohlson (1995) recommended alternative valuation model based on the residual income model that vastly relies on accounting fundamentals of the firm. However, the model was widely discussed among researchers and practitioners. The model stands as a substitute for the dividend discount model. Moreover, the study conducted by Lo and Lys (2000) shows the model gained broad practical application. In addition, Frankel and Lee (1996) confirm that Ohlson model is vastly suitable model for non-IPO cases. Moreover, the results of the Frankel and Lee (1996) show strong association within market value of the firm and the firms earnings. However, these models do not take into consideration dividend distributed to the shareholders. The study realized by Hand and Landsman (2005) confirms that dividends comprise an important element in setting the intrinsic value of the publicly listed companies. Danbolt and Rees (2002) studied the valuation of financial companies in Europe and they concluded that accounting valuation models quite well explain variation in the market

to book ratio. The study by Deloof et al. (2009) on the sample of 49 IPO companies in the Euronext stock market in Brussel confirm that investment banks prefer a DCF model in generating the IPO results. In addition, Roosenboom (2007) confirms that underwriters in French Stock Markets prefer the DCF model when the stock market is highly volatile.

Information's concerning each element of the company risks is an important input within the valuation. Scholar's claims that comparable multiple methods reduce company information asymmetry. The studies show a negative association within company information multiples and stock price returns. The work by Liu et al. (2002) indicates that earnings multiples significantly determine value of the company. The results of the work claim that further accessible evidence concerning the company generate more accurate valuation of the stock prices. In addition, cash flow and book value ratios signify the highest influence on the intrinsic value of the company while sales measure indicates low influence.

2.2 Asymmetry of information

This section defines the theory of information asymmetry where one party in the transaction has more information than the other party.

2.2.1 The theory of information asymmetry

Information asymmetry or markets with imperfect information's consider the situation when a party in the transaction holds more information than the other party. A situation where information's are not equally distributed among agents might lead to market failure. Moreover, when market prices do not contain all available information than they are not *Pareto Efficient* and does not allocate the entire existing recourses. The seminal contribution of Akerlof (1970), Spence (1973) and Stigliz (1976) showed the methods of diminishing information asymmetry on the different market places. The theory of

information asymmetry has found applications in different areas, such as: economics, health care, international relations, the stock market etc.

The notion of the markets with asymmetric information was initially presented by Akerlof (1970). His work considers the case of the automobile markets where there exists good cars and bad cars (named as Lemon market). Moreover, bad cars stand for lower prices while new cars with higher prices. However, in the unregulated markets is quite hard to identify the quality of the cars. The unregulated market for cars stimulates more bad cars to enter the market, named as *adverse selection*. However, sellers of the cars have more information than the buyers of the cars. In order to eliminate this problem within the markets, Akerlof (1970) proposes the counteracting institutions which provide guarantees for the products.

Spence (1973) uses the labor market to explain market with information asymmetry, named as signaling problem. Moreover, Spence (1973) considers employing individuals in the firm, as a decision carried under insecurity. The asymmetric information arises when an employee does not possess all the capabilities the employer requires. Since knowing the capabilities of the hired employee requires time, Spence (1973) considers this process as an investment choice completed under uncertainty. Educational profile and previous working experience are indices (signals) that reduce employer's uncertainty. However, the wage to the employees is determined based on these indices or attributes. The signaling equilibrium is achieved when the employer's views stand in line with wage set up for the employee and his indices. However, Rothschild and Stiglitz (1976) investigated the problems of adverse selection on the segmented market. Moreover, their study considered the way insurance companies and banks provide insurance grounded on the collateral and deductibles. Segmentation stands for the contracts given to individual clients based on their private information's. Standing on the individual

profile of the client interest rates and premiums are determined from the banks and insurance companies. Information asymmetry follows the principal-agent problem, since he is not sure if the agent will realize the tasks agreed on the contract. The most well-known contribution on the markets with asymmetric information has been done by Mirrlees (1999), Hölmstrom (1979) and Grossman and Hart (1983).

The situation when the information asymmetry occurs after the contract has been signed, is called *moral hazard*. The moral hazard is mainly referring to the concept of the *principal agent problem* where the principal tends to employ the agent in order to conduct a given task. The moral hazard concept finds its applications in diverse dimensions of the human life, such as: healthcare, doctors, banks, insurance companies, politics, etc. Mirrlees (1999) shows the case of the people that want to buy an insurance for their car. However, the insurance company is not assured if the driver will be "careful" when driving the car. The insurance companies to circumvent this problem should set up camera in each client, but is economically not feasible. Moreover, in the case of perfect information, the risk will be removed from risk averse individuals to the risk neutral entities (insurance companies). The moment when drivers are provided with the insurance, it might raise the number of car accidents. However, the drivers would be the first one who would be harmed from the car accidents. Moral hazard is eliminated from the fact that drivers might lose their life in the car accident. Moreover, insurance companies do not provide full coverage for the car accidents which is an additional element that eliminates moral hazard. Moral hazard elements are commonly found within the political system. Politicians occasionally do not keep the promises when they proclaim during the election campaigns.

Information asymmetry has been searched from scholars not only in the area of economics but also in finance. Lack of information during and after the transaction occurs might cause economic inefficiencies in

the marketplace. Moreover, most of the research has been focused on the ways to eliminate information asymmetry. Data are important incomes not only to understand the phenomena, but also producing accurate economic policies.

2.2.2 Information asymmetry in the stock markets

The aim of the companies is maximizing shareholders stock prices. Stock prices are mostly driven from the internal performance of the publicly listed companies. Detachment within the board of directors and management of the company, generates elements of information asymmetry that leads to moral hazard. Moreover, incentives standing on stock options and salaries based on the merits are elements that tend to eliminate moral hazard within the corporation. Information asymmetry is linked also with investors that buy stocks in the inefficient stock markets. Moreover, investors might not be sure if the stock prices stand on the all necessary information of the company. Standing on this issue, many risk averse investors do not conduct the transaction since they consider stock prices as unrealistic. Stock prices are a result of the audit companies, correct established IPO, insider information, etc. These elements creates a moral hazard since investors that buy stocks are not sure if these processes are conducted properly. Moreover, poor auditing was considered as one of the components that caused the financial crisis of 2008 (Sanoran, 2018). ENRON corporation was considered as one of the biggest accounting scandals that appeared in 2000 (Jordaan and De Villiers, 2018). The ENRON corporation excperienced continoues decrease in the stock prices.However, stock prices did not reflect the value of the company since financial statements were manipulated from the management in accordance with the audit company. Companies that address problems of corporate governance, diminish information asymmetry and moral hazard.

Stock markets react to the information delivered from the international financial institutions.The announcement released from the European Commission and International Monetary Fund on the Greek government debt, created a panic among banks and other institutional investors. Moreover, Greek bonds in 2009 were rated as „*junk bonds*"that made them unattractive for domestic and international investors (Gogstad et al. 2018). Reports published from state statistical agencies concerning the Greek debt level were questionable. European stock markets reacted to the Greek by generating a speculative downturn in the stock prices.

Informations are integral elementson reflecting realistic stock prices.In addition, information available on the companies financial postion, strategy, employees, etc increases investor confidence in buying stocks.Chen et al. (2006) studied the relationship within company information, and investing in the stock prices. Moreover, the study confirms the stock investments are highly sensitive toward information. The stock markets of the Eastern Europe stand on the low trade volumes and inefficiency attributes. However, low trade volume might be leaded from the information asymmetry linked with the stock prices.Financial investors are concerned if the prices generated on the stock markets of the Eastern European countries contain entire information.

2.2.3 Stock market efficiency

Market efficiency is a fundamental concept that clarifies the causes of the stock price movements. Moreover, efficient market hypothesis lies within the random walk theory where prices experience unpredicted pattern. Financial investors tend to find stocks that are undervalued and expect that the price will increase. Financial managers believe that possess the ability to identify stocks that outperform the average market returns. Market efficiency has consequences for both financial investors and portfolio managers since

it provides reliable market signals. Fama (1965) confirmed that new information's within the intrinsic value will cause instant effects on stock prices. In contrast, Shiller (2000) confirms that stock markets are not only driven from real financial and economic factors but also from psychological elements. Moreover, Shiller in his book "irrational exuberance" indicates that stock markets sometimes are driven by euphoria and stock prices do not reflect their intrinsic value. Efficient market hypothesis (EMH) claims that generating excess returns from predicting profits is unlikely to occur in the long run. Basically, all possible information's are involved within the stock prices. Market efficiency theory claims that investors should believe that stock prices are properly valued. Moreover, stock prices adjust to the new information before investors generate any action (buying or selling stocks). Competition among analysts for detecting undervalued stocks does not create space for over profits. In addition, the equilibrium stock price enables a small fraction of analysists to benefit from undervalued stocks.

There are three forms of the market efficiency, such as: weak form efficiency, semi-strong form efficiency and strong form efficiency. Weak form efficiency stands on the concept that current stock prices completely indicate past prices. Moreover, nobody can benefit from analyzing past prices. Basically, nobody can benefit from information that everyone knows. However, the semi-strong form claims that prices involve all available information's. In addition, information's not only concerning past prices, but also financial indicators of the company, such as: financial statements, dividend policy, possible mergers and acquisitions, etc. However, strong form market efficiency indicates that prices incorporate all possible information's, including public and private information (insider information's). However, even though managers of the company possess inside information, they can't benefit from it. Efficient market hypothesis shows that nobody is able

to consistently beat the market, however, there are cases when investors outperform the market.

The theoretical paradigm that free markets tend to solve economic problems dates back since the inception of the capitalist system. Smith (1776) sets up the first conceptual framework how the free markets operate within the capitalist systems. Moreover, Smith (1776) on his book "Wealth of Nations" clarifies the way markets adjust their own excesses. The enigmatic force that drives the markets, Smith named as "invisible hand". The concept of "invisible hand" stands on the idea that markets self-correct their own mistakes without government interventions. The idea of no-government intervention was widely extended from the Chicago School leaded by Milton Friedman. Freidman (2009) claims that in the free society, government actions generate more problems than economic benefits. Moreover, Friedman (2009) shows that room for the government intervention should be constrained merely in terms of national security.

The world financial and economic crisis of 2008-2009 showed that stock markets can be far from equilibrium and for a longer period of time. The world financial meltdown disproved the theory of market efficiency that markets can adjust very fast toward equilibrium. Moreover, government intervention was required to save the world financial system from collapse. During the crisis period, countries were pressed to spend taxpayer's money in order to help banks and other financial institutions from bankruptcy. Stiglitz (2002) shows that market fundamentalism is a failed economic concept since markets require rules and regulations to be functional. The level of the efficiency in the stock markets allows allocation of the financial resources into the companies that generates the highest returns. Moreover, inefficiency of the stock markets can cause the decline in the economic performance of the country (Lim et al. 2008).

Dragotă and Ţilică (2014) confirms that the stock markets of the eastern European countries create space for speculative investments. Their study of the 20 post communist eastern European countries claims that the stock markets of these countries are weak efficient form. The study by Stoica and Diaconasu (2011) from 2000 till 2010 for the eastern ex-communist countries show that these countries stand within the weak efficient form. Moreover, Stoica and Diaconasu (2011) indicates that in the stock markets of the Czech Republic, Croatia and Hungary are observed higher returns on Wednesdays that claims for the anomalies standing within these three stock markets. However, the study by Dritsaki (2011) shows that random walk process is implied within the Visegrad stock market. Moreover, the work claims that the stock markets of these countries are efficient in the weak form.

The profound idea that markets are functional and tend toward equilibrium are controversial. Market equilibrium lies within different dimensions of the economy, such: stock prices, bond prices, real market prices, etc. Moreover, all these prices are driven and influenced from a diverse set of elements which makes interesting for the researchers to study them.

2.2.4 Due diligence as a tool for reducing information asymmetry

Internal information's linked with legal and financial activities of the company are significant elements in stock price movements. Numerous materials are not accessible for the public opinion, since they are considered as confidential information's. However, these evidences are important when investors decide to take a short or long position on the shares of the company. Detecting problematic operations, in terms of human recourses, legal issues, financial problems, etc. are considered as a due diligence process. Moreover, risk elements identified in the due diligence process are considered as

off-balance sheet records. Financial and legal due diligence is not a legal requirement that must be realized from the companies.

Due diligence is mainly conducted during the mergers and acquisition (Perry and Herd, 2004). Corporate governance established in the best practices enables separation within owners and managers control. Due diligence perceives any direct or indirect pressure directed toward managers from the shareholders. Moreover, human recourses are integral elements for reaching the daily and strategic objectives of the company (Reiche et al. 2018). The educational level of the employees and their working experience is not shown in the annual reports of the company. In addition, needed training programs conducted by the employees, raise investors' confidence that company objectives can be achieved (Harding and Rouse, 2007). Companies might be in the court process for the several legal issues that can cause performance and reputational consequences. Potential investors can be informed on these issues, only when the legal due diligence is realized.

Due diligence is a confidential report that is accessible only for the potential investors. The team that realizes the due diligence is prohibited to release any of the internal information obtained during the process. Moreover, the results of the due diligence outcomes do not influence the intrinsic value of the company, but shape the investors attitude toward the company. In contrast, risk level of the company is measured through the volatility of the stock prices with the market prices.

2.2.5 Hazard linked with market prices

Stock markets are prone to booms and busts, that follow identical features like business cycles (GDP). Since the financial crisis of 1929-1933, shocks in the stock markets have become frequent. Moreover, the crisis of 2008-2009 showed the fundamental economic problems on the US economy (Magnani, 2017). During the crisis period, Central Bank intervenes by lowering the interest rate. Conducting open market

operations from individual central banks does not allow the economy to fall into recession.The Federal Reserve in the US, during the crisis of 1929-1933 left the economy to operate on its own devices, that caused many banks to go bankrupt (Titze, 2014).

The crisis of 2008-2009 started in the financial system and got transmitted into the real economy. Moreover, the crisis started in the US and gave spillover effect in the other countries. The crisis proved that the world is linked where financial problems in one country influence the other economies. The Federal Reserve (FED) in the United States reacted to the crisis by lowering the interest rate and providing more liquidity into the economy (Drobyshevskiy and Trunin, 2018). In addition, the European Central Bank (EUCB) reacted to the financial downturn of 2008-2009 with the identical measures by lowering interest rates. Cahn et al. (2017) considers that the intervention the from EUCB during the crisis period, was the key infusion not to allow the economies to fall into the recession. The central banks objective is saving, the economy when inflation stands beyond the targets.The FED and EUCB do not control stock markets when they experience an accelerating increase. However, it tends to save the stock markets from the huge decline. During the market crash of 1987 and credit crunch of the 1998 the FED intervened by injecting more money into the economy.

Investors learned from the movements of the FED that they will be protected when the stock market is having problems. Moreover, these phenomena are described by the Alan Greenspan as irrational exuberance or meta moral hazard. The phenomena of „*irrational exuberance*“ has created overconfidence in the stock markets(Shiller, 2000) where the central bank will save the financial system from collapse. The study conducted by Cecchetti*et al*. (2000) with US investors confirms that they are confident that the FED will protect the stock market from the crash. Moreover, the concept of the irrational

exuberance was considered as one of the sources that caused the crisis of 2008-2009.

During the crisis of 2008-2009 some of the banks were bailed out by the US and European governments. The crisis was followed from the weakening in the quality of the subprime lending's. The banks were considered "too big to fail" and "to interconnect to fail". Moreover, not only investment banks but also commercial banks were engaged in the risky financial activities, known as toxic financial instruments. Deregulation as the fundamental notion of the nowadays capitalist system, allowed even commercial banks to invest in different financial securities. However, depositors were holding a moral hazard since their deposits were invested in the risky financial instruments. Moreover, taxpayers were also exposed to the moral hazard since the government budget was used to bail out private economic entities (banks) from bankruptcy. The government fiscal stimulus happened in order to reestablish the self-confidence in the financial system.

2.2.6 Utility theory

Preferences represent sets of choices within two bundles of goods where the consumer is indifferent. Indifference curve represents possible combinations within two goods that generate an equal level of utility or satisfaction for the costumers. However, utility function represents mathematical representation of preferences. Demand function stands on the construction of the indifference curves. Microeconomic theories, such as: individual choice theory, substitution and income effect, utility theory are constructed from the indifference curves. Indifference curves are built under certain assumptions, such as: completeness, transitivity and non-satiation. Completeness assumption considers that consumers are indifferent from the diverse ranking of goods on the same indifference curve. The axiom of transitivity assumes that the consumer must prefer more one bundle toward the other bundles. In addition, indifference curves

cannot intersect or cross each other. Consumer choices are constrained from the available budget that he possesses. The optimal choice for each costumer is where the budget constrains tangent with the indifference curves. Indifference curves have been criticized for overgeneralizing assumptions of the human movements. Neumann and Morgenstern (1953) constructed investment preferences (indifference curves) through mathematical representation, named as utility theory. There are different techniques that scholars use to measure risk uncertainties.

The utility theory found a wide application of the investors financial decision. Moreover, investors contain diverse outlook on the risk level that particular security comprise. Current research shows the enormous influence of psychological properties on the daily investors trading (Bailey et al. 2011). Diverse methodologies have been used to detect investor's movements under different situations. Research results show that investors learn from their own mistakes in a quite slowly process (Seru et al. 2010). Investing in the stock market is linked with the attitude and risk appetites of the market participants (Kumari and Mahakud, 2015). The way group of investors behaves influence movements of the asset prices (Kumar and Lee, 2006; Kogan et al.2006) and macroeconomic outcomes (Korniotis and Kumar, 2006). Moreover, the risk acceptance of the investors, associates with the investment behavior and risk aversion (Madura, 2014). Risk taking behavior and risk tolerance, depends if the investor is: risk averse, risk lover or risk neutral. It is confirmed that risk taking is influenced by financial and social factors. Hoffmann et al. (2013) confirms that during 2008-2009 financial crisis, investors risk tolerance decreased while their risk perception increased. However, traditional economic theories claim that investors are rational in their investments since they tend to enhance their utility. However, investments behavior is hard to be explained with the utility theory since investor's behavior are mainly irrational (Benartziand Thaler,2007). Psychological

dimensions are integral element of the utility theory. Tversky and Khaneman (1992) combined psychological aspects within the utility theory, named as prospect theory. The financial crises generate huge negative returns for investors and as a results brand them to become risk averse (Barberis, 2013). Moreover, during the crises period financial investors decrease the transactions activity with financial securities (Agnew and Szykman, 2015).

3. METHODOLOGY AND DATA

The section describes the methodology used for the research work. Moreover, the section defines the methodological process conducted for the three objectives of the work.

3.1 Methodology

The research work contains diverse methodological process since it is based on different objectives. Each process contains its own methodological approach. The first objective of the work tends to cover the intrinsic value of the companies listed on the Prague Stock Exchange. The methodology used in the first objective will stand on the discounted cash flow (DCF) method. Monte Carlo simulation is conducted to generate possible estimated intrinsic values of the companies listed in PSE. Data used for the first objective were collected from the audited financial statements of the listed companies within the PSE. Language program *Python 3.5.3* has been used to generate the analysis.

The second objective was completed via existing literature on the issue of the factors influencing stock prices in the PSE. The third objective measure the diversification risk of the individual stock exchanges within Visegrad countries. Portfolio diversification techniques are used to obtain results of the third objective. Two inputs were used to generate results of the third objective, such as: weekly stock prices and weekly trade volume. Each stock exchange has been considered as an independent portfolio within the work. The following programs have been used to generate the results of the third objective, such as: Python 3.6.3 (version: 0.21.0), Numpy (version: 1.13.3), Jupiter Notebook (version: 5.2.0). The results of the third objective will deliver clear signals what will happen with the risk-reward tradeoff when PSE join other stock markets of Visegrad countries.

The methodology used for the second objective will be based on the existing literature. However, results obtained from the first objective enable to see percentage differences within market value and intrinsic value of the companies listed in PSE. The literature review will stand on the studies conducted in the Czech Republic and moreover. In addition, the intrinsic value of the first objective will show the extent of the deviation between fundamental value of the companies and their market prices. The literature review will help explain the causes for the deviation of market prices from their intrinsic value. The limitation of the second objective stands on the fact that it is not my own work, but it is based on the results of the other scholars.

3.1 DCF model

The intrinsic value of the companies stands on expectations for the future cash flows. The adjustments are conducted on each component within the DCF in order to get a real outlook within the company, industry and the country where the company is operating (in our case adjustments are made for the Czech Republic).

The DCF model represents the intrinsic value that is purely generated from the financial statements of the firm. Cash flow stands as one of the key inputs within the valuation process. Moreover, future cash flows are discounted for the risk exposure of the company. Different scholars' approach with diverse methodologies to the firm's value. Valuation is not a correct science with clear methodological process. Moreover, assumptions involved within the valuation enable scholars and practitioners to describe in diverse forms. However, equity valuation represents current share prices of the company in the stock market. According to Fama (1968) these two values converge within them when stock markets are very efficient. However, these metrics are produced from different environments. Equity value is generated from market forces (supply and demand) while the intrinsic value of the mechanical process. Equity value depends on the market

participants, such as: brokers, dealers, investment funds, hedge fund. In contrast, intrinsic value hinge on the methods and vision that the evaluator perceives for the company. There is no collective consensus among researchers concerning the valuation map that should be used in the process. In addition, intrinsic value is widely considered as an estimation value since stands in the opinion of particular evaluator or a group of evaluators.

Equity valuation models are based on the profound work of Miller and Modigliani (1961). MM theory considers that the equity value of the firm relies on its earning power and risks linked with individual assets. However, MM theory considers that firm value does not depend on the way assets are financed. The model is constructed under assumptions of no taxes, no transaction costs, no debt influence, etc. In contrast, the free market mechanism operates under multiple tax systems, varied transaction costs and diverse interest rates that influence firm's value. Moreover, the way capital structure (equity vs debts) is arranged indicates company's financial costs and as a result influence equity value. Moreover, MM theory considers that weighted average cost of capital remains constant among years since, no changes are imposed on the cost of debt and equity. However, interest rates are instable in the capitalist economies and cost of equity is vastly relying on the stock market returns.

Finance textbooks treat the firm valuation from different perspectives, such as: asset valuation based, valuation standing on the DCF model and comparable multiples (Brealey et al.2012). The asset based approach stands for the difference within market value of assets and market value of the liabilities. Moreover, the net asset value method (NAV) is mainly used in the periods when the company is generating negative earnings. The book value of the liabilities is almost equal to the market value. The market value of the assets is changeable,

since some assets are exposed to the changes in prices and depreciation.

Multiple based approach is divided into equity multiples and enterprise multiples. Equity multiples are linked to the company performance, such as: earnings, sales, cash flow, etc. Equity multiples stand for the price-earnings ratio (P/E), price to sales ratio (P/S), price to book ratio (P/B) and so on. Equity multiples enable the investors to check if the company is overvalued or undervalued within the stock market. Moreover, equity multiple ratios are used when identical companies already exist in the market place. However, an enterprise multiples indicate ratios, such as: an enterprise value to EBIT (EV/EBIT), an enterprise value to EBITDA (EV/EBITDA) and enterprise value to the total sales (EV/S). There are limitations within multiple indicators since comparing identical companies from different countries might lead to misleading results. Benchmark companies from different countries operate under diverse risk elements, such as: political, economic, environmental etc.

Kaplan and Ruback (1995) on their study, observe the accuracy of the DCF model to predict a firm's value. Moreover, their study confirms that three CAPM approaches show that discount rate stands as a reliable indicator in estimating the intrinsic value of the firm. In addition, their results confirm that the DCF model performs with identical outcomes as multiple based approach. However, scholars and practitioners were constantly concerned if the DCF model and multiple based approach are suitable for the bankrupted economic entities. Collins et al. (2000) tested the validity of the DCF model and comparable based methods on the bankrupt companies. Their results confirm that models deliver high level of error within bankrupted companies. In addition, the reasons for the error stands mainly on finding accurate discount rate and appropriate growth rate.

DCF model has been widely studied by the classical mathematics that indicates the present value of the assets (Brigham and Houston, 1992; Sharpe et al. 1999). The study by Thomas et al. (1994) claims that DCF model is more suitable for valuing companies than an accounting based model. The DCF model does not consider uncertainties linked with used parameters. The parameters are considered constant or random within the model. Campbell and Shiller (1981) have used a DCF model based on dividends to detect the position of the stock prices, however, results showed that DCF results were not within the market price. Discounted Cash Flow method reflects time interval of money based on the specific risk on an asset. However, P/E ratio is an additional financial technique to value the position of stocks. The study by Demirakos et al. (2010) for the 94 UK listed companies confirms that DCF model outperform P/E ratio as indicators of the company value. DCF model has found application in the initial public offerings of the companies listed in the stock markets. However, application of the DCF model found popularity after 1990s, when in that period multiple ratios were the main determinants of the company value (Glaum and Friedrich, 2006). DCF model detects the value of the company not the price since the price is arranged within buyers and seller (Fernandez, 2007).

Analysts of the listed companies, are an important element of the stock price movements since they provide key information's for the potential investors. Sell side analysts prefer the DCF model instead of any other models since they consider that the model offers a realistic outlook of the company (Imam et al, 2008). Financial analysts tend to improve their valuation of the stock, since the main target group for delivering the information's are fund managers. The main concern of the analysts is that the DCF model used for multiple periods is not able to capture the uncertainties linked with the business environment (Block, 1999). Moreover, analysts shape their DCF model grounded in

the industry where the company is operating, with unstable growth rate and volatile earnings.

The work conducted by Bancel and Mittoo (2014) on their survey with the European valuation specialists confirmed that most of them use DCF model or multiple based ratios on the valuation. However, according to their work experts use diverse inputs and different assumptions that drives completely different value of the company. Bancel and Mittoo (2014) claim that severe academic debate is required for standardization of the valuation procedures. Moreover, their study claims that relative valuation technique is used only when the stock markets are efficient. Additional model stands on discounting future cash dividends that highly depends on the constant dividend policy of the company

Beside DCF there are different methods used in the valuation, such as: balance sheet based methods, income statement based methods and goodwill based method. Balance sheet based method tends to obtain the value of the company standing on the accounting items which are based on the historical costs but do not represent the market value of the company. Moreover, elements of the company such as: contract, human recourses, organizational problems, etc. are not represented on the financial statements (Fernandez, 2007). Moreover, Fernandez (2007) shows that the method based income statement that uses earnings multiples is effective only when the stock market is efficient. However, goodwill based method contains elements of valuation, such as: patents, strategic alliances, licenses, etc. which are not part of the financial report. However, the method does not consider the dynamism of the industry and external factors that influence company value.

The following formula indicates the elements of the DCF model, such as: FCFF, growth rate and WACC.

$$DCF = \sum_{t=1}^{\infty} \frac{FCFF_t(1+g)}{(1+WACC)} \quad (1)$$

DCF (Discounted Cash Flow) represents the present value of the firm (estimated intrinsic value). FCFF represents free cash flow of the firm in the specific years. Where g shows the potential growth rate of FCFF. Moving forward on DCF terminal values, the geometric progression delivers less added cash flow on the present value. The study uses Free Cash Flow to the Firm (FCFF) as part of the geometric progression. Moreover, standard finance theories require discounting FCFF for WACC. DCF is a frontward looking indicator in the valuation of public companies; it detains future cash flows that the company will generate. DCF model incarcerates risk-reward trade-off, captured through discount rate. FCFE is another type of cash flow, which is discounted for the Capital Asset Pricing model. However, both FCFF and FCFE should provide with identical results (Bancel and Mittoo, 2014).

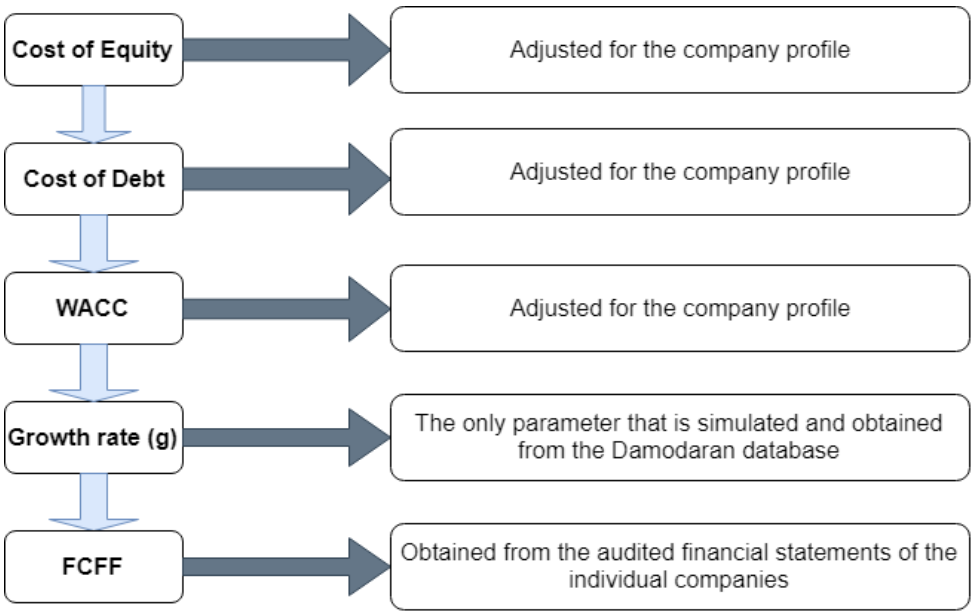

Figure 2 Inputs used during the valuation of the companies listed in PSE (Source: Authors own elaboration based on WACC model)

Figure 2 shows the inputs that will be used during the valuation of the companies listed on the PSE. Cost of equity (CAPM) will be

adjusted for the Czech Republic while cost of debt for the company's financial profile. The growth rate is obtained from the Damodaran Database (Damodaran, 2017).

However, the methodology used in the valuation process, recognize these limitations:

L1: The study does not consider the possibility of future mergers and acquisition.

L2: The study does not consider the life span of the company or bankruptcy of the company.

L3: The study does not consider possible future profitable projects of the companies.

L4: The study assumes same tax structure in all Visegrad countries and identical transaction costs

3.1.1 Risk free rate (country risk)

Country risk is a central part of the investment decisions and it plays an important role in the market value of the companies. Rating agencies appraise the countries or company's ability to pay their debt. Moreover, rating agencies solely provide opinions and their reports are not bidding for any investor or country. However, White (2010) confirms that opinion delivered from the rating agencies have gained the force of law. Corporates rating is based on the financial indicators and the arrangement of the corporate governance. Countries are rated based not solely on the economic situation, but also on the political environment, social context and legal institutions. The indicators used from the committees of the rating agencies stand to a certain degree undescribed (Vernazza and Nielsen, 2015; Amstad and Packer, 2015). Involvements of the subjective elements within the process from the rating analysts might lead to biased results. Emerging markets are characterized by lack of transparency in terms of political decision and economic data. Luitel et al. (2016) considers that emerging economies are the ones that are hardly effected from the subjective elements of

the rating agencies. Moreover, the study claims that the business model established from the rating agencies, favor the lobby groups and rich countries. Analysts of the rating agencies are concerned with the desire and capability of the governments to pay back their debts. Central Bank independence generates trust among the rating analysts in terms of the macroeconomic stability. Independent centralbanks are mandated to keep inflation under control. The importance of the independence institutions of the rating agencies is shown in the case of Poland and Hungary. In addition, the rating agencies (Moody's, S&P and Fitch) downgraded Hungarian bonds after the constitutional changes and elections in 2010 (Bodea and Hicks, 2018).

Countries tend to issue bonds in order to finance their capital projects. Rating agencies create confidence among investors in the country's economic and political position. Rating agencies are mainly invited from countries to evaluate and rate their bonds. Moreover, a downgrade in the rating reflects higher interest and lower bond prices. Bonds that are appraised from the rating agencies have strong influence on their interest rates (Vaaler and Block, 2006). Rating agencies were characterized by lack of transparency and not a clear guideline for their methodology. However, rating agencies are private companies and they realize profits from the rating fees covered from the bond issuers. The financial crisis of 2008-2009 risked the reputation of the rating agencies. During the crisis period rating agencies delivered a good report for the financial institution's that were close to bankruptcy. After the financial meltdown the rating agencies increased their transparency via showing their rating methodology. USA set up a new regulatory framework in 2010 concerning the transparency of the rating agencies. European Union in 2009 reformulated the transparency law on the rating methodology. Since 2010, rating agencies have stood more on the quantitative inputs when they reach the opinion concerning sovereign rating (Amstad and Packer, 2015). Countries that have a well-established democratic system, followed by

the rule of law, property rights and independent institutions are characterized by a better rating (Beaulieu et al, 2012; Biglaiser and Staats, 2012).

Rating of the firms stands for the default rate or the likelihood of going bankrupt. Commercial banks set up the interest rate for the companies based on the ratios, such as: solvency, liquidity, turnover, etc. Low performance and illiquidity of the company increase interest rate and vice versa. However, the distance within the borrower and lender indicate the qualitative information's that might be collected from the loan officers (Agarwal and Hauswald, 2010). In contrast, the studies confirm that integrating the soft information on the rating of corporate bonds, deliver accurate rating results. Interest rate imposed on the government bonds, reflect underlying economic and political conditions of the country. Moreover, government bonds are extensively used in the valuation of companies and possible future projects. Rating that is grounded in the biased methods might lead to unrealistic government bonds interest rates. In addition, small deviation in the interest rate leads to enormous changes in the net present value of the company.

3.1.2 Discount rate

The discount rate is a standard metric used in the valuation of companies, rent, private and public projects, etc. The indicator is used in determining present value of possible future cash flows. Moreover, discount rate shows not only the returns, but also the risk level attached to particular companies, project or financial asset (Damodaran, 2012). A lower discount rate generates higher net present value for the company or project and vice versa. Valuation of the companies based on free cash flow to equity is discounted by the cost of equity (Capital Asset Pricing Model). In contrast, firm value standing on the free cash flow of the firm is discounted for the weighted average cost of capital (WACC). The discount rate is an important element of the investor's

decision making process. Cochrane (2011) claims that movements in the discount generate higher influence than uncertainties linked with future cash flows. Investors are more relaxed when they operate in the environment with lower discount rate. Moreover, the introduction of the Life Cycle Cost Analysis (LCCA) discount rate found application in the assessment of the various fixed assets (Fuller, 2009).

CAPM is used as discount rate when FCE (Free Cash Flow to Equity) is used within the valuation. In contrast, WACC is used to discount FCFF (Free Cash Flow to the Firm). The following inputs are used during the valuation process of the listed companies:

$$CAPM = R_{fr} + \beta(R_m - R_{fr}) \qquad (2)$$

$CAPM$ Corresponds to the capital asset pricing model. Where R_{fr} represents risk free government bonds while $(R_m - R_{fr})$ shows risk premium. RmIs obtained from the average stock market return, in our case from PSE. R_{fr}Is collected from short term Czech government bonds.

$$WACC = \left[\left(\frac{MV(Debt)}{MV(Equity)+MV(Debt)}\right)\right] \times rd \times (1 - tax.rate) + \left[\left(\frac{MV(Equity}{MV(Equity)+MV(Debt)}\right) \times re\right] \qquad (3)$$

$WACC$ stands for the weighted average cost of capital. MV (Equity) represents the market value of equity, MV (Debt) shows the market value of debt, tax rate shows the tax on profit that the company is paying for Czech government, *rd* represents the cost of debt and re shows the cost of equity. WACC is a crucial element in the geometric progression that captures the value of the firm, higher WACC corresponds to the lower value of the company. All these inputs are included within the discounted cash flow model.

Public investments are appraised standing on the identical features like private projects. However, outcomes driven from the public investments must generate social benefits while private investments

are focused solely on creating wealth for the shareholders. Cost benefit analysis has been broadly used in the assessment of the long term public investments. Moreover, the cost-benefit analysis is regularly discounted with factor named as "social discount rate". Price (1988) defines the social discount rate as the indicator claimed on the social consumption or incomes accumulation. The social discount rate stands for the rate of return on the projects realized in the private sector. According to European Union regulation each investment project must be based on the cost-benefit analysis (Rambaud and Torrecillas, 2006). The European Commission has set up a benchmark for the social discount rate (SRD) in the range of 5% of the co-financed projects. However, for the specific projects, different SDR must be justified with detailed analysis. Countries within the EU have established unique methodology for calculating social discount factor. The United Kingdom set up SDR in the range of 6%, while the rate is revised to the range of 3% since the economic prospect of the country improved (HMT, 2003). Moreover, in France the Commissariat General du Plan declined SDR from 8% to 4%, both in real and nominal terms (CGP, 2005). The social discount rate for the public projects implemented by the Italian government stands in the range of 5% (CPRP, 2001). However, the budget office of the United States has created a guideline for the investors that are interested to apply in the government public projects. The SDR for the public investments in the US is 7%, while sensitivity analysis is required with different possible discount rate factors (OMB, 1994).

The professor Answarth Damodaran from the Stern School of Business at New York University created a world online database that generates data on diverse valuation issues (Damodaran, 2018). Moreover, the discount rate within the online database is detached among industries and between countries. Damodaran database is extensively used among scientific researchers and practitioners.

Discount rate on the cross country level is diverse since each country contains unique risk levels.

3.1.3 Free Cash Flow to the Firm

Free cash flow to the firm (FCFF) represents the amount of cash flow available after depreciation, taxes, investments and working capital paid. Moreover, free cash flow to the firm stands for the volume of cash remained for the shareholders and debtholders (Brealey and Myers, 2012). Cash flow based methods are becoming very popular methods in valuating companies, since they consider the company as a cash generator (Fernandez, 2007). However, there are different approaches to calculating FCFF but each method has its own explanations. However, all forms of calculating FCFF are accounting based, generated from the audited financial statements. Moreover, FCFF has found applications also in the business valuation via calculating the intrinsic value of the company (Damodaran, 2012). Investors are mainly interested in the cash flow that the company generates for their shareholders. There are companies that operate under profitable terms, but with negative cash flow and this can send the company to the bankruptcy. The formula (4) shows one of the forms for calculating FCFF.

$$\mathrm{FCFF} = \mathrm{NOPAT} + \mathrm{depreciation}\ \&\ amortization - CAPEX - \Delta NWC \qquad (4)$$

NOPAT stands for the net operating profit after taxes, CAPEX shows capital expenditures and NWC represents net working capital. Changes in the net working capital (NWC) indicate the capacity of the company to cover its short term debt. Capital Expenditures show an increase in the level of the fixed investments on the yearly basis. Depreciation and amortization since they are not cash outflows, are summed within the formula of FCFF.

The second version of the FCFF comprises cash flow from operations (CFO) as a major input, interest expenses that the company is paying on the bonds and loans and subtracted with the capital expenditures. The formula (5), shows the second arrangement of the FCFF.

$$\mathrm{FCFF} = \mathrm{CFO} + \mathrm{int.exp}(1 - \mathrm{tax\ rate}) - \mathrm{CAPEX} \quad (5)$$

CFO shows how well the company is using her human and physical recourses to generate cash. Tax rate stands for the corporate profit tax rate imposed by government. Financial analysts use diverse formula to reach the FCFF, since only publicly traded companies have mandatory reporting requirements from the tax authorities. However, private companies don not operate under identical reporting standards as publicly traded companies. The formula (6) shows the third form of calculating FCFF.

$$\mathrm{FCFF} = \mathrm{NI} + \mathrm{dep}\ \&\ amort + int.\mathrm{exp}(1 - \mathrm{tax\ rate}) - \mathrm{CAPEX} - \Delta\mathrm{NWC} \quad (6)$$

The formula (6) computes FCFF through net income (NI) through adding depreciations & amortization, interest expenses and subtracting capital expenditures and networking capital.

3.1.4 Growth rate

The future is considered unknown, since being quite hard to predict the events that have not been undertaken. However, economists set up assumptions on the variables that are unknown. Growth rate set up on the company's value is linked with the uncertainties related to the future cash flows. Prediction models are used in the different areas, such as: stock markets, economic performance, medicine etc. The work by Alexopoulos et al. (2018) used non-linear logistic models standing on the Heligman–Pollard approach to predict the mortality rate in the UK and Wales.

Predicting the financial performance of the companies was standing as the major concern of the scholars. Bankruptcy prediction models tend to capture the probability of the companies default. The models commonly use accounting and non-accounting metrics to generate influential components that drive the companies to insolvency. Financial condition is the vital aspect of the current and future company's health. Moreover, (Kapliński, 2008) considers that the financial health of the company is very reliant on the indicators, such as: liquidity, solvency, performance, etc. In addition, bankruptcy models stand largely on the probability outcomes, standing on the experiential observations (De Laurentis et al. 2011). The most well-known bankruptcy prediction index is Altman Z-score, which is compounded of the six company specific ratios (Altman, 1968). The index contains different weights of each financial component, and is considered as one of the most accurate model for predicting bankruptcy of the company. Moreover, bankruptcy models are used to appraise the risk level of the company even though their accuracy is uncertain.

Future growth level of the industries is still undefined among scholars. However, there is consensus among academics on the way the economy operates. Competition is a key force that drives innovation, increase quality and lower prices. Moreover, competition can be ensured even with two players in the market when they don't have cooperative agreements on the prices or quantity. Companies might operate in high profit margins for many years under unregulated market. However, when the industry gets matured and new entries occurs, previous growth is not possible in the highly competitive market. Companies within a highly competitive industry operate where price equals marginal costs and growth rate is determined by the industry growth. Monopolies are mainly regulated from the governmental agencies where their output prices are set up by the government authorities. The growth rate of the monopolies is influenced from the cost structure and demographic factors. Porter

(1989) shows that the growth rate of the industry is not only influenced from the macroeconomic indicators, but also from the internal forces that drives dynamism of the industry. Moreover, his work confirms that internal competition, the power of buyers, the power of suppliers, governmental regulations and possible new entries influence the vitality of the industry.

Professor Aswath Damodaran has classified growth rate estimations among different industries and with different ratios (Damodaran, 2017). Groupings of the estimated growth ratios within the online database, stand such as: return on equity decomposition by industry, earnings per share (EPS), and historical growth earnings by industry and the historical growth rate on the operating income.

3.1.5 Beta coefficient

Risk-reward tradeoff paradigm stands as the regular attitude on their investments. Uncertainties in the financial markets are largely identified through the volatility of returns. The risk of the listed companies is captured through the beta coefficient, that measure sensitivity of the markets returns with the company returns. Unsystematic risk is linked with management capacity to compete with other players. However, systematic risk is measured through the beta coefficient within the CAPM (Sharpe, 1964). The studies realized by (Baker et al. 2011; Frazzini and Pedersen, 2014; Li et al. 2014) confirmed an abnormal relationship within the beta coefficient as risk component and compounded annual returns. Their studies showed that low beta stocks are opposed to the higher risk adjusted returns. However, portfolios with high beta stocks are linked with lower risk adjusted returns. Moreover, portfolios of low beta stocks outperform portfolios of low beta stocks. The main reason why low beta stocks outperform high beta stocks is not linked with their growth rate, but mainly with their returns associated with their trading, necessary to rebalance volatility (Berrada et al. 2014). According to the interviews

with the valuators, 65% of them use inputs for obtaining the beta coefficient for a three years' period (Bancel and Mittoo, 2014).

$$\beta = r\frac{\sigma_i}{\sigma_m} \quad (7)$$

Beta coefficient measures the sensitivity of stock returns with market returns. Higher beta imposes a higher risk to the company. Where β represents the beta coefficient, while σ_i shows standard deviation of particular stocks or portfolio and σ_m reflects the standard deviation of the stock market, which is referred as standard beta. Beta coefficient represents the slope of the linear relationship on the regression analysis, regressing returns of the company with the returns of the stock market. According to the Fernandez (2007) using the beta coefficient of the other companies that operate in the same industry is one of the errors in the valuation.

3.1.6 Monte Carlo Simulation

Simulation of the Discount Cash Flow is calculated by using Monte-Carlo technique. Growth rate is the only parameter that is simulated to generate random growth rate values. Moreover, to generate a random growth rate is used a Monte Carlo simulation method, known as the Percentage Point Function (PPF). PPF is a type of cumulative distribution function. Percentage Point Function (PPF) is used to generate the growth rates, based on that the calculation of the growth rates are reached by inputting three parameters:

- X - randomly generated number where x such as: $0<x<1$ (probability)
- Growth rate mean (based on the Damodaran database estimations)
- Standard deviation of growth rate

Number of randomly generated growth rates are equal with the number of years we want to simulate. Standard deviation of 1% is used

for each company. Moreover, each year we generate randomly x values used for the PPF calculations. Each sample has its own randomly generated growth rate values. Based on the sample size, the experiment is repeated under the same conditions and independently from each other. What we want to find with PPF is the x value in the formula of Cumulative Distribution Function, such as:

$$P(X >= x) = p, \text{ where p is the randomly generated number} \quad (8)$$

So, we want to find x area by given the probability p. So in this case we have inverse DCF that we call PPF, where we are going to find the x value. Parameters below define the experiment conducted with Monte Carlo Simulation, such as:

- Cash Flow for the first year (known as 'CF_1')
- Growth Rate in decimal format (known as 'g')
- Standard deviation
- Discount Rate in decimal format (known as 'r')
- Number of years to simulate
- Number of samples or simulations

The process starts with randomly generating growth rates for the number of years specified. In addition, the second step starts with calculating cumulative DCF. Cumulative DCF interrupts adding new values if the difference of the two consecutive DCF is less than 6%. Cumulative DCF output can be less than the number of years that are specified in the parameter. Moreover, we are interested to identify the list of Cumulative DCFs when they are reaching the max value before the specified year in the parameter. Moreover, each company has been simulated with three different sample sizes, such as: 500, 1000 and 10000. For each company are provided three normal distributions based on their corresponding number of samples. Plots represent Normal Distribution of their own Cumulative DCF results.

Tools used for the simulation process:

- Programming Language: Python 3.5.3
- Development Environment: Jupyter Notebook
- Random Number Generator: used “np.random.rand” method from Pandas library, ver: 0.24.1
- Generating Random Growth Rate (as ‘g’) we used: “norm.ppf” function from “scipy.stats” library, ver: 1.2.1
- Calculation of Standard Deviation, Mean, Maximum, Minimum values: used DataFrame methods “std”, “mean”, “max”, “min”, from Panda Libscipyrary, ver: 0.24.1
- Representing “Comulative DCF” and Normal Distribution plots we used: pyplot functions from Matplotlib Library, ver: 3.0.2 and for PDF we used: stats functions from scipy Librar, ver: 1.2.1
  (The program concerning the implementation of the formula is available on request).

3.2 Diversification model

Risk stands for the consequences generated from the actions completed under uncertainty. Risk reflects the likelihood of losing well-being, happiness, financial incomes, managerial position, etc. Moreover, risk is linked with the odds that something undesirable will occur. However, financial risk considers the possibility that shareholders and other stakeholders will fail to generate positive returns from their investment. Investors tend to be rewarded for the risk exposed on their investments (Aker and Jacobson, 1987). The standard theoretical paradigms confirm that more risk is compensated with extra rewards. The concept of risk is defined as the uncertainty associated with asset returns. Moreover, the work considered risk merely in the circumstances when there are diverse likelihoods related to the particular event. In contrast, when there are no uncertainties

linked to a particular event than that occasion is not exposed to a specific risk.

Modern risk theories are discussed mainly from the portfolio diversification perspective. Markowitz (1952) proposed a three dimensional model where risk is measured from the variance of returns, correlation coefficient within asset classes and their weights within the portfolio. Increase on each of the elements, such as: variance, correlation and weights raise the risk level of the portfolio. Moreover, the model developed by Sharpe (1964) and Lintner (1965) enhance the concept of risk through involving systematic risk as a component indicator. Systematic risk is mainly generated from the market shocks and is beyond manager's capability to control them. Moreover, systematic risk might be generated from political events, economic crisis, nature, etc. In contrast unsystematic risk can be eliminated through diversification. Unsystematic risk is diminished from diversification via spreading the investments in a diverse set of financial securities.

The Markowitz (1952) model is used to generate an individual risk level of each stock market in the Visegrad countries. Stock prices are used to generate weighted average return and correlation coefficient within each company listed in the stock markets. Weights are obtained from the trade volume. Moreover, Markowitz (1952) model is used for measuring the risk of the individual stock markets, but also for measuring the risk of the common Hypothetical Visegrad stock market. The work considers stock markets of V4 countries as individual portfolios. Standard deviation of returns and weights concentration are other elements that influence risk level of the individual portfolios (individual stock markets). The risk level is obtained from multiple factors, such as: correlation coefficient, standard deviation of the returns, the variance of the returns and weights concentration. Higher values in these variables increase risk level. The risk level of the

portfolio (individual stock market markets) is measured through the standard deviation of return. Correlation coefficient within financial assets is and additional element that raise or lower risk level (Sentana, 2004; Tang 2004; Behr at al 2013; Medo et al. 2009; Drake and Frank, 2010). In addition, portfolio with 50 stocks eliminates completely unsystematic risk (Cleary and Copp, 1999; Domian et al. 2007). In contrast, the work realized by (Evans and Archer, 1968; Jannings, 1971; Johnson and Shanon, 1974; Bird and Tippett, 1986; Statman, 1987; Surz and Price, 2000; Tang, 2004; Brand and Gallagher, 2005) confirm that total risk benefits are achieved in the portfolio with five to sixteen stocks.

The Markowitz (1952) formula is used to measure the risk level of the individual stock markets and Visegrad Stock Market.

$$\sigma_k^2 = \sum_i^{n_k} w_{ik}^2 \sigma_{ik}^2 + 2 \sum_i^{n_k} \sum_{j \neq i}^{n_k} w_{ik} w_{jk} \sigma_{ik} \sigma_{jk} \rho_{ijk} \qquad (8)$$

Formula explanation: σ_k^2 of the portfolio in the year k is computed on the sample of n_k companies. Index i indicates a company, j is an auxiliary index assuring that covariance is computed on distinct companies, ω-represents weight of each listed company within the portfolio based on their total assets, ω^2 represents weight in square, σ^2- variance of returns, σstands for the standard deviation of returns while $\varphi(i,j)$ shows correlation coefficient within returns of the companies in the portfolio.

Mathematical formula has been implemented from the following computer programs: Python 3.6.3 (version: 0.21.0), Numpy (version: 1.13.3), Jupiter Notebook (version: 5.2.0). Generating the inputs of the risk level (σ^2) starts with splitting the tables that contain prices and trade volume. Following matrix has been used to generate the results *(the program concerning the implementation of the formula is available on request)*.

The process of pooling two or more stock markets stands as follows. We present an example of pooling two stock indexes. Let A be the first stock index and B the second stock index. A_d represents dates and data (prices and trade volume) for the stock A and B_d represents dates and data for the stock index B. Merging the two stock indexes is realized through intersection within A_d and B_d. The new generated portfolio (A+B) create a new stock market with existing prices and trade volumes from A_d and B_d since prices and trade volumes are collected on the common dates for both stock market (they are intersected by dates). Risk and return calculations of the merged stock indexes follow the same process when calculating one stock market.

Financial securities are exposed to the risk-reward tradeoff in the investment process. Investors might have diverse attitudes toward risk in different circumstances. Moreover, some people are risk averse and they prefer less risky investments. Risk averse concept stands for the investors that when facing identical returns in two investments, they favor the investment with lower risk. Mainly risk adverse investors prefer to invest in the safe financial assets, such as: deposits accounts, certificate of deposits, government bonds, etc. where the standard deviation of returns is close to zero. Risk lover's investors tend to be exposed to the higher risk level. In contrast, risk neutral investors intend to get a certain amount of returns and does not depend on the risk exposed on the investment. Moreover, risk exposure mainly stands in three diverse statistical grounds, such as: distribution probability, standard deviation of returns and relative measure of risk. Standard deviation of returns captures deviation of returns from their mean. Moreover, higher standard deviation of returns implies higher risk exposure for the investors. A relative measure of risk or variation coefficient stands for the deviation of returns from the expected returns. Moreover, the higher the coefficient of variation indicates greater insecurity for the investors.

3.3 Data

This section indicates the way data are collected for the first research question (DCF model) and for the third and fourth research question (Diversification Model).

3.3.1 Model 1 data (DCF model)

The study uses secondary data of the companies listed on the Prague Stock Exchange (PSE, 2018). Data were collected from the annual statements of listed companies in PSE. The following accounting items were used to generate results for the intrinsic value of the listed companies, such as: interest expenses, property-plant & equipment, depreciation & amortization, cash flow from operations, total equity and total liabilities (PSE, 2017). The growth rate has been obtained from the Damodaran database (Damodaran, 2018). Growth rate within the Damodaran Database is classified based on the industry characteristics. However, risk free rate measured through interest rate is collected from 10 years' Czech government bonds (CNB, 2018). Moreover, 10 blue chip companies in 2017 from the Prague Stock Exchange were selected for generating the estimated intrinsic values. The selected companies were, such as: O2, Phillip Morris CR, Moneta Bank, Komercni Banka (KB), Vienna Insurance Group (VIG), Kofola Ceskoslovensko, CEZ, Erste Group Bank and Stock Spirit PLC (PSE, 2018). In contrast, companies such as: Central European Media Enterprises Ltd and Pegas Nonwovens were not selected since they were generating negative FCFF from 2013 till 2017.

3.3.2 Model 2 data (Diversification Model)

Model 2 uses two types of inputs (stock prices and trade volume) to generate diversification risk of the individual stock markets (portfolios). Data concerning stock prices and trade volume on the individual stock markets of the Visegrad countries are collected from the Thomson Reuters Eikon database (Eikon, 2018). Stock prices and trade volume are collected from 2009 till 2017, on the weekly basis.

Moreover, prices and volume of trading are collected in a euro currency that enables pooling of the Visegrad Stock Exchanges.Moreover, 12 companies are selected from the PSE, 16 companies from BUX, 20 companies from WIG20 and 6 companies from SAX. However, companies are changing among years since some companies are leaving the stock exchange while the others are entering it.

4. RESULTS

The section indicates the results of the first, second and the third objective of the work. This section indicates estimated intrinsic values of the companies listed in PSE, factors influencing stock prices in the PSE and diversification risk linked with Visegrad Stock Exchanges.

4.1 Verification of the first research question (Q1: O1)

This section represents the results of the first objective of the work, responding to the first research question. Moreover, this section generates estimated intrinsic values of each company listed in the PSE.

What is the estimated intrinsic value of the companies listed on the Prague Stock Exchange?

4.1.1 Case of CEZ, a.s.

Company Profile

CEZ Group is a multinational company with headquarter in the Czech Republic. The company operates in central and southeastern European countries and Turkey. Moreover, the business model is oriented on trading electricity, natural gas and coal exploitation. The company by 2018 contains 30,392 active employees. The parent company contains almost 70% of the shares within the ownership structure. The shares of the company are listed on the Prague Stock Exchange and Warsaw Stock Exchange. The main activities outside Czech Republic are focused on: distribution of electricity, trade and selling of electricity. The CEZ Group contains ownership and co-ownership of the asset distribution in Germany, Slovakia, Hungary and Poland (CEZ, 2019). The first trading day on the Prague Stock Market started on 22.06.1993. The analysts within the PSE, consider the shares of the CEZ as liquid financial securities (PSE, 2019).

Figure 3 shows CEZ Group closing prices within the PSE from 14.01.2013 till 29.12.2017, on the daily basis. Closing stock prices are

represented in the Czech Koruna. The companies share prices in the PSE by 14.01.2013 were 680 CZK while in 29.12.2017 the prices dropped to 496.5 CZK, a decline of 26.9%. However, it is clear from the graph that there was a tendency of price decline from 2013 to 2017 of the CEZ share prices. Maximum price was reached on 04.01.2013 reaching 680 CZK and the minimum one on 26.02.2016 reaching 368 CZK.

Figure 3 Closing prices for the CEZ Company in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

Trade volume is one of the indicators the financial analysts give a high focus. Moreover, trade volume represents shares of the particular company that have been traded within the specific period of time. Figure 4 shows the trade volume of the CEZ as from 14.01.2013 till 29.12.2017 within the PSE. Moreover, the volume of trading dropped from 1,153,704 CZK (14.01.2013) to 385,584 CZK (29.12.2017), a decline of 66.5%. However, on average volume of trading among years declined that shows that CEZ shares were less traded within the PSE.

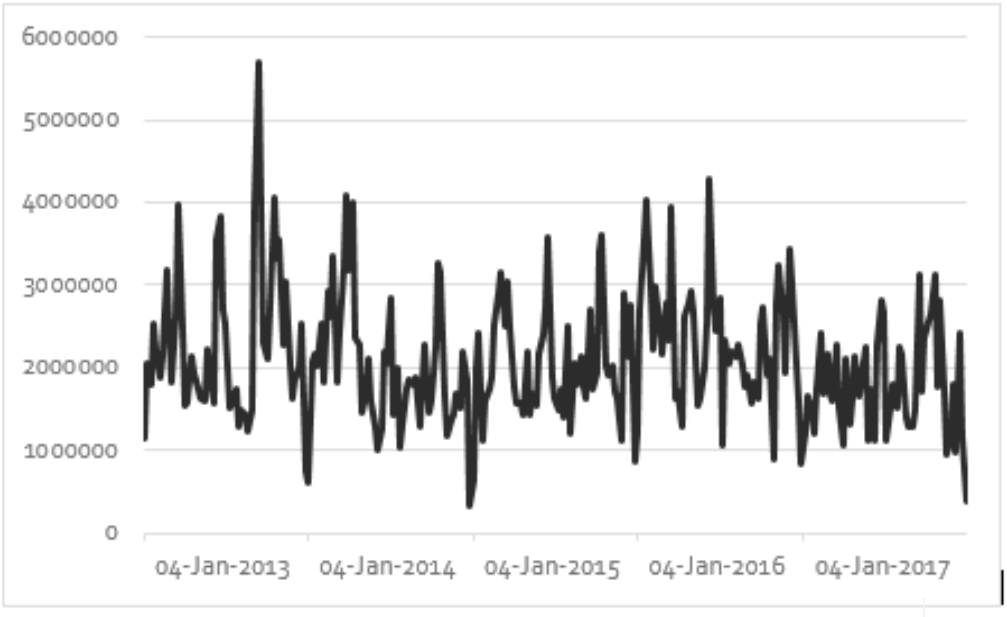

Figure 4 Trade volume for the CEZ Company in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

Estimated Intrinsic Value of the CEZ as

The intrinsic value of the company represents expectations for the company future free cash flows. DCF model is used to detect the present value of the company based on its future cash flows. Moreover, all the ratios have been adjusted for the company risk profile. CAPM has been used to obtain cost of equity of the company. WACC is used to observe cost differences in financing activities of the company.

Table 1 shows important elements used within the valuation of CEZ Company. CAPM is built on the components, such as: risk free rate (RFR), market returns (RM) and the beta coefficient. RFR is obtained from 10 years' Czech government bonds while markets return (RM) stand for the yearly returns generated from the Prague Stock Market. Beta coefficient stands for the regression of the market returns (PSE)

with the CEZ stock returns. The beta coefficient for the CEZ Group from 2011 till 2017 is 0.75. Moreover, Beta coefficient is used as a constant metric among for calculating CAPM from 2013 till 2017. The beta coefficient for the CEZ Group shows that the company is less volatile (riskier) than the Prague Stock Exchange. Capital expenditures (CAPEX) are calculated from the net differences on the property, plant and equipment's (PPE) via adding depreciation as non-cash outflow of the company. Table 42 in the appendix shows all accounting items used to obtain the ratios. PSE experienced positive and negative average returns, the largest drop occurred during 2011 that corresponds with the Greek debt crisis. The corporate tax rate in the Czech Republic was 19% from 2011 till 2017. Free Cash Flow to the Firm (FCFF) is conducted where interest expenses are added into the cash flow to operations and subtracted for the capital expenditures. Table 1 shows changes in the WACC of the CEZ from 2011 till 2017. Cost of equity stands for CAPM times percentage of equity in the capital structure. However, the cost of debt stands for interest rate times percentage of debt in the total structure. Average WACC for CEZ Company ranges within 2.8%. However, the highest WACC for the CEZ occurred in 2013 (WACC=3.1%) while the WACC used as the discount rate in the model was 2.5% (2017).

Table 1 Components used within the valuation process of the CEZ Company, from 2013 till 2017

	2013	**2014**	**2015**	**2016**	**2017**
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	3.1%	2.7%	2.4%	2.3%	2.5%
Corporate Tax Rate (CZ)	19%	19%	19%	19%	19%
CAPEX(in million CZK)	34,750	27,687	23,441	34,509	30,429
FCFF (in million CZK)	45,960	49,902	52,996	20,660	19,551

Source: Authors own elaborations based on the CEZ as audited financial statements (CEZ, 2018).

Geometric progression for the CEZ Company has been conducted for the 30 years with 500, 1000 and 10000 simulations. The Monte Carlo simulation method has been used to generate the simulations. FCFF of the year 2017 was used as the first input in the geometric progression. Since CEZ operates in the industry of energy, Damodaran database is used to set up the growth rate of the company. The growth rate stands in the range of 8.96%. Moreover, key three inputs used for the defining intrinsic value of the CEZ Company, are as follows:

Standing on these inputs, simulation with 500, 1000 and 10000 samples deliver the results as follows. Table 2 shows the estimated intrinsic value of the CEZ with three different samples.

Table 2 Estimated intrinsic value of the CEZ Company with 500, 1000 and 10000 samples

Es. Cumulative DCF Max (in billion CZK)	Es. Cumulative DCF Mean (in billion CZK)	Es. Cumulative DCF Min (in billion CZK)	Number Of Simulations	Number of years	Starting year for the simulations
264.58	242.37	216.37	500	30	2017
267.22	242.68	215.34	1000	30	2017
276.15	242.74	208.53	10000	30	2017

Source: Authors own elaborations based on the audited financial statements of the company (CEZ, 2018).

The company CEZ as in 2017 had 534,385,000 shares outstanding, while average stock price 2017 was 435.6 CZK/share, in the PSE index. However, the stock price on the 28.12.2017 was 496.5 CZK/share. Number of years in the Table 3 represent the forecasted future free cash flow to the firm used in the normal geometric progression. Mean intrinsic value with 500 samples was 242.3 billion CZK, maximum was 264.5 billion CZK while the minimum one in the range of 216.3 billion CZK. The mean intrinsic value with 1000 samples was in the range of 242.6 billion CZK, minimum one was standing in the range of 215.3 billion CZK while maximum in the range of 267.2 billion CZK. Simulations with 10000 samples shows DCF mean was 242.7 billion CZK, DCF maximum was 267.1 billion CZK while the minimum was 208.5 billion CZK. However, the book value of the company in 2017 was in the range of 371 billion euro. The Table 3 shows the deviations of the stock prices from their estimated intrinsic value with 500, 1000 and 10000 samples

Table 3 Deviation within market prices, book value per share and estimated intrinsic value per share

Es. DCF mean 500 samples/CEZ number of shares	**Es. DCF 1000 samples/CEZ number of shares**	**Es. DCF 10000 samples/CEZ number of shares**	**Book Value/CEZ Number of shares**	**Average Market Price of CEZ (2017)**
453.5 czk/share	454.1 czk/share	454.3 czk/share	696 czk/share	435.6 czk/share

Source: Authors own elaborations based on the audited financial statements of the company (CEZ, 2018)

According to the Table 3 estimated DCF mean with 500 samples was 453.5 CZK/share in 2017, while with 1000 samples was 454.1 CZK/share and with 10000 samples in the range of 454.3 CZK/share. Book value per share stands in the range of 696 CZK while the average market price in 2017 was 435.6 CZK. The deviation of the market prices from the estimated DCF mean with 500 samples in 2017 was 3.94%. Deviation of market prices in 2017 with 1000 samples stands in the range of 4.07%. However, the deviation with 10000 samples in 2017 was in the range of 4.11%. Stock prices of the CEZ Group as in 2017 were undervalued in the range of 4%. Moreover, CEZ stock prices were lower compared to their estimated intrinsic value per share. According to the generated results the company was undervalued in the range of 19 CZK.

The book value of the company is based on the historical registration of the accounting items and does not represent market prices. The deviation of the estimated DCF mean with 500 samples from the book value per share was 53.4%. The average deviation between book value per share and three different DCF results, stands in the range of 53%. Figure 5 shows the distribution of the DCF-s with 10000 samples which shows that the majority of the trails are lying within 230 billion CZK and 250 billion CZK.

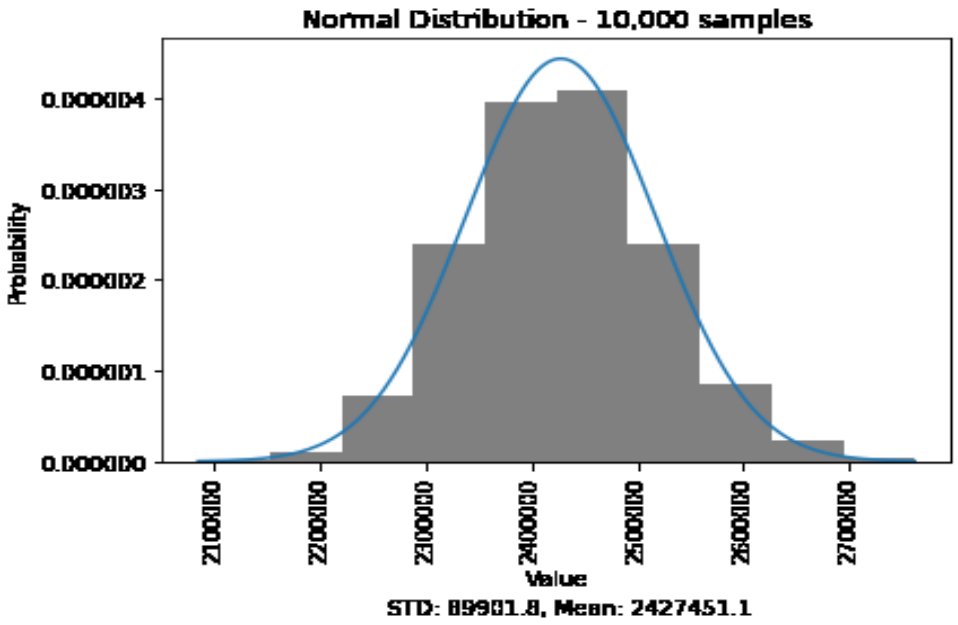

Figure 5 Normal distribution for the CEZ Company in the CZK with 10000 samples
(Source: Authors own elaborations based on the audited financial statements of the company (CEZ, 2018))

4.1.2 Case of Kofola ČeskoSlovensko a.s.

Company Profile

The business sector that the company covers is a production and distribution of the non-alcoholic drinks. Moreover, by 2017 Kofola Česko Slovensko stands as the main producers and distributors of the non-alcoholic drinks in the eastern and central Europe. The main target markets are the Czech Republic and Slovakia. The company has been established in 1960 with its operations solely in the Czech Republic and Slovakia. However, the company is also present in: Poland, Slovenia and Russia (PSE, 2018).

Figure 6 shows stock prices of the Kofola Česko Slovensko a.s. from 04.12.2015 till 29.12.2017. During this period prices were moving within 500 CZK/share and 360 CZK/share. Average stock price in this

time interval was in the range of 420.1 CZK. Minimum price was 360 CZK (23.12.2016) while the maximum on was 502.5 CZK (04.12.2015).

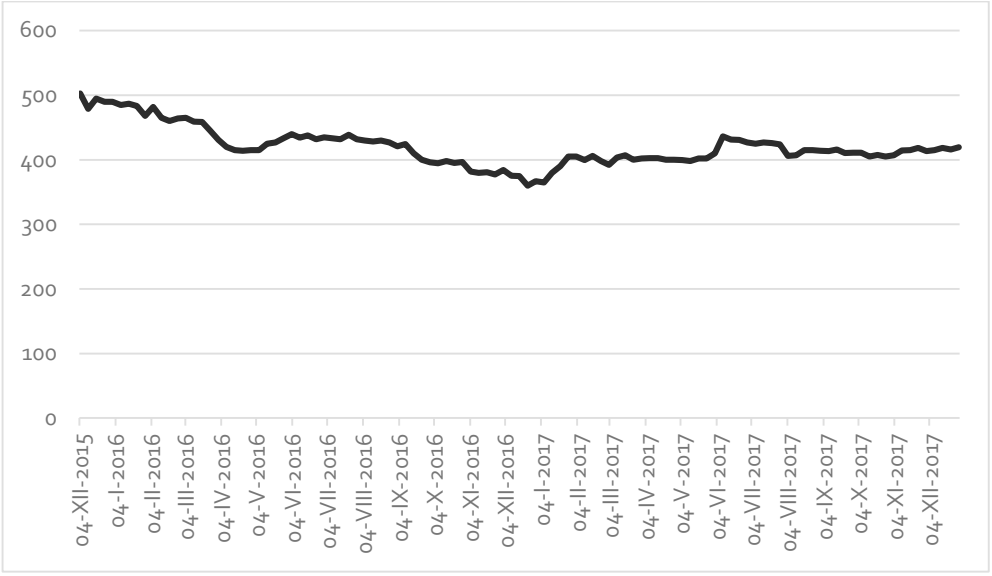

Figure 6 Close prices for the Kofola CeskoSlovensko in the CZK, from 2015 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Figure 7 shows the trade volume of the Kofola ČeskoSlovensko a.s. from 04.12.2015 till 29.12.2017. The company was characterized from huge volatility in the trade volume from 2015 till 2017. However, the minimum trade volume was 441 CZK (26.02.2016) while the maximum trade volume was 40,809 CZK (04.12.2015) that corresponds to the period when the company entered the PSE index. Average trade volume during this period was 6946.6 CZK.

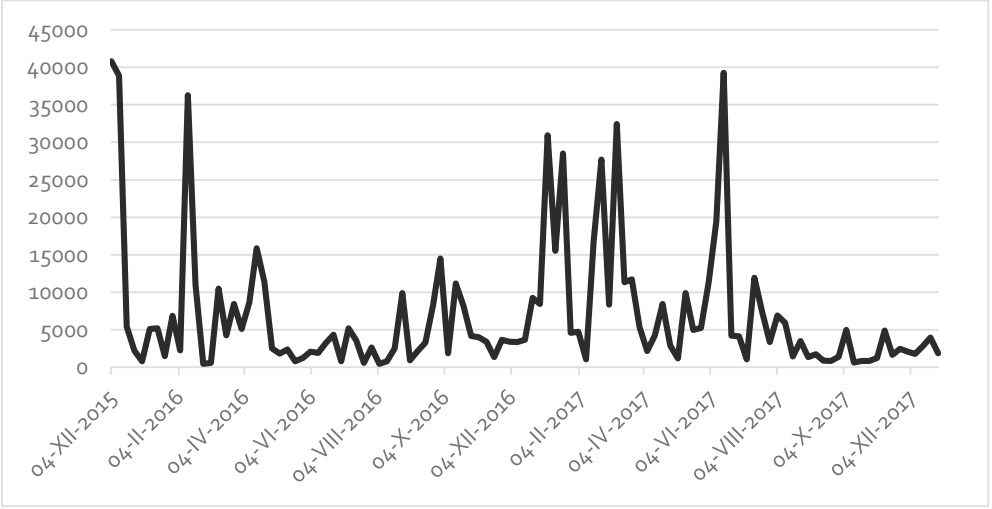

Figure 7 Trade volume for the Kofola CeskoSlovensko in the CZK, from 2015 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

Estimated Intrinsic Value of the Kofola ČeskoSlovensko a.s.

Risk free rate, market returns and tax rate as inputs used to estimate intrinsic value are identical for each company used in the study. However, beta coefficient for the Kofola ČeskoSlovensko a.s stands in the range of β =-0.1. Moreover, when PSE moves 1% positively, Kofola ČeskoSlovensko moves -0.1% against the market. Beta coefficient shows that Kofola ČeskoSlovensko offers diversification benefits within the PSE index. However, the company has a short history within the PSE that would allow observing trends in the long time interval. The company had a positive free cash flow to the firm from the 2013 till 2017. Table 4 shows that from 2014 till 2017 it is clear that FCFF has tendency to increase. The accounting items used for generating FCFF stand in the Table 43 in the appendix. Average WACC of the company from 2013 till 2017 was 3.86%. The maximum WACC was in 2016 (4.8%) while the minimum one in 2017 (3.0%). The parameter used in the simulation is the WACC of the 2017 (3.0%).

Table 4components used within the valuation process from 2011 till 2017 of the Kofola ČeskoSlovensko a.s.

In CZK	2013	2014	2015	2016	2017
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	3.8%	2.9%	3.0%	2.7%	3.0%
Corporate Tax Rate (CZ)	19%	19%	19%	19%	19%
CAPEX (in million CZK)	0.2	0.5	1.2	0.4	0.5
FCFF (in million CZK)	481	197	200	261	272

Source: Authors own elaborations based on the CEZ as audited financial statements (KCS, 2018)

The Table 5 indicates the estimated intrinsic value of the company with 500, 1000 and 10000 samples. However, mean DCF is almost identical with three samples, standing in the range of 8.5 billion CZK. The geometric progression stops within 20 years for the Kofola ČeskoSlovensko while the starting year for the simulation is 2017. DCF max with 500 samples is 9.1 billion CZK, with 1000 samples is 9.2 billion CZK and with 10000 samples is 9.4 billion CZK. The minimum estimated DCF with 500 and 1000 is almost standing in the range of 7.7 billion CZK while with 10000 samples was 7.5 billion CZK. However, book value in 2017 of the Kofola ČeskoSlovensko a.s. was in the range of 1.9 billion CZK, almost three times lower than the estimated DCF mean with 500, 1000 and 10000 samples.

Table 5 Estimated intrinsic value of the Kofola CeskoSlovensko a.s. with 500, 1000, 10000 samples

Es.Cumulative DCF Max (in billion CZK)	**Es. Cumulative DCF Mean (in billion CZK)**	**Es.Cumulative DCF Min (in billion CZK)**	**Number Of Simulations**	**Number of years**	**Starting year for the simulations**
9.10	8.48	7.72	500	20	2017
9.28	8.49	7.71	1000	20	2017
9.42	8.49	7.58	10000	20	2017

Source: Authors own elaborations based on the audited financial statements of the company (KCS, 2018).

According to the Table 6 average stock price for the Kofola ČeskoSlovensko a.s. in 2017 was 409.04 CZK. However, book value per share in the range of 88.5 CZK. DCF mean per share, with 500 samples was 380.7 CZK, with 1000 samples in the range of 381.1 CZK and with 10000 samples in the range of 381.04 CZK. Deviation within market prices and DCF per share, with 500 samples was 7.4%, while with 1000 samples the deviation is 7.3% and with 10000 samples deviation was 7.3%. Average stock market prices in 2017, on average, were deviating from their estimated intrinsic value in the range of 7%. Moreover, we can claim that the market value of shares and the estimated intrinsic value were quite close. Standing in the results, the company is overvalued in the range of 29 CZK.

Table 6 Deviation within market prices, book value per share and estimated intrinsic value per share for the Kofola CeskoSlovensko

Es. DCF mean 500 samples/ Kofola number of shares	**Es. DCF mean 1000 samples/ Kofola number of shares**	**Es. DCF mean 10000 samples/ Kofola number of shares**	**Book Value/ Kofola Number of shares**	**Average Market Price of Kofola (2017)**
380.7 czk/share	381.1 czk/share	381.04 czk/share	88.5 czk/share	409.04 czk/share

Source: Authors own elaborations based on the audited financial statements of the company (KCS, 2018).

Figure 8 shows normal distribution of estimated DCF-s with 10000 samples. According to the Figure 8 estimated DCF results mainly lie within 8.2 billion CZK and 8.7 billion CZK.

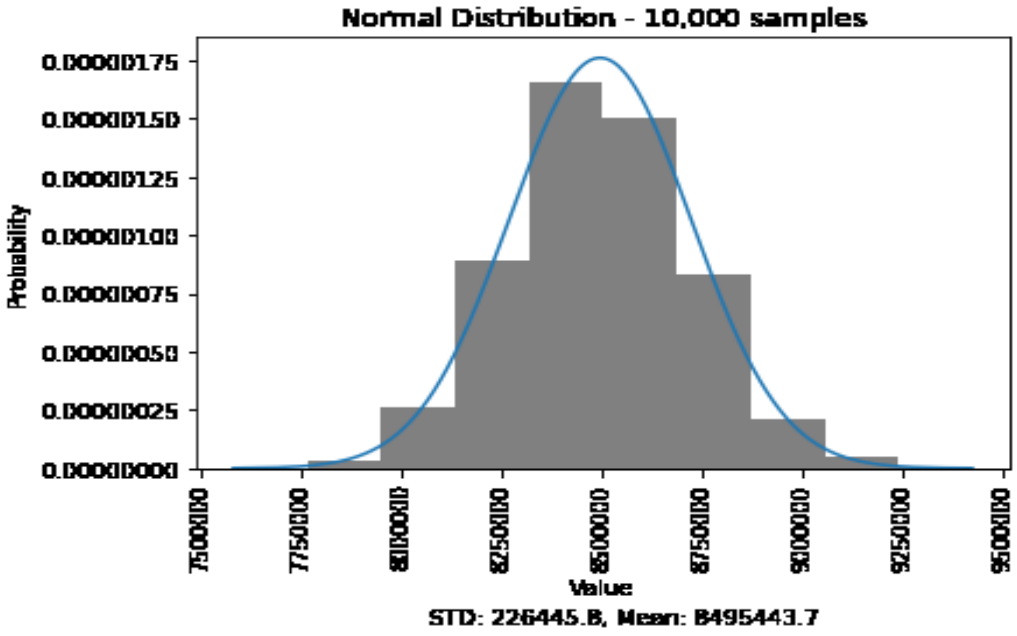

Figure 8 Normal distribution for the Kofola CeskoSlovensko in the CZK with 10000 samples
(Source: Authors own elaborations based on the Kofola ČeskoSlovensko a.s audited financial statements (KCS, 2018)

4.1.3 Case of Stock Spirit Group PLC

Company Profile

Stock Spirit is a listed company in the PSE, operating in the industry of alcoholic beverages. The company holds almost more than 40 brands of spirits, such as: vodka, liqueur, rum, brandy, etc. Moreover, the main target markets are Czech Republic, Poland and Italy (PSE, 2017). The Stock Spirit Group distributes its products in more than 50 countries through arrangements with other companies (SSG, 2017).

Figure 9 shows daily stock prices of the Stock Spirit Group PLC from 25.10.2013 till 29.12.2017. Stock prices of the company during this period were ranging within the 100 CZK and 40 CZK. Average price during this period was 71.6 CZK. The maximum price reached on 31.10.2014 (109.15 CZK) while the minimum one on 04.12.2014 (40.6 CZK).

Figure 9 Stock prices for the Stock Spirit Group PLC in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Figure 10 indicates the level of trade volume for the Stock Spirit Group PLC from December 2013 till December 2017. The average trade volume of the Stock Spirit Group PLC during this period was 109763.6CZK. Minimum trade volume was 1030 CZK on 09.05.2014 while the maximum trade volume occurred on 04.12.2015 in the range of 1686796 CZK.

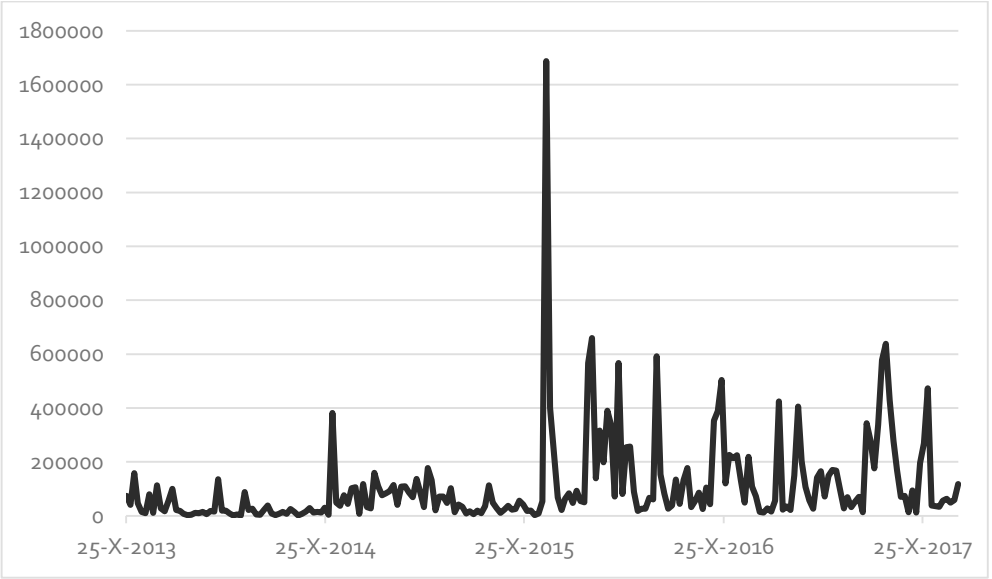

Figure 10 Trade volume for the Stock Spirit Group PLC in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Estimated Intrinsic Value of the Stock Spirit Group PLC

Table 7indicates free cash flow and inputs for the Capital Asset Pricing Model of the Stock Spirit Group PLC. CAPEX shows the amount of funds that a company uses to maintain physical assets since 2013 till 2017. However, FCFF as the amount of cash that remains for debtholders and stockholders, tends to remain identical from 2015 till 2017.Average WACC for the Stock Spirit Group PLC from 2013 till 2017 was 2.88. Minimum WACC was 2.3% in 2017 while the

maximum one was 3.3% in 2013. WACC of 2017 (2.3%) is used as the parameter in the simulation. Beta coefficient of the company was β=0.55. Moreover, when the PSE is moving 1% up or down, the company is moving the identical direction for 0.55%.

Table 7 Components of the valuation process for Stock Spirit Group PLC from 2013 till 2017

	2013	**2014**	**2015**	**2016**	**2017**
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	3.3%	2.6%	2.1%	1.9%	2.3%
CAPEX (in million czk)	16	4	6	5	5
FCFF (in million czk)	146	173	57	57	51

Source: Authors own elaborations based on the audited financial statements of the Stock Spirit Group PLC (PLC, 2018).

Table 8 shows the estimated intrinsic value for the company with three different samples. Simulations with 500, 1000 and 10000 samples show that the estimated intrinsic value of the companies ranges within 9 billion CZK in 2017. However, estimated DCF mean with three different samples stands in the range of 7 billion CZK and DCF min in 2017 was in the range of 6 billion CZK. In contrast, book value of the company was 354 million CZK that represents high difference from the estimated mean intrinsic value.

Table 8 Estimated intrinsic value of the Stock Spirit Group PLC with 500, 1000 and 10000 samples

Es. Cumulative DCF Max (in billion CZK)	Es. Cumulative DCF Mean (in billion CZK)	Es. Cumulative DCF Min (in billion CZK)	Number Of Simulations	Number of years	Starting year for the simulations
9.36	7.86	6.95	500	20	2017
9.16	7.88	6.93	1000	20	2017
9.16	7.85	6.58	10000	20	2017

Source: Authors own elaborations based on the audited financial statements of the Stock Spirit Group PLC (PLC, 2018).

The estimated intrinsic value per share, with 500, 1000 and 1000 samples is represented in the Table 9, DCF mean with three diverse samples was around 39 CZK/share. However, the deviation of the DCF mean with 500 samples from market prices in 2017 was 44% while with 1000 deviation was 45%. The deviation of the DCF mean with 10000 samples from average market prices in 2017 was 43.3%. The deviation of the Stock Spirit Group PLC from the DCF mean with 500, 1000 and 10000 samples was in the range of 44%. However, the deviation between the DCF mean per share, with three samples and book value per share was 22 times higher. Moreover, book value per share was smaller than market prices in 2017 for 34 times. Based on the results, the company is overvalued in the absolute numbers in the range of 22 CZK.

Table 9 Percentage differences within market prices, book value per share and estimated intrinsic value per share for the Stock Spirit Group PLC

Es. DCF mean 500 samples/PLC number of shares	**Es. DCF mean 1000 samples/PLC number of shares**	**Es. DCF mean 10000 samples/PLC number of shares**	**Book Value/PLC Number of shares**	**Average Market Price of PLC(2017)**
39.3 czk/share	39.4 czk/share	39.2 czk/share	1.77 czk/share	61.4 czk/share

Source: Authors own elaborations based on the audited financial statements of the Stock Spirit Group PLC (PLC, 2018).

The Figure 11 shows the estimated DCF with 10000 samples for the Stock Spirit Group. However, most of the estimated intrinsic value is ranging within 7.5 billion CZK and 8 billion CZK.

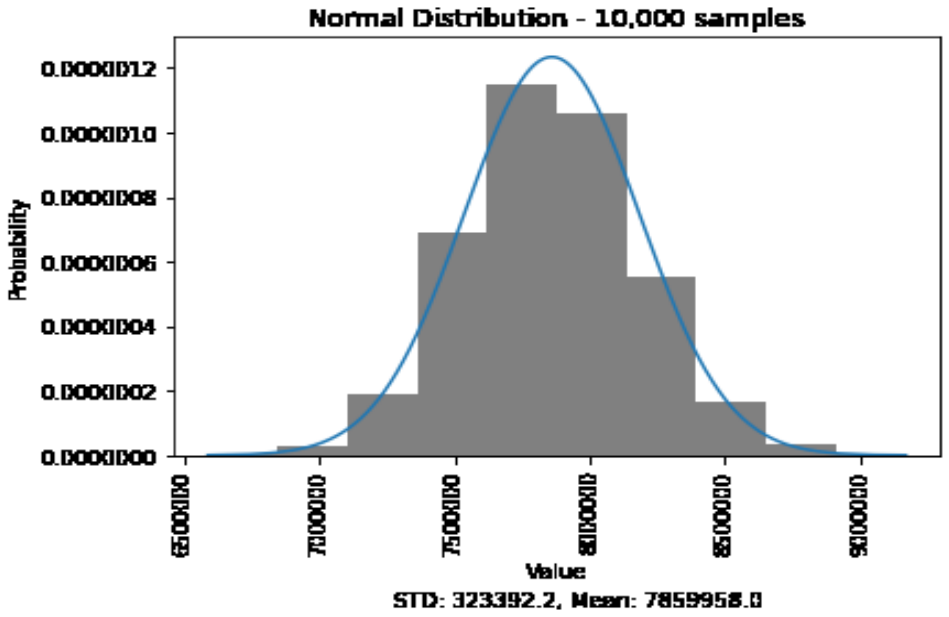

Figure 11 Normal distribution for the Stock Spirit Group PLC in the CZK, with 10000 samples
(Source: Authors own elaborations based on the audited financial statements of the Stock Spirit Group PLC (PLC, 2018).

4.1.4 Case of the Unipetrol Orlen Group

Company Profile

The Unipetrol Orlen Group is a joint stock company engaged in the production of crude oil, distribution of fuels and petrochemical products. The company stands as an important player in the Czech Republic and Eastern Europe in the refinery and petrochemical industry. Moreover, the company share part of 2005 within the PKN Orlen Refinery and is one of the ten largest companies in the Czech Republic. The company within itself involves companies such as: Česká rafinérská, Unipetrol Rafinérie, Koramo, Kaučuk, Chemopetrol (Unipetrol, 2018). The company was regularly listed in the PX index till 2018 (PSE, 2018). In addition, 94% of the shares of the company in August 2018 were bought from the largest Polish refinery (PKN Orlen) at the price 380 CZK/share (Reuters, 2018).

Figure 12 shows the stock prices in the PSE of the Unipetrol Orlen Group from 02.01.2013 till 29.12.2017. It is clear from the Figure 12 that stock prices of the Unipetrol Orlen Group increased enormously on January 2017, reaching the level above 350 CZK/share. The maximum stock price of the company was reached on 10.11.2017 (385 CZK/share) while the minimum one on 23.09.2014 (113.2 CZK/share). The average stock price of the company from 2013 till 2017 within the PSE was 184.1 CZK/share.

Figure 12 Stock prices for the Unipetrol Orlen Group in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Figure 13 represents the volume of trading of the Unipetrol Orlen Group within the PSE from 02.01.2013 till 29.12.2017. The company was characterized from the constant volatility in the trade volume. However, during 2015 and 2016 the Unipetrol Orlen Group reached the highest levels of the trade volume. The average volume of trading from 2013 till 2017 was 37,651 CZK. The minimum volume of trading occurred on 13.01.2017 (22 CZK) while the maximum one on 29.04.2015 (1,956,211 CZK).

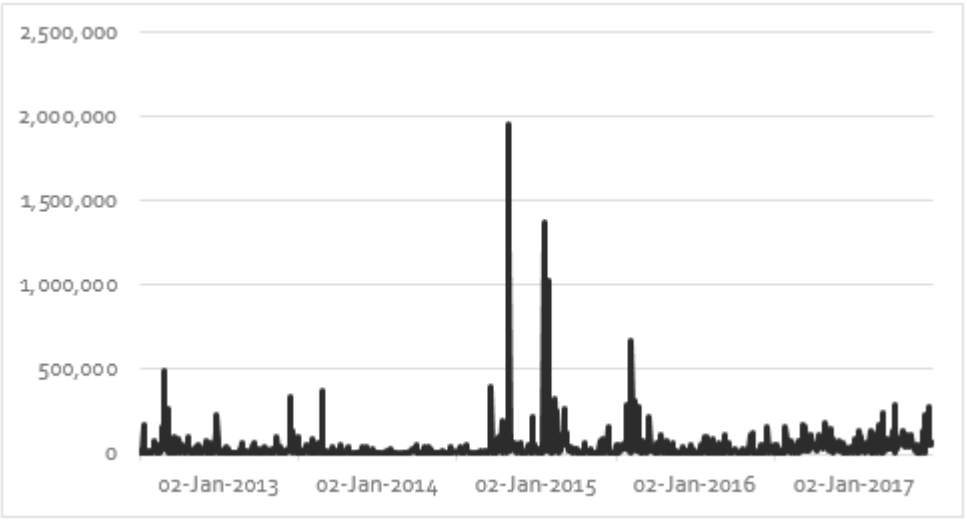

Figure 13 Trade volume for the Unipetrol Orlen Group in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Estimated intrinsic value of the Unipetrol Orlen Group.

Table 10 shows elements, such as: market returns, risk free rate, capital expenditures and free cash flow to the firm from 2013 till 2017 for the company Unipetrol Orlen Group. The company experienced negative FCFF from 2014 till 2016 while in 2017 had a positive FCFF. Items used for calculating FCFF stand on the Table 45 in the appendix. The Unipetrol Orlen Group had positive CAPEX from 2015 till 2017, which shows that was constantly investing in the fixed assets. Beta coefficient of the company was β=0.56, half risky than the Prague Stock Exchange. Average WACC of the company from 2013 till 2017 was 1.7%, average cost of debt was 0.5% and average cost of equity 1.2%. The highest WACC was in 2016 (2.7%) while the lowest one in 2017 (1.2%).

Table 10 Components used within the valuation process of the Unipetrol Orlen Group from 2013 till 2017

	2013	**2014**	**2015**	**2016**	**2017**
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	1.3%	1.1%	0.6%	0.5%	1.2%
CAPEX (in million czk)	-1	0	5	2	15
FCFF (in million czk)	39	-53	-134	-1870	2084

Source: Authors own elaborations based on the audited financial statements of the Unipetrol Orlen Group (Unipetrol, 2018).

Table 11 shows estimated intrinsic values of the Unipetrol Orlen Group with three different samples. Estimated maximum intrinsic value with three samples ranges within 51 and 54 billion CZK while the minimum one within 35 and 36 billion CZK. However, average DCF mean with three types of simulations stands within the range of 43 billion CZK. However, the book value of the company in 2017 was 26.3 billion CZK, 1.6 times lower than the estimated intrinsic value. The normal geometric progression has been conducted for 30 years.

Table 11 Estimated intrinsic value of the Unipetrol Orlen Group with 500, 1000 and 10000 samples

Es. Cumulative DCF Max (in billion CZK)	Es. Cumulative DCF Mean (in billion CZK)	Es. Cumulative DCF Min (in billion CZK)	Number Of Simulations	Number of years	Starting year for the simulations
51.99	43.77	36.77	500	30	2017
53.72	43.48	36.21	1000	30	2017
54.20	43.50	35.39	10000	30	2017

Source: Authors own elaborations based on the audited financial statements of the Unipetrol Orlen Group (Unipetrol, 2018).

Table 12 represents DCF mean of the Unipetrol Orlen Group with 500, 1000 and 10000 samples and average market price in 2017. The deviation of the average market price IN 2017 from estimated DCF mean with 500 samples was15.5%. In addition, deviation of the market prices from the DCF mean with 1000 samples was 16.0%, while of the simulations with 10000 samples was 15.9%. Basically the deviation of the estimated intrinsic value of the average market price in 2017 was within 15% and 16%. According to the estimated results the company was overvalued in the market for almost 45 CZK. However, the deviation of the market prices from their book value is almost 50%. The company was overvalued in 2017 in the range of 46 CZK.

Table 12 Deviation with market prices, book value per share and estimated intrinsic value per share of the Unipetrol Orlen Group

Es. DCF mean 500 samples/Unipetrol number of shares	**Es. DCF mean 1000 samples/Unipetrol number of shares**	**Es. DCF mean 10000 samples/Unipetrol number of shares**	**Book Value/Unipetrol Number of shares**	**Average Market Price of Unipetrol (2017)**
241.4 czk/share	239.8 czk/share	239.9 czk/share	145.2 czk/share	285.8 czk/share

Source: Authors own elaborations based on the audited financial statements of the Unipetrol Orlen Group (Unipetrol, 2018).

Figure 14 shows the normal distribution of the DCF-s with 10000 samples. Moreover, the majority of the DCF-s were standing within 42 billion CZK and 45 billion CZK.

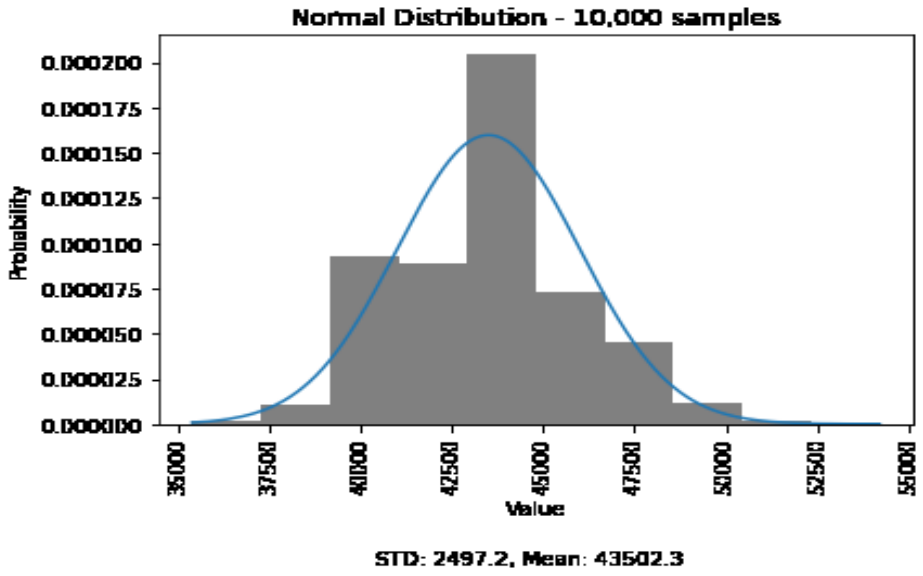

Figure 14 Normal distribution for the Unipetrol Orlen Group in the CZK with 10000 samples
(Source: Authors own elaborations based on the audited financial statements of the Unipetrol Orlen Group (Unipetrol, 2018))

4.1.5 Case of the Erste Group Bank

Company Profile

Erste Group Bank is considered as one of the major players of the financial service suppliers in the Austria and Eastern Europe. The bank is established in 1819 via providing banking services for more than 15 million clients. The bank has mainly generated revenues from retail and corporate clients that stands as the main business focus. Moreover, stands as most innovative banks in terms of retail clients (PSE, 2018).

Figure 15 Indicates daily stock prices of the Erste Group Bank from 04.01.2013 till 29.12.2017. According to the Figure 15, stock prices of the Erste Group Bank were constantly increasing during 2017. Average stock price from 2013 till 2017 was 698.87 CZK. The minimum stock price was 483.60 CZK on 10.10.2014 while the maximum one was 979.70 CZK on 06.10.2017.

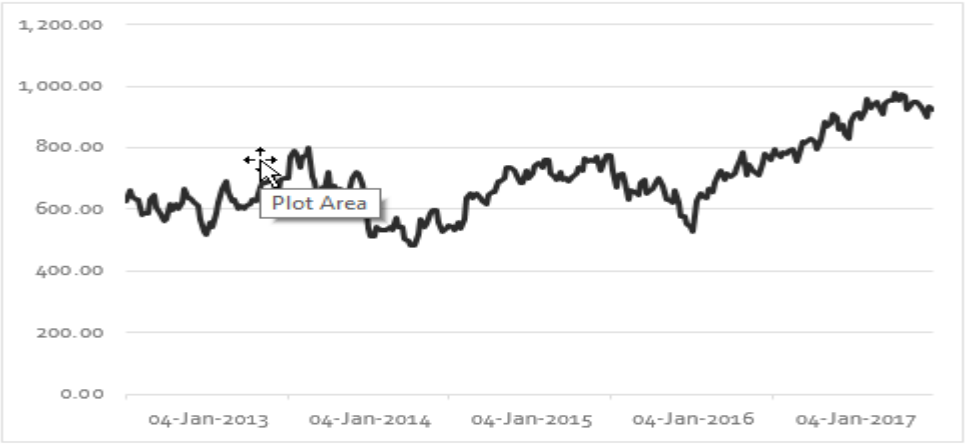

Figure 15 Stock prices for the Erste Group Bank in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Figure 16 shows the level of daily trading with the shares of Erste Group Bank from 04.01.2013 till 29.12.2017. It is clear from the figure that the trade volume of the bank experienced a huge volatility during

this time interval. Average trade volume from 2013 till 2017 was 654,445 CZK. Minimum trade volume occurred on 25.12.2015 (85,729 CZK) and the maximum one on 06.02.2015 (2.7 million CZK).

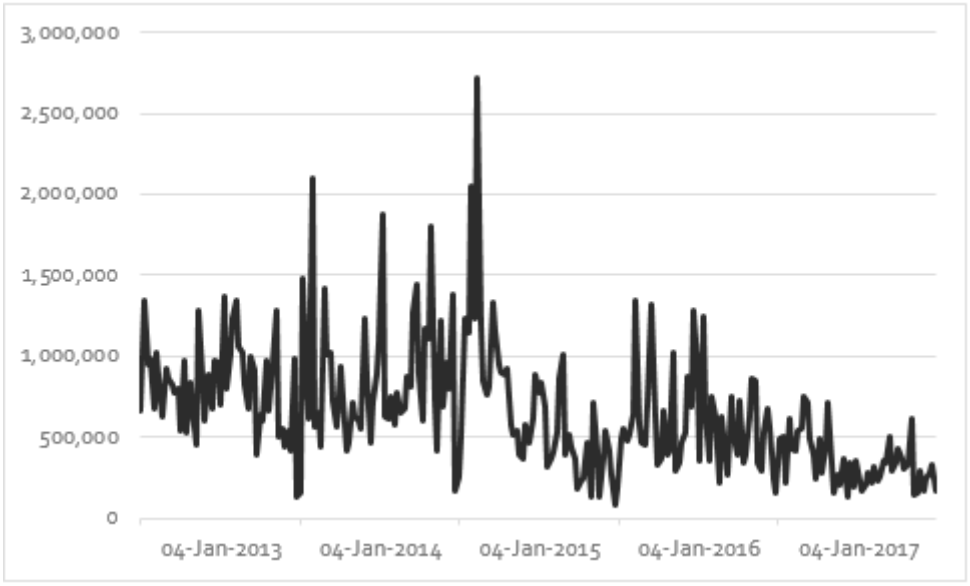

Figure 16 Trade volume for the Erste Group Bank in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Estimated Intrinsic Value of the Erste Group Bank

Table 13 represents some of the key indicators used for estimating the intrinsic value of the Erste Group Bank. FCFF was negative in 2013 and 2014 while it turned positive from 2015 till 2017. Market returns and risk free rate stands identical for each listed company in the PSE. However, CAPEX stands positive each year that shows that the company was constantly investing in their fixed assets. Maximum WACC was in 2013 (4.5%) while the minimum one on 2016 (3.0%).

WACC tends to decrease from 2013 till 2017 where average WACC was 3.7%.

Table 13 Components used within the valuation process for the Erste Group Bank from 2013 till 2017

	2013	**2014**	**2015**	**2016**	**2017**
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	4.5%	4.2%	3.9%	3.4%	3.3%
CAPEX (in million czk)	65757	85317	73410	72710	59653
FCFF (in million czk)	-15259	-91644	48548	31801	30571

Source: Authors own elaborations based on the audited financial statements of the Erste Group Bank (EGB, 2018).

The Table 14 shows the estimated intrinsic value in absolute numbers for the Erste Group Bank with three different samples. The maximum estimated DCF with three different samples ranges within 1.4 trillion CZK and 1.5 trillion CZK while minimum one ranges within 1.2 trillion CZK. Estimated DCF mean with three different samples ranges within 1.3 trillion CZK. However, book value of the bank in 2017 was 466 billion CZK, 3 times less than the estimated DCF mean. FCFF was discounted (r) at 3.2% and growth rate at 8.07%.

Table 14 Estimated intrinsic value for the Erste Group Bank with 500, 1000 and 10000 samples

Es. Cumulative DCF Max (in billion CZK)	**Es. Cumulative DCF Mean (in billion CZK)**	**Es. Cumulative DCF Min (in billion CZK)**	**Number Of Simulations**	**Number of years**	**Starting year for the simulations**
1.48	1.36	1.26	500	30	2017
1.48	1.36	1.26	1000	30	2017
1.50	1.36	1.23	10000	30	2017

Source: Authors own elaborations based on the audited financial statements of the Erste Group Bank (EGB, 2018).

Table 15 indicates DCF mean per share, book value per share and average market price in 2017. Deviation within estimated DCF mean with 500 samples and market price in 2017 was 360%. However, deviation of market prices in 2017 from the DCF mean with 1000 samples was 360.7%, while from the DCF mean with 10000 samples was 360.8%. Basically the market price of the Erste Group Bank in 2017 was 3.6 times less than the estimated DCF mean per share. However, the company was devaluated for 2,297 CZK in 2017. The deviation of the average stock market prices from the book value per share in 2017 was 123% or 203 CZK in absolute numbers.

Table 15 Deviation within market prices, book value per share and estimated intrinsic value for Erste Group Bank

Es. DCF mean 500 samples/Erste Group Bank number of shares	**Es. DCF mean 1000 samples/ Erste Group Bank number of shares**	**Es. DCF mean 10000 samples/ Erste Group Bank number of shares**	**Book Value/ Erste Group Bank number of shares**	**Average Market Price of the Erste Group Bank (2017)**
3175.7 czk/share	3178.5 czk/share	3178.9 czk/share	1084.33 czk/share	881.1 czk/share

Source: Authors own elaborations based on the audited financial statements of the Erste Group Bank (EGB, 2018).

Figure 17 shows the normal distribution of the DCF-s with 10000 samples for the Erste Gorup Bank. Mainly the DCF-s are lying within 1.3 trillion CZK and 1.4 trillion CZK.

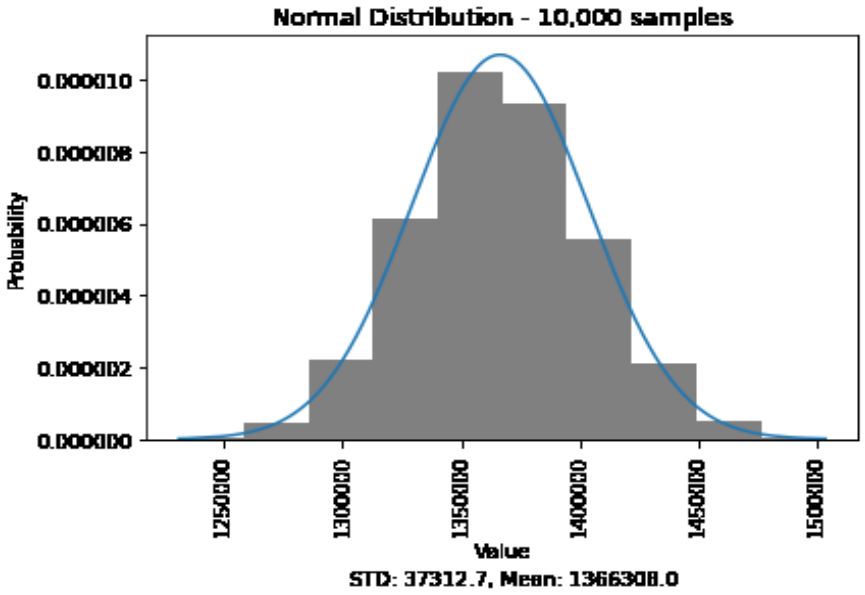

Figure 17 Normal distribution for the Erste Group Bank in the CZK with 10000 samples
(Source: Authors own elaborations based on the audited financial statements of the Erste Group Bank (EGB, 2018))

4.1.6 Case of the Komercni Banka

Company Profile

Komercni Banka (KB) is one of the major banks operating in the Czech banking industry. The bank is part of the Societe General Group, providing financial services in the retail, financial investments and corporations. Besides traditional banking services such as: deposits and loans, the bank offers insurance and pension fund schemes. KB providefor its client services, such as: leasing, capital market services, payment services etc.

Figure 18 shows stock prices of the Komercni Banka (KB) within the PSE from 04.01.2013 till 29.12.2017. The average stock price of the bank during this period was 932.5 CZK. The minimum stock price was 706 CZK on 19.07.2015, while the maximum one 1,120 CZK on 20.03.2015. According to the Figure 18 stock prices of KB from 2013 till 2017 were moving within 1200 CZK and 700 CZK.

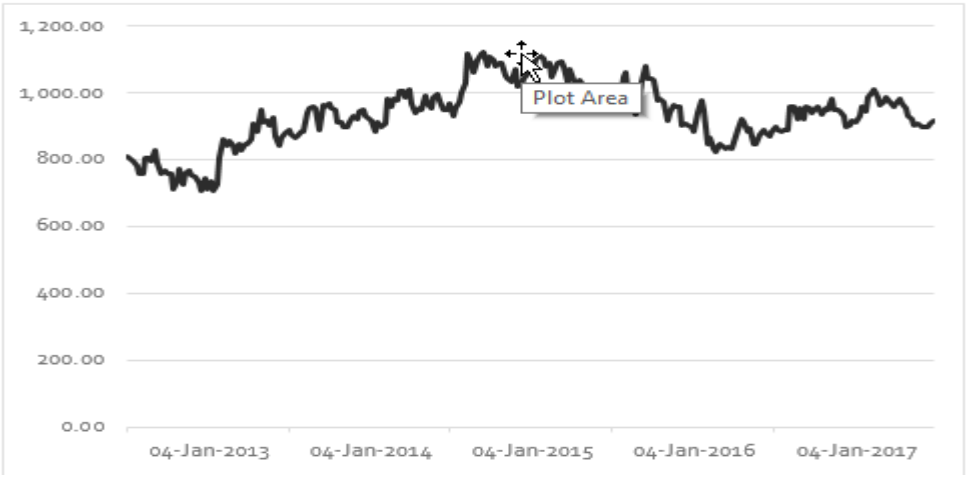

Figure 18 Stock prices for the Komercni Bank in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Figure 19 shows the level of trading with the stock of Komercni Banka within the PSE from 04.01.2013 till 29.12.2017. Averaging daily trading with the stock of KB during this period was 902.9 CZK. Minimum trade volume was 122,003 CZK on 29.12.2017 and maximum one was 3,249,090 CZK on 05.08.2016.

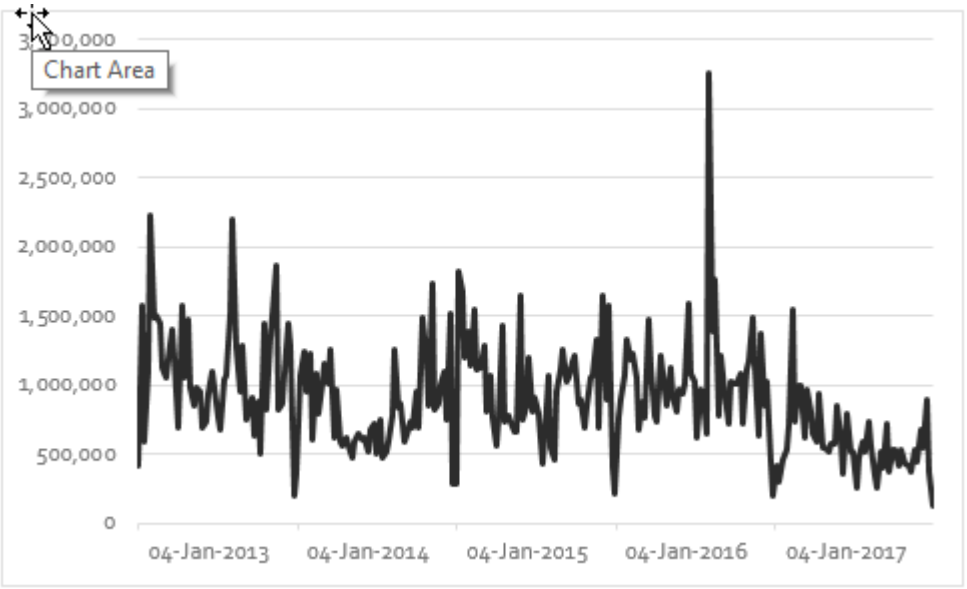

Figure 19 Trade volume for the Komercni Banka from 2013 till 2017 (Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Estimated Intrinsic Value of the Komercni Banka (KB)

Table 16 shows risk free rate, market returns, capital expenditures and free cash flow to the firm of the KB bank from 2013 till 2017. Based on the Table 16, cash flow available for shareholders and debtholders (FCFF) was positive from 2013 till 2017. CAPEX was positive from 2013 till 2017, indicating that the KB bank was constantly investing in the physical assets. WACC was declining from 2013 till 2017.Minimum WACC of the KB bank was 3.2% in 2016 while maximum WACC was 4.4% in 2013. WACC of 2017 (3.3%) is used as the discount rate in the simulation. Beta coefficient of the

company till 2017 was β=1.26, 26% more risky than the Prague Stock Exchange.

Table 16 Components used in the valuation process for the Komercni Banka from 2013 till 2017

	2013	**2014**	**2015**	**2016**	**2017**
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	4.4%	4.0%	3.8%	3.4%	3.3%
CAPEX (in million czk)	10477	3610	12833	9615	11382
FCFF (in million czk)	16199	21971	10475	12719	11035

Source: Authors own elaborations based on the audited financial statements of the Komercni Banka (KB, 2018).

Table 17 represents the estimated intrinsic value of the KB bank with 500, 1000 and 10000 samples. Maximum DCF with three different sample simulations ranges within 531 and 546 billion CZK while the minimum one ranges within 442 and 445 billion CZK. However, estimated DCF mean with 500, 1000 and 10000 samples we reach the level of 492 billion CZK. The book value of the KB bank in 2017 was 100.4 billion CZK, almost 4.5 times less than the estimated intrinsic value with three different samples.

Table 17 Estimated intrinsic value of the Komercni Banka with 500, 1000 and 10000

Es. Cumulative DCF Max (in billion CZK)	Es. Cumulative DCF Mean (in billion CZK)	Es. cumulative DCF Min (in billion CZK)	Number of Simulations	Number of years	Starting year for the simulations
531.67	492.81	445.40	500	30	2017
538.47	492.51	455.30	1000	30	2017
546.90	492.44	442.35	10000	30	2017

Source: Authors own elaborations based on the audited financial statements of the Komercni Banka (KB, 2018).

Table 18 indicates estimated DCF mean of the KB bank with 500, 1000, 10000 sample simulations. The deviation of the average market prices in 2017 from estimated DCF mean with 500 samples was 276%, while from the estimated DCF mean with 1000 samples was 275.7%. However, deviation of the average market prices from estimated DCF mean with 10000 samples was 257.7%. Basically, an average market price of the KB bank was 2.7 times lower than the estimated intrinsic value in 2017. Moreover, standing on the estimated results from the Table 18 market prices of the KB bank in 2017 was undervalued for 1651 CZK. However, average market price in 2017 was 1.8 higher than book value per share.

Table 18 Deviation within market price, book value per share and estimated intrinsic value for the Komercni Banka

Es. DCF mean 500 samples/KB Bank number of shares	**Es. DCF mean 1000 samples/ KB Bank number of shares**	**Es. DCF mean 10000 samples/ KB Bank number of shares**	**Book Value/ KB Bank number of shares**	**Average Market Price of the KB Bank (2017)**
2593.1 czk/share	2591.5 czk/share	2591.2 czk/share	527.9 czk/share	939.8 czk/share

Source: Authors own elaborations based on the audited financial statements of the Komercni Banka (KB, 2018).

Figure 20indicates normal distribution of the estimated DCF-s for the KB bank with 10000 samples. Majority of the DCF-s stand within 480 billion CZK and 500 billion CZK.

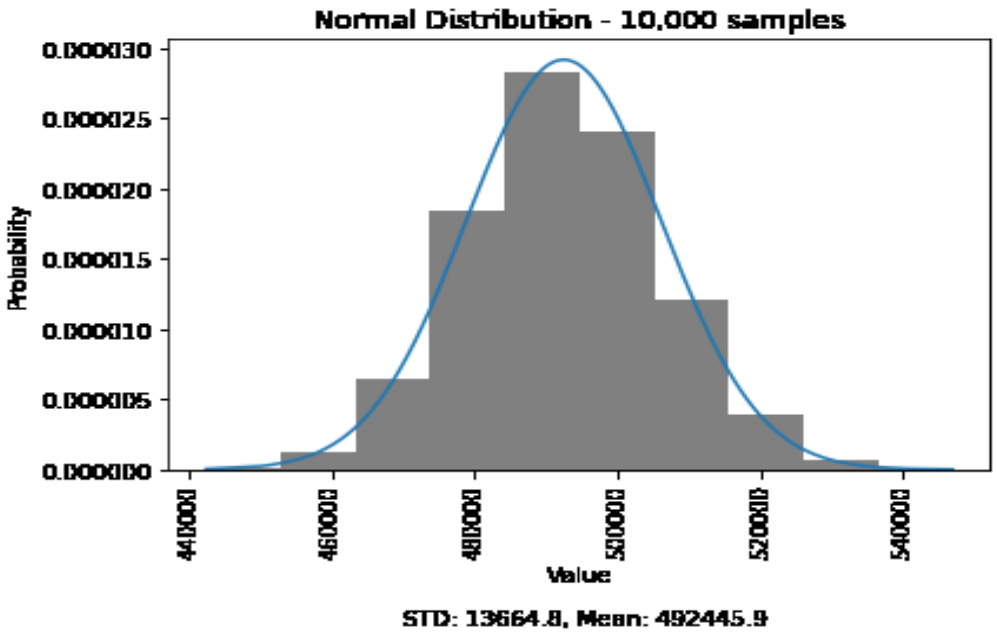

Figure 20 Normal distribution for the Komercni Banka in the CZK with 10000 samples
(Source: Authors own elaborations based on the audited financial statements of the Komercni Banka (KB, 2018))

4.1.7 Case of the O2 Company

Company Profile

O2 stands as the biggest company in the field of telecommunication industry within the Czech Republic. The company is providing for the Czech costumers: LTE technology and state-of-the-art HSPA. Moreover, the company is aggressively developing new business lines within the telecommunication industry in the Czech Republic. Data facilities and voice offers are additional competitive advantages of the company. In addition, it is the only company in the Czech Republic and eastern European countries that hold Tier III certificate concerning the data services. The company is considered as the main IP TV provider within the Czech territory (PSE, 2018).

Figure 21 indicates daily stock prices of the O2 Company from 04.01.2013 till 29.12.2017. During January and February of 2016, stock prices of the company experienced a huge increase, more than 300%. The average stock price of the O2 Company during this period was 152.4 CZK. The minimum stock price was 39.9 CZK (22.04.2015) while the maximum prices was 288 CZK (21.03.2017).

Figure 21 Stock prices for the O2 Company in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Figure 22 represents the trade volume level of the O2 Company in the Prague Stock Exchange, from 04.01.2013 till 29.12.2017. Average trade volume from 2013 till 2017 was 1,063 CZK. Minimum trade volume was 68,189 CZK (22.12.2017) and the maximum trade volume was 10,565,249 CZK (22.05.2015). According to the Figure 22 volume of trading with the shares of the O2 Company, experienced enormous volatility from 2013 till 2017.

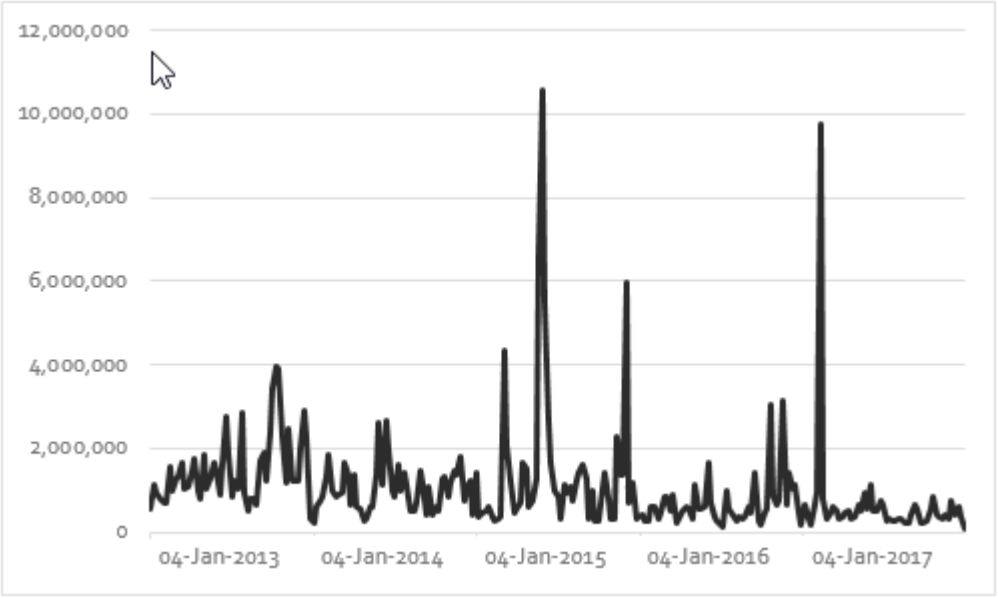

Figure 22 Trade volume for the O2 Company in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Estimated intrinsic value of the O2 Company

Table 19 represents key elements that are used for estimating the intrinsic value of the O2 Company. Capital expenditures were positive from 2013 till 2017 while in 2015 experienced negative investments in the fixed assets. Free cash flow to the firm was positive from 2013 till 2017. Beta coefficient as a parameter used in the CAPM was β=0.44. The company was 56% less risky than the Prague Stock Exchange. Maximum WACC of O2 Company was 3.5% in 2016 while the minimum WACC was 2.1% in 2013. Average WACC of the company was in the range of 2.6%. WACC of 2017 (2.5%) was used as input parameter in the simulation.

Table 19 Components used during the valuation process for the O2 Company from 2013 till 2017

	2013	2014	2015	2016	2017
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	2.1%	1.5%	2.0%	1.9%	2.5%
CAPEX (in million czk)	6,198	2,667	-29,547	1,479	1,683
FCFF (in million czk)	11,122	10,360	41,290	7,768	6,848

Source: Authors own elaborations based on the audited financial statements of the O2 Company (O2, 2018).

Table 20 indicates estimated DCF mean for the O2 Company with three different samples. Estimated maximum intrinsic value ranges within 358 billion CZK and 369 billion CZK while the minimum one was ranging within 295 billion CZK and 309 billion CZK. Average estimated DCF mean with three samples stands in the level of 330 billion CZK. However, book value of the company in 2017 was 15.6 billion CZK.

Table 20 Estimated intrinsic value for the O2 Company with 500, 1000 and 10000 samples

Es. Cumulative DCF Max (in billion CZK)	Es. Cumulative DCF Mean (in billion CZK)	Es. Cumulative DCF Min (in billion CZK)	Number Of Simulations	Number of years	Starting year for the simulations
359.05	330.71	309.42	500	30	2017
358.15	330.58	304.43	1000	30	2017
369.60	330.32	295.63	10000	30	2017

Source: Authors own elaborations based on the audited financial statements of the O2 Company (O2, 2018).

According to the Table 21 deviation within estimated DCF mean with 500 samples and average market price of the O2 in 2017 was 4 times lower. The deviation of the market price in 2017 from simulations with 1000 samples and 10000 is almost identical (400% lower). However, the deviation of the market price in 2017 from the book value per share in 2017 was 5.3 times higher. According to the results from the Table 21, average share prices of the O2 Company in 2017 were devaluated in the range of 819 CZK. In contrast, average share price in 2017 was overvalued from book value in the range of 219 CZK.

Table 21 Deviation within market price, book value per share and estimated intrinsic value per share of the O2 Company

Es. DCF mean 500 samples/O2 number of shares	**Es. DCF mean 1000 samples/ O2 number of shares**	**Es. DCF mean 10000 samples/ O2 number of shares**	**Book Value/ O2 number of shares**	**Average Market Price of the O2 (2017)**
1089.4 czk/share	1089 czk/share	1088.1 czk/share	51 czk/share	270 czk/share

Source: Authors own elaborations based on the audited financial statements of the O2 Company (O2, 2018).

Figure 23 represents a normal distribution of the DCF-s for the O2 Company with 10000 samples. The DCF-s within the distribution are mainly lying within 320 billion CZK and 340 billion CZK.

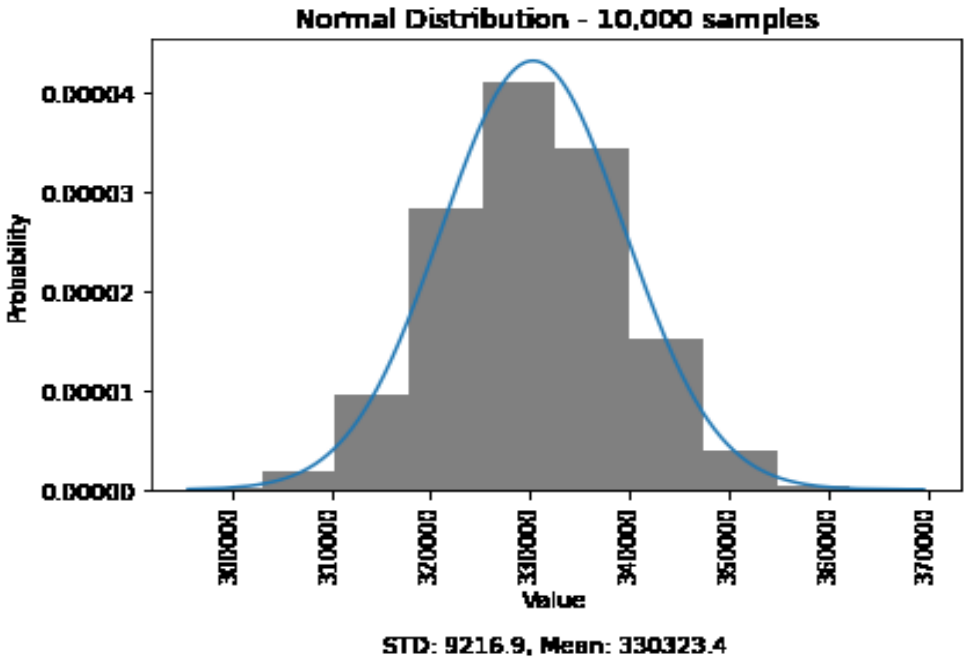

Figure 23 Normal distribution for the O2 Company in the CZK with 10000 samples
(Source: Authors own elaborations based on the audited financial statements of the O2 Company (O2, 2018))

4.1.8 Case of Vienna Insurance Group (VIG)

Company Profile

The Vienna Insurance Group is a listed company in the PSE that provide insurance services. The company has the headquarter in Vienna, but operates also with its subsidiaries in: Czech Republic, Albania, Bulgaria, Bosnia, Germany, Moldova, Estonia, Poland, Romania, Turkey, Hungary, Ukraine, etc. Vienna Insurance Company has been established in1824 and stands as the major insurance company in the Central and Eastern European countries (PSE, 2018).

Figure 24 represents closed stock prices of the Vienna Insurance Group (VIG) from 04.01.2013 till 29.12.2017. The average stock price of the VIG from 2013 till 2017 was 817.94 CZK in the Prague Stock Exchange. However, minimum closed stock price of the company was

450.6 CZK on the 08.06.2016 while the maximum closed stock price was 1,164 CZK on the 03.04.2015. According to the Figure 24 the stock prices of the VIG from January 2013 till February 2015 were moving within the range of 1000 CZK. However, the stock prices of the company experienced a 50% decline from January 2015 till January 2016.

Figure 24 Close prices for the Vienna Insurance Group in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

Volatility in the trade volume with the shares of the VIG Company in the PSE is shown in the Figure 25. Average trade volume from 04.01.2013 till 29.12.2017 of the VIG Company was 56,987 CZK. The minimum volume of trading was 304 CZK on 26.12.2014 while the maximum trade volume was 375,045 CZK on 18.05.2016.

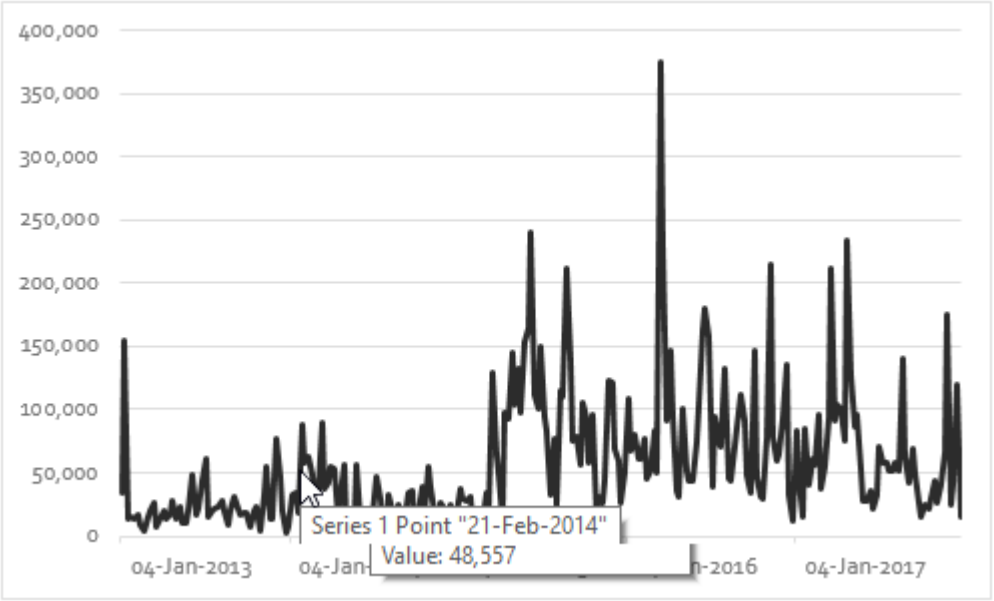

Figure 25 Trade volume for the Vienna Insurance Group in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018))

Estimated Intrinsic Value of Vienna Insurance Group (VIG)

Table 22 indicates some of key items used for calculating estimated DCF of the VIG Company, from 2013 till 2017. According to the Table 22 Free Cash Flow to the Firm was positive among all years except in 2017 (-77 billion CZK). However, CAPEX was constantly positive from 2015 till 2017, where maximum CAPEX occurred in 2016 (113 billion CZK). Average WACC of the company from 2013 till 2017 was 3.78%. Minimum WACC was 3.25% in 2013 while the maximum WACC was 4.41% in 2013. WACC of 2017 (3.25%) was used as the discount rate in the simulation. Beta coefficient of the company till 2017 was β=0.98, almost identically risky as the Prague Stock Exchange.

Table 22 Components used within the valuation process for the Vienna Insurance Group from 2013 till 2017

	2013	**2014**	**2015**	**2016**	**2017**
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	4.4%	4.0%	3.8%	3.3%	3.2%
CAPEX (in million czk)	9,141	(13,044)	16,412	113,004	23,341
FCFF (in million czk)	33,253	52,624	20,511	(77,312)	13,684

Source: Authors own elaborations based on the audited financial statements of the Vienna Insurance Group company (VIG, 2018).

Table 23 show estimated DCF-s with the 500, 1000 and 10000 samples. The maximum estimated DCF with three different samples, ranges within 581 and 589 billion CZK. The minimum estimated DCF with three simulation samples ranges within 473 billion CZK and 489 billion CZK. However, mean estimated intrinsic value of the VIG Company in 2017 was approximately 533 billion CZK. The book value of the company in 2017 was in the range of 154 billion CZK, 3.4 times lower than the estimated intrinsic value.

Table 23 Estimated intrinsic value for the Vienna Insurance Group with 500, 1000 and 10000 samples

Es. Cumulative DCF Max (in billion CZK)	Es. Cumulative DCF Mean (in billion CZK)	Es. Cumulative DCF Min (in billion CZK)	Number Of Simulations	Number of years	Starting year for the simulations
581.40	533.28	485.73	500	30	2017
589.61	533.71	489.78	1000	30	2017
587.34	533.56	473.46	10000	30	2017

Source: Authors own elaborations based on the audited financial statements of the Vienna Insurance Group company (VIG, 2018).

According to the Table 24 estimated DCF mean per number of shares with three different samples was 416 CZK. However, the deviation of the market prices from the estimated DCF mean with three different samples was 54.1%. However, the deviation of the book value per share was almost 4.3 times lower than the market prices in 2017. Standing in the results from the Table 24 the company was overvalued in the range of 224 CZK.

Table 24 Deviation within market price, book value per share and estimated intrinsic value per share for the Vienna Insurance Group

Es. DCF mean 500 samples/VIG number of shares	Es. DCF mean 1000 samples/ VIG number of shares	Es. DCF mean 10000 samples/ VIG number of shares	Book Value/ VIG number of shares	Average Market Price of the VIG (2017)
416.6 czk/share	416.9 czk/share	416.8 czk/share	120.3 czk/share	641.2 czk/share

Source: Authors own elaborations based on the audited financial statements of the Vienna Insurance Group company (VIG, 2018)

The Figure 26 shows the normal distribution of the VIG Company with 10000 samples. Majority of the DCF-s within the distribution stand between 520 billion CZK and 540 billion CZK.

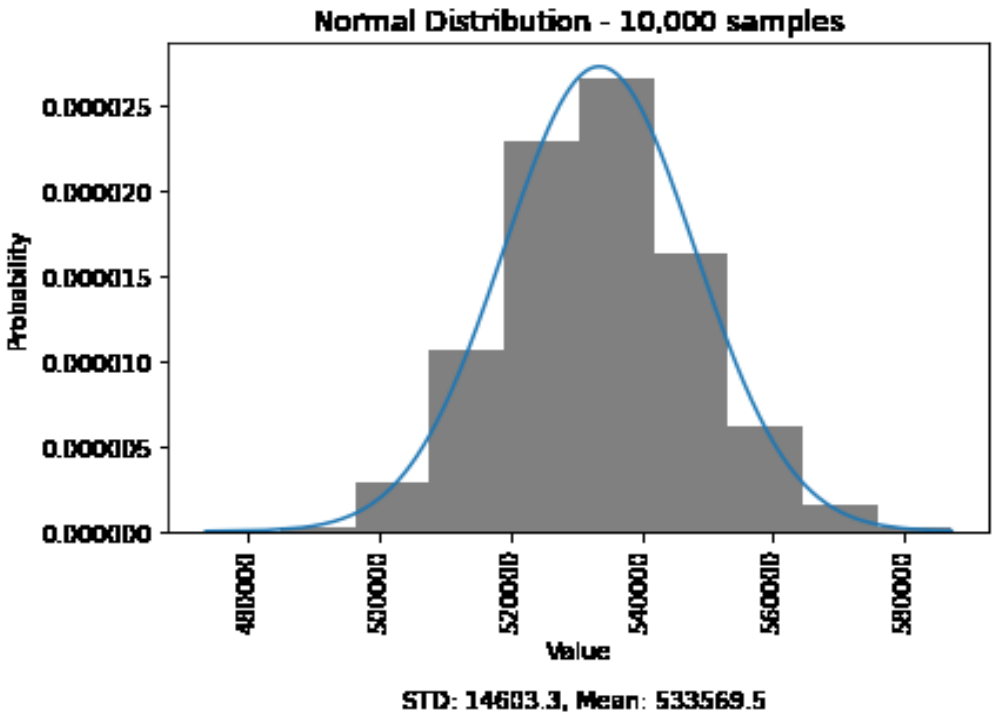

Figure 26 Normal distribution for the Vienna Insurance Group in the CZK with 10000 samples
(Source: Authors own elaborations based on the audited financial statements of the Vienna Insurance Group company (VIG, 2018)

4.1.9 Case of the Phillip Morris CR

Company Profile

Phillip Morris CR is a branch of the mother company Phillip Morris International. The company is considered as the largest producer of the tobacco products in the Czech Republic and is listed on the Prague Stock Exchange (PM, 2018). The shares of the local company Tabak a.s. were acquired from PM International and renamed the company as Phillip Morris CR. Moreover, the company contains within its brand, cigarettes such as: Marlboro, L&M, Petra and Sparta (PSE, 2018).

According to the Figure 27 from 0.4.01.2013 till 29.12.2017 stock prices of the company were ranging within 10,000 CZK and 16,000 CZK. The average stock price of the company during this period was 12,045 CZK. The minimum stock price of the company from 2013 till 2017 was 9,805 CZK on 07.11.2014 while the maximum one was 16,849 CZK on 06.10.2017.

Figure 27 Closed stock prices for the Phillip Morris CR in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018).

Figure 28 shows the volume of trading with the stocks of the Phillip Morris CR from 04.01.2013 till 29.12. 2017.The average trade volume of the company during this period was in the range 4,367 CZK. Maximum trade volume from 2013 till 2017 was 18,949 CZK (07.11.2014) while the minimum one was 571 CZK (08.08.2014)

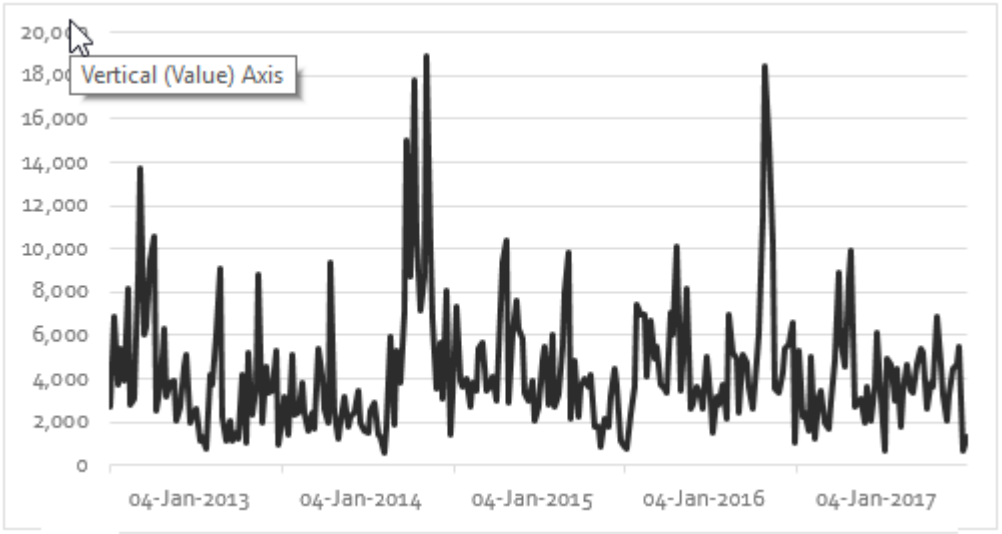

Figure 28 Trade volume for the Phillip Morris CR in the CZK, from 2013 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018).

Estimated Intrinsic Value of Phillip Morris CR

Table 25 shows the elements of the valuation process, such as: risk free rate, market returns, CAPM, CAPEX and FCFF from 2013 till 2017. Capital expenditures that remains important element of investment in the physical assets were positive for the company except in 2014. FCFF was positive during 2013, 2014, 2015 and 2017 while negative in 2016. According to the table average WACC from 2013 till 2017 for the Phillip Morris CR was 3.9%. Minimum WACC of the company was 3.2% in 2017 while the maximum WACC was 4.5% in 2013. WACC is used as the discount rate since the FCFF is used to generate possible future cash flows. The input used as a discount rate is the WACC of 2017 (3.2%). However, the beta coefficient for the Phillip Morris CR was β=0.27. The coefficient shows the company was the least risky since the sensitivity toward PSE is close to zero.

Table 25 Components used during the valuation process of the Phillip Morris CR from 2013 till 2017

	2013	2014	2015	2016	2017
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	4.5%	3.7%	3.5%	3.8%	3.2%
CAPEX (in million czk)	9,141	(13,044)	16,412	113,004	23,341
FCFF (in million czk)	33,253	52,624	20,511	(77,312)	13,684

Source: Authors own elaborations based on the audited financial statements of the Phillip Morris CR (PM, 2018).

Table 26 indicates estimated intrinsic values of the Phillip Morris CR with three different samples. Maximum value from the simulations with three samples provide DCF in the range of 3.8 trillion CZK and 3.9 trillion CZK. Maximum DCF with 500, 1000 and 1000 samples stand within 3.3 trillion CZK and 3.2 trillion CZK. However, the estimated mean intrinsic value was in the range of 3.5 trillion CZK in 2017. Growth rate (g) used for generating future Free Cash Flows was 4.89%. Moreover, growth rate has been set up based on the Damodaran database for the tobacco companies.

Table 26 Estimated intrinsic value for the Phillip Morris CR with 500, 1000 and 10000 samples

Es. Cumulative DCF Max (in trillion CZK)	Es. Cumulative DCF Mean (in trillion CZK)	Es. Cumulative DCF Min (in trillion CZK)	Number Of Simulations	Number of years	Starting year for the simulations
3.81	3.53	3.31	500	30	2017
3.91	3.55	3.27	1000	30	2017
3.89	3.54	3.22	10000	30	2017

Source: Authors own elaborations based on the audited financial statements of the Phillip Morris CR (PM, 2018).

DCF means per number of shares of the Phillip Morris CR are represented in Table 27. The book value of the company in 2017 was negative, that shows negative book value per number of shares. Deviation within mean estimated DCF and average market price of the company in 2017 was 6.5 times. Basically the company was undervalued in the range of 12,554 CZK.

Table 27 Deviation within market price, book value per share and estimated intrinsic value per share for the Phillip Morris CR

Es. DCF mean 500 samples/Phillip Morris CR number of shares	Es. DCF mean 1000 samples/ Phillip Morris CR number of shares	Es. DCF mean 10000 samples/ Phillip Morris CR number of shares	Book Value/Phillip Morris CR number of shares	Average Market Price of the Phillip Morris CR (2017)
2276.7 czk/share	2284.7 czk/share	2279.8 czk/share	-139 czk/share	14,830.7 czk/share

Source: Authors own elaborations based on the audited financial statements of the Phillip Morris CR (PM, 2018).

Figure 29 indicates a normal distribution of the DCF-s for the Phillip Morris CR with 10000 samples. The majority of the DCF-s are lying within 3.5 and 3.6 billion CZK.

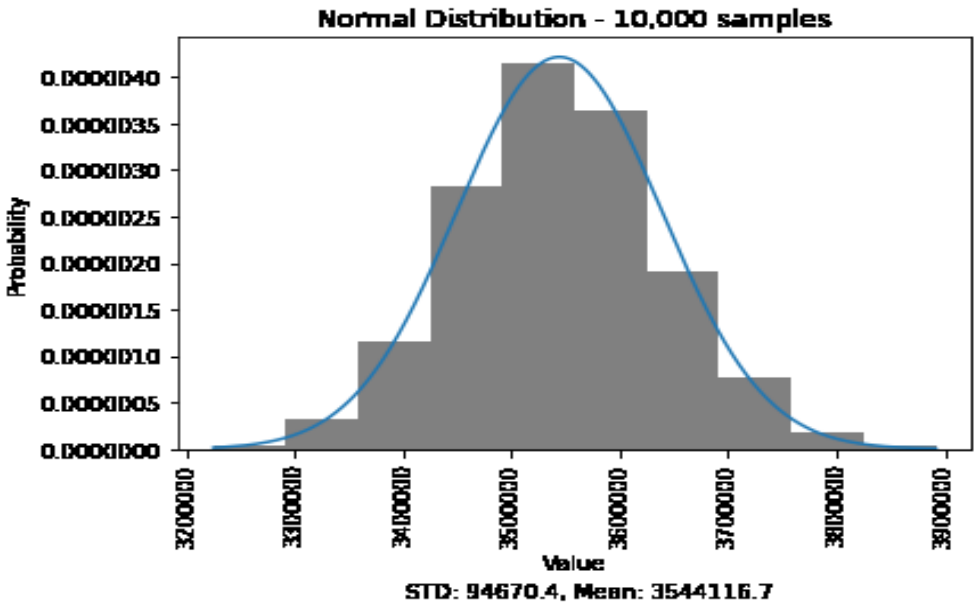

Figure 29Normal distribution for the Phillip Morris CR in the CZK with 10000 samples
(Source: Authors own elaborations based on the audited financial statements of the Phillip Morris CR (PM, 2018)

4.1.10 Case of Moneta Bank

Company Profile

Moneta Bank operates within the Czech banking industry and supervised from the Czech National Bank. Moneta Bank business activities stand within retail landings and loans to small and medium enterprises (SME-s). The Moneta Bank is quite well positioned with its market capitalization within the Czech banking market by providing banking services to households. Moreover, the bank has authorization from the Czech Central Bank to deliver a wide range of financial services (PSE, 2018).

Figure 30 indicates closed stock prices of the Moneta Bank within the PSE, from 06.05.2016 till 29.12.2017. The bank entered the Prague Stock Exchange on May 2016. Average stock price from 2016 till 2017 was 79.20 CZK. The minimum stock price was 68.05 that corresponds with the day the bank entered the PSE (04.05.2016). However, the maximum stock price of the company was 88.60 CZK (10.02.2017).

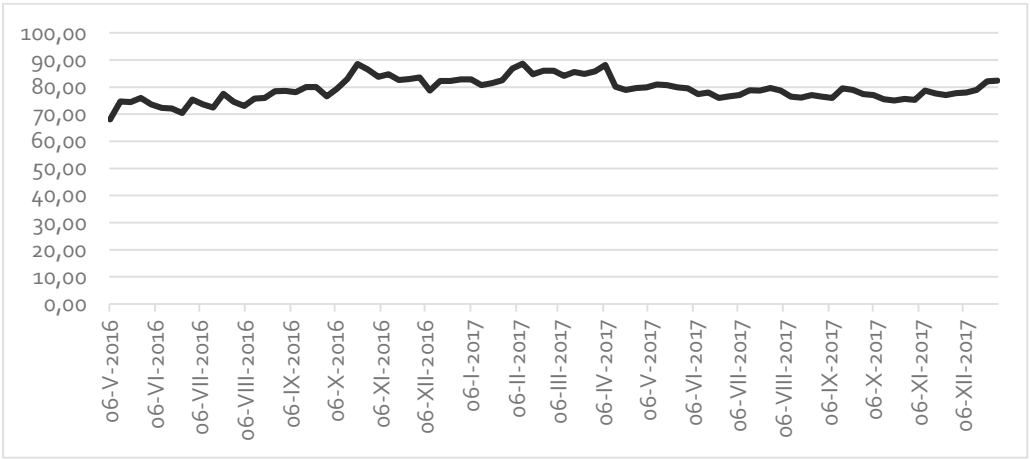

Figure 30 Closed stock prices for the Moneta Bank in the CZK, from 2016 till 2017
(Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

Figure 31 indicates the trade volume of the Moneta Bank from 04.05.2016 till 29.12.2017. The bank has the highest trade volume within PSE during this period. Average trade volume from May 2016 till December 2017 was 8.3 million CZK. Minimum trade volume was 1.3 million CZK (29.07.2016) while the maximum trade volume was 44.7 million CZK (02.12.2016).

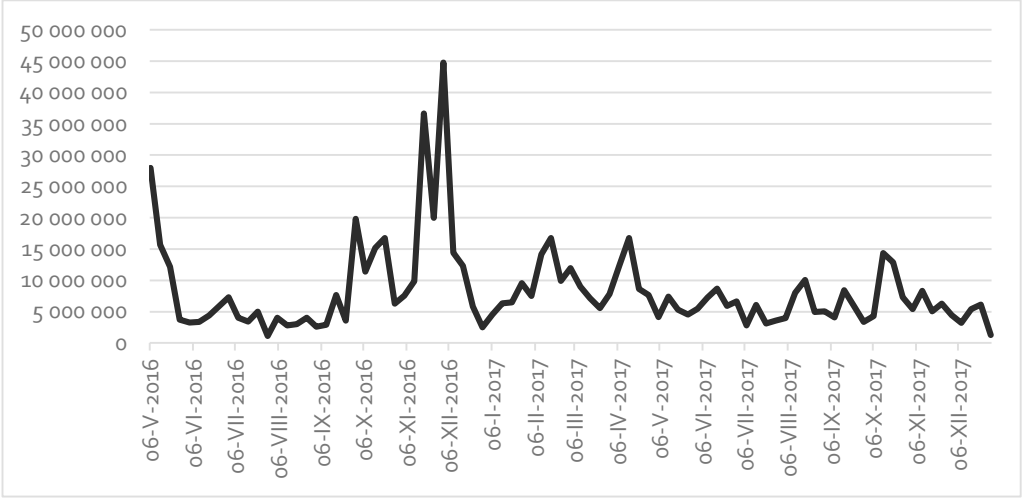

Figure 31 Trade volume for the Moneta Bank in CZK, from 2016 till 2017 (Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

Estimated Intrinsic Value of the Moneta Bank

Table 28 indicates that free cash flow to the firm was constantly positive for the Moneta Bank. Moreover, there was always cash flow available to the debtholders and shareholders of the bank from 2013 till 2017. CAPEX show that was increasing each year that shows the bank was continuously investing in its physical assets. Average WACC from 2013 till 2017 in the Moneta Bank was 3.5%. Minimum WACC was 3.2% in 2017 while the maximum WACC was 3.8% in 2013.The input used as the discount rate in the simulation was the WACC of 2017 (3.2%). Beta coefficient for the Moneta Bank was β=0.76, 24% less volatile than the Prague Stock Exchange.

Table 28 Components used during the valuation process of the Moneta Bank from 2013 till 2017

	2013	**2014**	**2015**	**2016**	**2017**
RFR	2.0%	0.67%	0.49%	0.53%	1.5%
RM (PSE)	0.48%	0.56%	0.085%	-0.09%	0.64%
WACC	3.8%	3.2%	3.5%	3.1%	3.2%
CAPEX (in million czk)	1,584	1,373	2,008	2,201	2,114
FCFF (in million czk)	12,442	11,525	10,332	9,104	8,455

Source: Authors own elaborations based on the audited financial statements of the Moneta Bank (MB, 2018).

Table 29 shows estimated DCF in the absolute number with 500, 1000 and 10000 samples. The maximum estimated intrinsic value with three different samples ranges within 41 billion CZK and 42 billion CZK. Estimated mean intrinsic value with 500, 1000 and 10000 samples were ranging within 38 billion CZK. The book value of the company in 2017 was 25.7 billion CZK, 34% less than mean DCF with three different samples.

Table 29 Estimated intrinsic value of the Moneta Bank with 500, 1000 and 10000 samples

Es. Cumulative DCF Max (in billion CZK)	Es. Cumulative DCF Mean (in billion CZK)	Es. Cumulative DCF Min (in billion CZK)	Number Of Simulations	Number of years	Starting year for the simulations
42.37	38.41	35.34	500	30	2017
41.61	38.40	35.01	1000	30	2017
42.60	38.42	34.52	10000	30	2017

Source: Authors own elaborations based on the audited financial statements of the Moneta Bank (MB, 2018).

Table 30 contains components such as: DCF per number of shares outstanding, book value per share and average market price of the bank in 2017. According to the generated results average market price of the Moneta Bank in 2017 is deviating from its intrinsic value with 500, 1000 and 1000 samples in the range of 6.5%. Average stock prices in 2017 were overvalued for almost 5 CZK. However, the deviation of the average market price in 2017 from the book value per share stands in the range of 59%.

Table 30 Deviation within market price, book value per share and intrinsic value per share for the Moneta Bank

Es. DCF mean 500 samples/Moneta Bank number of shares	**Es. DCF mean 1000 samples/ Moneta Bank number of shares**	**Es. DCF mean 10000 samples/ Moneta Bank number of shares**	**Book Value/Moneta Bank number of shares**	**Average Market Price of the Moneta Bank (2017)**
75.1 czk/share	75.1 czk/share	75.2 czk/share	50 czk/share	79.9 czk/share

Source: Authors own elaborations based on the audited financial statements of the Moneta Bank (MB, 2018)

Figure 32 indicates normal distribution of the DCF-s with 10000 samples in the Moneta Bank. Mainly the DCF-s within the normal distribution stand between 38 billion CZK and 39 billion CZK.

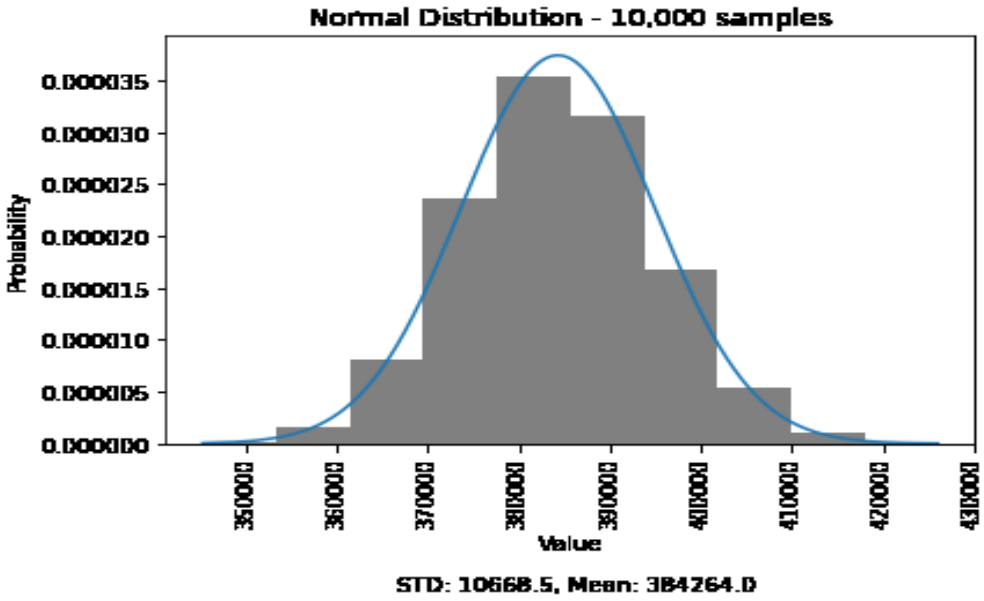

Figure 32 Normal distribution for the Moneta Bank with 10000 samples (Source: Authors own elaborations based on the audited financial statements of the Moneta Bank (MB, 2018)

4.1.11 Overall results

This section represents estimated intrinsic values of the 10 selected companies within the Prague Stock Exchange. Moreover, the companies are divided among Czech listed companies and international one.

Estimated intrinsic value of the 10 selected companies from the PSE

Table 31 and Table 32 indicate Czech and international companies that are listed on the PSE. Deviation of market prices in 2017 from their estimated intrinsic value with 10000 samples was in the range of 179.82%. However, the average deviation of the market prices from estimated intrinsic value in the absolute numbers was 1766.6 CZK. The companies overvalued in 2017 were, such as: Kofola Ceskoslovensko, Unipetrol Orlen Group, Moneta Bank, Stock Spirit, Phillip Morris and Vienna Insurance Group. In contrast, 4 companies were undervalued in 2017, such as: CEZ, Komercni Banka, Unipetrol Orlen Group and O2.

Table 31 shows Czech companies listed on the Prague Stock Exchange. The average deviation of the Czech companies in the PSE from the average market price in 2017 was 58.17% or in absolute numbers 350 CZK. The company that has the lowest deviation within estimated intrinsic value and market price was Moneta Bank (5 CZK), followed by CEZ (19 CZK), Unipetrol Orlen Group (46 CZK) and Komercni Banka (1651 CZK).

Table 31 Indicates if the companies listed in the PSE are undervalued or overvalued in 2017

Czech listed companies	**DCF mean 10000 samples / number of shares (in CZK)**	**Average Market Price in 2017 (in CZK)**	**Deviation in %**	**Deviation in absolute numbers (in CZK)**	**Market Position in 2017**
CEZ a.s.	454.3	435.6	4	19	Undervalued
Kofola Ceskoslovensko a.s.	381.0	409.0	7	29	Overvalued
Unipetrol Orlen Group	239.9	285.8	16	46	Overvalued
Komercni Banka (KB)	2591.2	939.8	257	1651	Undervalued
Moneta Bank	75.2	79.9	7	5	Overvalued

Source: Authors own elaborations based on the audited financial statements of the Czech companies listed in the PSE (PSE, 2018).

Table 32 shows the level of deviation within average market prices in 2017 and the estimated intrinsic value for the international companies listed on the PSE. The average deviation of the international company's stock prices from their estimated intrinsic value was 301% or in the absolute number 3183 CZK. Average stock prices of the international companies were deviating5.2 times more thana deviation occurred by Czech listed companies. However, the company with the lowest deviation was Stock Spirit Group (22 CZK), followed by Vienna Insurance Group (224 CZK), O2 (819 CZK), Erste Group Bank (2,297 CZK) and Phillip Moris CR (12,554 CZK).

Table 32 Indicates if the international companies within the PSE are undervalued or overvalued in 2017

International listed companies	**DCF mean 10000 samples/ number of shares (in CZK)**	**Average Market Price in 2017 (in CZK)**	**Deviation in %**	**Deviation in absolute numbers (in CZK)**	**Market Position in 2017**
Stock Spirit Group PLC	39.2	61.4	43	22	Overvalued
Erste Group Bank	3,178.9	1,084	360	2,297	Undervalued
O2	1,088.1	270	400	819	Undervalued
Vienna Insurance Group (VIG)	416.6	641.2	54	224	Overvalued
Phillip Morris CR	2,276	14,830	650	12,554	Overvalued

Source: Authors own elaborations based on the audited financial statements of the international companies listed in the PSE (PSE, 2018).

According to the results obtained from the valuation, average stock prices in 2017 of the Czech listed companies are closer to the estimated intrinsic value than international listed companies. The deviation of the average market price in 2017 from their estimated intrinsic value of the Czech listed companies was 58% or 350 CZK while for international listed companies was 301% or 3183 CZK. Overall deviation of 10 selected companies within the PSE was in the range of 179.82%. The company that was close to the equilibrium from the Czech listed companies in 2017 was Moneta Bank with deviation of 6.5% or 5CZK.

However, from the international listed companies only Stock Spirit PLC was closer to the equilibrium with 43.3% deviation or 22 CZK.

4.2 Verification of the second research question (Q2:O2)

This section definesthe elements that influence stock prices in the PSE, standing on the work of the other scholars. The second research question stands in line with the second objective of the work. Moreover, this section provides only qualitative analysis.

Which are the factors that deviate prices from estimated intrinsic value to market prices?

4.2.1 Factors influencing stock prices on the Prague Stock Exchange (PSE)

The results of the second objective observe influential factors that influence movements in the PSE. Moreover, it is generally recognized that stock prices are influenced by real economic factors and psychological factors. Standing on the microeconomic principles, key mechanism that moves stock prices is linked with demand and supply for stocks. Demand is driven by the performance of the company and macroeconomic fundamentals. Stock price movements based on the firm specific elements, stand on the items such as: profit, capitalization level, turnover, etc. However, macroeconomic items that have an influence on the stock prices stand on: economic growth, inflation, exchange rate, etc. Supply of stocks depends on the current price level of the listed stocks and the need of the company for new funds.

The second research question of the thesis tends to identify factors that deviate prices from intrinsic value to the market prices of the companies listed on the PSE. Moreover, the study is focused on the elements that drive demand for stocks in the Prague Stock Exchange. Visegrad countries are mainly focused on the banking industry to finance the economic activities of the businesses. In contrast, stock

markets contain a small portion within the financial system to inject business operations. Banks tend to be the main lender of the business activities and human consumption in V4 countries. In contrast to the stock markets, banks solely offer contractual debt arrangements within borrower and the lender. Bank assets to the GDP in Czech Republic stand for 69%, in Poland 65%, Slovakia with 64% and Hungary approximately 60% (Pražak and Stavarek, 2017).

Since PSE contains limited market capitalization, it did not gain the attention from international investors and researchers. Hanousek and Filler (2000) studied the impact of the macroeconomic variables on the stock markets of the Visegrad countries. According to the authors, stock markets in the Czech Republic and Slovakia have lost the connection with the domestic macroeconomic settings. Their work confirms that money supply, exports and imports have significant effect on the stock prices. Moreover, Hanousek and Novotny (2013) studied the impact of the Lehman brother collapse of the companies listed in the PSE, from January 2009 till July 2009.Their study confirms that PSE was vastly sensitive from the US financial distress, but merely in the short-run.

Macroeconomic indicators are an essential element in forming safe situation for financial investors. Increase in GDP, lower interest rate and inflation within targets push investors to invest and raise thestock's value. The work by Pražak and Stavarek (2017) confirms that the macroeconomic environment is a significant component in influencing stock prices in Visegrad countries. Moreover, by using Johansen co-integration test, the work of Pražak and Stavarek (2017) confirms that the unemployment rate has a positive effect while GDP has a negative effect on the stock prices. However, in the case of the Czech Republic, unemployment and GDP have a positive effect on the stock prices while interest rate, money supply and inflation have negative effects. R^2 was low, according to the author which claims that there are other

important factors which must be included in the model to explain the phenomena.

Horobet and Dumitrescu (2009) detect link within macroeconomic variables and dynamic movements in the stock prices of Visegrad stock markets. His work confirms that in the case of Czech Republic consumer price index (CPI) exhibits a positive effect while exchange rate negative effect. Moreover, the authors claim that interest rate indicate a positive effect on the stock prices in the Czech Republic that is the consequence of the market illiquidity. Relationship within the GDP and stock prices is related to the business cycles. According to the Horobet and Dumitrescu (2009) results of the study confirm similarity in the way stock markets behave in the Visegrad countries. In addition, Kulhánek (2012) investigated the links within stock prices, GDP and money supply in the Visegrad stock exchanges, from 1995 till 2012. The results of the study confirm that in the long term, there exists co-integration within GDP, money supply and stock prices in the Visegrad countries.

Movements in the interest rate determined by the Central Banks tend to influence credit easing. Credit facilitation influence consumption and investments which havean indirect effect on the stock markets. Stoica et al. (2014) studied the influence of the national and international interest rates on the stock markets of the Eastern European countries. Results obtained from the Vector Error Correction model confirm that international interest rates have a significant effect on the Eastern and Central European stock exchanges (Czech Republic, Hungary, Poland and Romania).

Economic growth encourages the dynamism of each industry within the country. General finance paradigms confirm a negative long run association within GDP and equity returns of the listed stocks. The study by Gajdka and Pietraszewski (2016) confirm a positive connection within the economic growth and stock markets of the

eastern European countries. Intangible assets such as: patents, research and developments, software are a vital part in raising investors' confidence.

Globalization of real and financial system has made the economies more integrated. Moreover, deregulation of the financial system in the 1980s has made stock markets highly dependent within each other. Fraser and Oyefeso (2005) show that the stock markets of UK, US and seven major European stock markets are highly integrated in the long term where diversification benefits achieved in the short term does not provide long run returns. Moreover, the work by Georgoutsos and Kouretas (2001) on the US, UK, Japan and German stock market on the data provided for the period 1980-2000 indicate that stock markets are highly dependent within them. Integration within stock markets does generate room for the international investors invest in stocks that have negative or zero correlation. The crisis of 2008 proved the paradigm that financial downturns in one country, influence other stock markets.

The stock markets of Central and Eastern Europe are small in size and cannot influence the other major stock markets. The pioneering study by Linne and Orlowski (1998) detected the co-integration within stock markets of Eastern and Central Europe (Slovakia, Hungary, Poland, Czech Republic and Russia) with the stock markets of western countries (Germany, UK, France, Switzerland, Japan and US). In addition, results of study confirm that only the Slovak Stock Market is influenced from the western stock markets while the others are mainly influenced from the domestic economic situation. Gelos and Sahay (2000) investigated the impact of various crises on the eastern stock markets. The results of the study show that the Budapest stock market has highly reacted to the Asian and Russian crisis while the Prague stock market was insensitive toward the crisis. Moreover, the authors claim that the motives of the BUX reaction stand on the fact that the

Budapest Stock Market is mostly owned by international investors. In addition, results of Gelos and Sahay (2000) are confirmed by Zalewska and Schotman (2005) that the Hungarian Stock Exchange was influenced from the Asian and Russian financial downturn while Prague Stock Exchange had the least impact.

Gilmore and McManus (2002) on their study perceived short term and long term relationship within US stock markets and Eastern stock markets (Czech Republic, Hungary and Poland), from 1995 till 2001. The results of the work confirm the short term correlation, while in the long term no significance within stock exchanges appears. However, the study by Scheicher (2001) investigates the integration within four eastern stock indexes (Czech Republic, Poland and Hungary) by using multivariate GARCH components. The work shows that only two stock indexes have co-integration, such as: Budapest Stock Exchange and Warsaw Stock Exchange. In contrast, no co-integration is performed within Prague Stock Exchange and the other Visegrad Stock Markets.

Figure 33 shows the results obtained from different authors concerning the factors that influence stock prices in the PSE. The factors are divided among macroeconomic indicators and the influence of the international stock markets on the PSE stock prices.

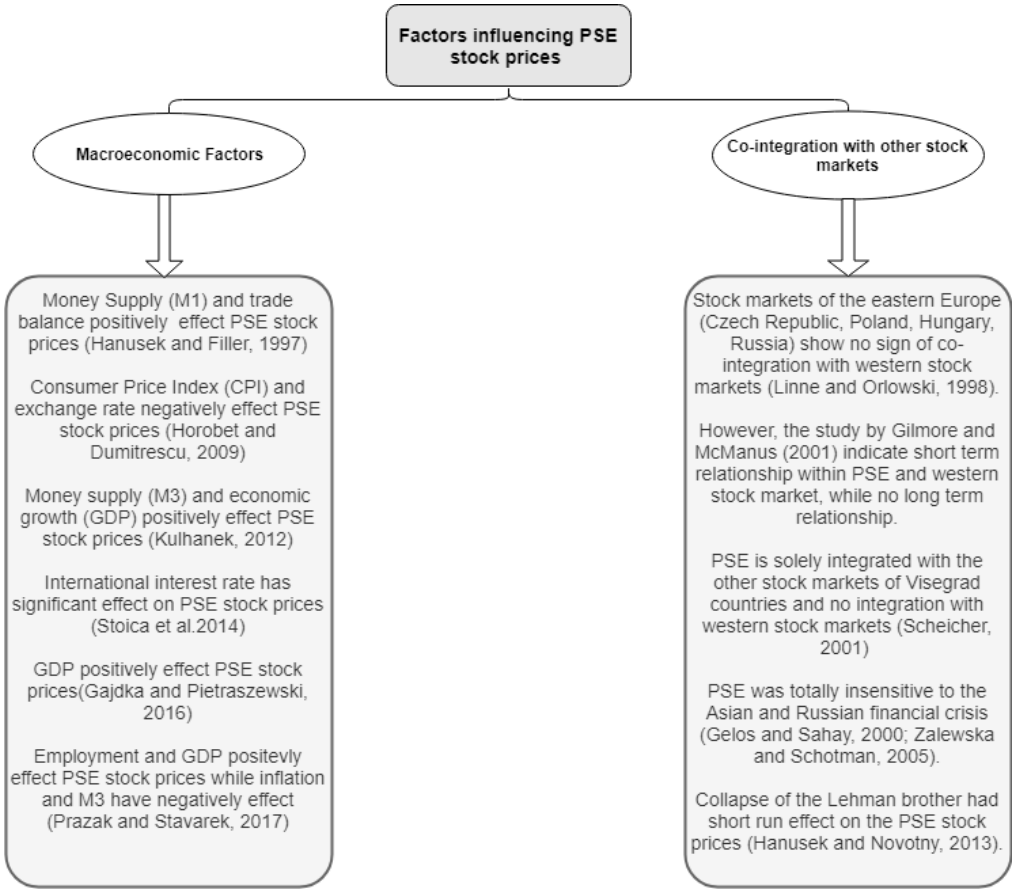

Figure 33 Indicates elements that influence prices on Prague Stock Market (PSE)

(Source: Authors own elaboration based on the other scholar's results)

Research completed from the mentioned scholars, indicate diversification signals for the national and international investors. It is clear from the results obtained that stock exchanges of the Eastern Europe provide no diversification benefits in the short term. In addition, Eastern stock markets tend to have short term positive correlation with developed stock exchanges. However, in the long run these stock indexes tend to have their independent path from the western stock indexes and provide diversification benefits for long run investors. However, from the studies we reveal a conclusion that PSE is missing the connection with domestic economic settings. Macroeconomic indicators do not deliver encouragement for the PSE investors. In

addition, these indications create a signal that investor's rationality is not driven from a real event but more from chaotic movements.

Standing in the results from the other scholar's factors that influence stock prices in the PSE, are nationally and internationally based. Macroeconomic indicators such as: GDP, employment and money supply tend to affect positively PSE stock prices. In addition, inflation measured via GDP deflator and CPI tend to have a negative effect. However, results concerning co-integration of the PSE with the other stock indexes are mixed. In the short run PSE tend to have some level of integration with the other western stock markets, while in the long run this integration is reduced.

4.3 Verification of the third research question (Q3: O3)

This section provides results on the risk level based on the diversification method of the Visegrad Stock Exchanges (VSE), from 2009 till 2017. Moreover, the stock exchanges of the Visegrad countries are considered as individual portfolios.

What is the risk level of the individual stock markets, such as: PSE, SAX, BUX and WIG20?

4.3.1 Diversification risk of the Visegrad Stock Exchanges

The work has used the diversification portfolio technique to respond the third research question that corresponds with the third objective of the work (Q3:O3). In order to verify the third research question, the work identifies diversification risk on the time interval from 2009 till 2017. Moreover, standard deviation of returns, correlation coefficient within stock prices and concentration level, identify the risk level of the individual stock markets in the Visegrad countries. Table 13 represents the risk level of the Visegrad Stock Exchanges from 2009 till 2017. Bratislava Stock Exchange is represented through the SAX, named as Portfolio A. Warsaw Stock Exchange (WIG20) indicates Portfolio B, Budapest Stock Exchange (BUX) stands for Portfolio C

and Prague Stock Exchange (PSE) as Portfolio D. The stock exchanges of the Visegrad countries, have been considered as an individual portfolio. In this section we obtain the results that stand as the third objective of the work. Moreover, the outcomes of this section answer's the third main research question.

However, SAX is considered the riskiest portfolio during 2009 and 2011 which corresponds with the financial meltdown of 2008-2009 and European debt crisis of 2011. During 2009, portfolio A (SAX) was 4.4 times riskier than portfolio B (WIG20), 6.8 times riskier than portfolio C (BUX) and 5.8 times riskier than portfolio D (PSE). However, during 2011 portfolio A (SAX) was 2 times riskier than portfolio B (WIG20), 2.5 times riskier than portfolio C (BUX), 1.8 times riskier than portfolio D (PSE).

Table 33 Risk level of the Visegrad Stock Exchanges from 2009 till 2017.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	Avg. Risk 2009-2017
Portfolio A (SAX)	19.6	0.38	5.98	0.84	0.26	0.04	0.16	0.63	0.05	3.1
Portfolio B (WIG20)	4.48	2.21	2.76	1.95	1.27	0.76	2.41	1.11	1.82	2.09
Portfolio C (BUX)	2.87	1.22	2.32	0.54	0.29	0.37	0.82	0.72	0.52	1.07
Portfolio D (PSE)	3.37	0.83	3.35	1.03	1.05	0.52	0.83	0.28	0.27	1.28

Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018).

Figure 34 shows the risk level (diversification risk) from 2009 till 2017 of the Visegrad Stock Exchanges. The lowest average risk level and the highest diversification benefits from 2009 till 2017 has BUX ($\sigma = 1.07$), followed by PSE ($\sigma = 1.28$), WIG20 (2.08) and SAX ($\sigma = 3.11$). Basically the lowest diversification benefits and the highest average risk level from 2009 till 2017 contains SAX. The lowest risk during 2009 contained BUX, followed by PSE, WIG20 and SAX.

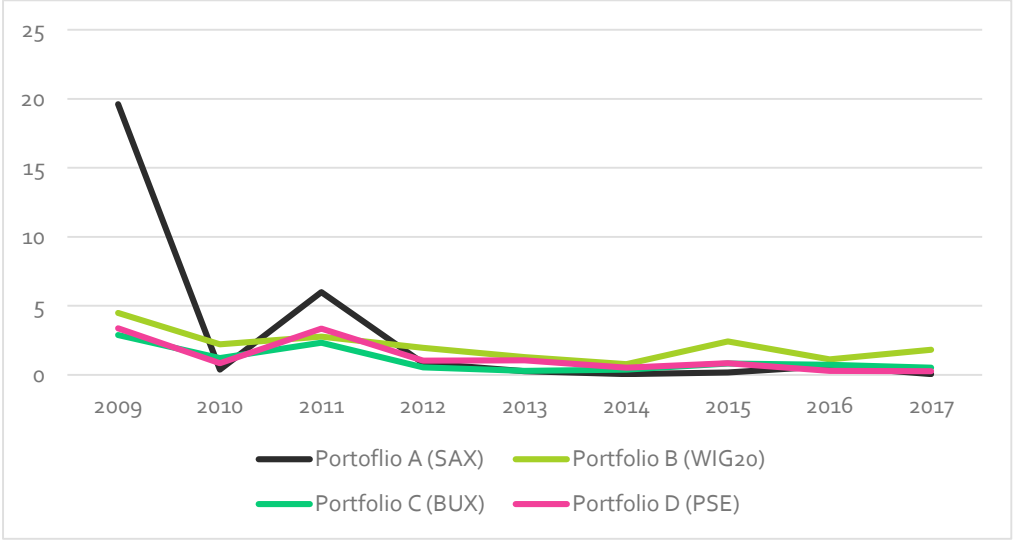

Figure 34 Risk level for the Visegrad Stock Exchanges from 2009 till 2017 (Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

Table 34indicates the average standard deviation of returns (std) of the Visegrad stock indexes. However, during 2011 WIG20 on average was the most volatile stock exchange followed by SAX, BUX and PSE. On average the most volatile stock exchange from 2009 till 2017 is WIG20 while the lowest volatile is BUX. Moreover, WIG20 is 10.1 times more volatile than SAX, 28.6 times more volatile than BUX and 23.9 times more than PSE.

Table 34 Average standard deviation of the Visegrad Stock Exchanges

	2009	2010	2011	2012	2013	2014	2015	2016	2017	Avg.STD 2009-2017
Std-Portfolio A (SAX)	9.45	2.88	3.48	3.06	2.32	2.86	4.08	3.73	3.17	3.89
Std-Portfolio B (WIG20)	26.68	13.24	14.25	42.05	87.24	42.94	35.93	32.92	59.29	39.39
Std-Portfolio C (BUX)	1.99	1.31	2.68	1.21	1.02	0.84	1.73	0.65	0.93	1.37
Std-Portfolio D (PSE)	0.65	3.44	1.99	1.3	2.68	1.21	1.01	0.84	1.72	1.65

Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018).

Table 35 indicates an average correlation coefficient of the listed companies in the respective stock exchanges of the Visegrad countries. Moreover, the correlation between stocks of the listed companies is an

important element of raising or lowering risk level. It is clear that during the crisis of 2009 and 2011, an average positive correlation increase in almost all stock exchanges. The highest positive correlation during 2009 stands in BUX ($Rij = 0.64$) while the lowest one in PSE ($Rij = 0.28$). However, during the European debt crisis of 2011 the highest average correlation is linked with BUX, followed by PSE, WIG20 and SAX. In addition, from 2009 till 2017 the highest average correlation within companies stands in PSE ($Rij = 0.37$), followed by WIG20 ($Rij = 0.29$), BUX ($Rij = 0.28$) and SAX ($Rij = 0.1$).

Table 35 Average correlation coefficient within the listed companies in the stock exchanges of Visegrad countries

	2009	2010	2011	2012	2013	2014	2015	2016	2017	Avg. Corel 2009-2017
Cor-Portfolio A(SAX)	0.6	0.046	-0.02	-0.04	0.17	-0.17	0.5	-0.13	-0.09	0.1
Cor-Portfolio B(WIG20)	0.56	0.36	0.61	0.19	0.18	0.08	0.31	0.14	0.22	0.29
Cor-Portfolio C(BUX)	0.64	0.25	0.7	0.26	0.04	0.08	0.32	0.12	0.16	0.29
Cor-Portfolio D(PSE)	0.28	0.84	0.64	0.25	0.7	0.26	0.04	0.08	0.32	0.38

Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018).

Table 36 shows the number of combinations based on the listed of companies listed on the individual stock exchanges of Visegrad countries from 2009 till 2017. The lowest number of combinations from 2009 till 2017 stands on SAX, which corresponds with the lowest number of listed companies. In addition, on average WIG20 has 13.6 times more combinations than SAX, 1.4 times more than BUX and 1.5 times more than PSE. Stock exchanges that have a higher number of listed companies as a result contain a higher number of combinations.

Table 36 Number of combination generated from number of listed companies of the Visegrad Stock Exchanges

	2009	2010	2011	2012	2013	2014	2015	2016	2017	Avg. Nr of Comb 2009-2017
Combin-Portfolio A(SAX)	1	3	10	15	15	15	15	15	15	11.5
Combin-Portfolio B(WIG20)	91	105	136	153	171	190	190	190	190	157.3
Combin-Portfolio C(BUX)	91	91	120	120	120	120	120	120	120	113.5
Combin-Portfolio D(PSE)	66	78	91	91	120	120	120	120	120	102.8

Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

The table 37 shows the weighted average return of the Visegrad stock exchanges. From 2009 till 2017, the highest weighted average returns stand for WIG20 (5.13%), followed by BUX (3.15%), PSE (1.13%) and SAX (0.30%). It is confirmed from the financial theories that higher risk level is compensated with higher returns.

Average weighted returns from 2009 till 2017 show the performance of the portfolios (stock markets), if they move with the theoretical paradigms. WIG20 is the second risky stock market ($\sigma = 2.09$) from the sample size while it generates the highest returns ($War = 5.13\%$). Moreover, BUX is the lowest risky stock market ($\sigma = 1.07$) while stands as the second portfolio with the highest returns ($War = 3.15\%$). PSE is the third risky stock markets ($\sigma = 1.28$) while stand as the third portfolio with the highest returns ($War = 1.13\%$). In addition, SAX is the most risky stock market ($\sigma = 3.1$) and drives the lowest returns ($War = 0.30\%$). Most of the results move against the theory where the stock markets with lowest risk generate higher average return and the other way around.

Risk-reward tradeoff of individual stock exchanges from the time interval 2009 till 2017, tends to move against the theoretical paradigms. Risk level for the SAX tend to move in the opposite directions with the rewards. The correlation between risk and weighted average returns is Rij=-0.71.

Table 37 Weighted average returns of the Visegrad Stock Exchanges from 2009 till 2017

	2009	2010	2011	2012	2013	2014	2015	2016	2017	Avg.War
War-Portf. A(SAX)	-1.29%	0.29%	0.86%	0.08%	0.12%	0.05%	0.13%	-0.03%	0.09%	0.30%
War-Portf. WIG20)	0.03%	0.02%	-0.02%	0.05	-0.03%	0.01%	-0.05%	0.10%	0.07%	5.13%
War-Portf. C(BUX)	1.22%	0.25%	-0.89%	0.66%	-0.42%	-0.43%	0.38%	0.87%	1.51%	3.15%
War-Portf. D(PSE)	0.16%	0.44%	-0.76%	0.24%	-0.17%	0.18%	0.66%	0.47%	-0.09%	1.13%

Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018).

Based on the results obtained, risk level is diverse among portfolio (stock exchanges) of the Visegrad countries. The riskiest stock index on average from 2009 till 2017 is SAX, followed by WIG20 and PSE. The least risky index or the best diversified is BUX that also generates second highest average weighted returns for the investors.

4.4 Verification of the fourth research question (Q4:O3)

This section identifies the risk level of individual stock exchanges (portfolios) when they operate jointly. Moreover, the fourth research question stands in line with the third objective of the work. Responding the fourth research question stands on the risk level from the different pooling's within the stock exchanges of Visegrad countries.

How would change, risk level of the PSE when it joins stock markets of the hypothetical Visegrad countries?

4.4.1 Risk level of the Visegrad Stock Exchanges (VSE) from different pooling's

Table 38 represents diverse pooling's within stock exchanges of Visegrad countries. Moreover, in the table 18 are presents all possible pooling's (combinations) within Visegrad stock exchanges. There are six possible pooling's with two stock exchanges, four diverse pooling's with three stock exchanges and one pooling with four stock exchanges. Poolings with four stock exchanges represent hypothetical

common Visegrad stock exchange. The financial crisis of 2009 indicated that all possible pooling's within stock exchanges, reflected an increase in the risk level. During 2009 the portfolio DB which consists of PSE and WIG20 contained the highest risk level ($\sigma = 4.31$) while the lowest risk level stands for portfolio CA when BUX joins with SAX ($\sigma = 2.59$). During the European debt crisis of 2011, portfolio CA (BUX+SAX) contains the lowest risk ($\sigma = 2.35$) while portfolio DA (PSE+SAX) stands for the highest risk level ($\sigma = 3.01$).

However, on average, from 2009 till 2017 the highest risk level (the lowest diversification) stands for portfolio DB where Warsaw Stock Exchange (WIG20) joins with Prague Stock Exchange (PSE). Portfolio DC, where PSE joins BUX ($\sigma = 0.813$) together with portfolio DCA where PSE joins BUX and SAX ($\sigma = 0.810$) contain almost identical risk level. Portfolio DCBA (PSE+BUX+WIG20+SAX) that represents a common Visegrad Stock Exchange stands as the fifth least risky portfolio. Moreover, portfolio DCBA (PSE+BUX+WIG20+SAX) stands almost in the identical risk level with portfolio DCB (PSE+BUX+WIG20).

Table 38 Risk level from different pooling's of the Visegrad Stock xchanges from 2009 till 2017

	2009	2010	2011	2012	2013	2014	2015	2016	2017	Avg.Risk 2009-2017
Portfolio DC (PSE+BUX)	2.89	1.19	2.39	0.56	0.38	0.34	0.77	0.44	0.43	0.813
Portfolio DA (PSE+SAX)	2.13	0.82	3.01	1.01	1.05	0.5	0.83	0.29	0.26	0.971
Portfolio DB (PSE+WIG20)	4.31	2.01	2.84	1.85	1.16	0.72	1.85	0.79	1.21	1.554
Portfolio CB (BUX+WIG20)	3.32	1.13	2.52	1.19	0.7	0.48	1.31	0.86	1.03	1.153
Portfolio CA (BUX+SAX)	2.59	1.22	2.35	0.54	0.28	0.34	0.82	0.72	0.48	0.844
Portfolio BA (WIG20+SAX)	3.93	2.2	2.77	1.97	1.24	0.81	2.28	1.12	1.63	1.753
Portfolio DCB (PSE+BUX+WIG20)	3.32	1.11	2.54	1.16	0.72	0.47	1.18	0.69	0.88	1.094
Portfolio CBA (BUX+WIG20+SAX)	3	1.13	2.53	1.19	0.7	0.46	1.31	0.86	1	1.148
Portfolio DCA (PSE+BUX+SAX)	2.61	1.19	2.42	0.56	0.38	0.31	0.77	0.45	0.4	0.81
Portfolio DCBA (PSE+WIG20+SAX)	3.8	2.01	2.8	1.84	1.16	0.71	1.85	0.8	1.18	1.544
Portfolio DCBA (PSE+BUX+WIG20+SAX)	2.99	1.11	2.55	1.16	0.72	0.45	1.18	0.69	0.85	1.089

Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

Table 39 indicates the standard deviation of returns of the diverse pooling's within Visegrad stock indexes. It is clear that volatility (std) increase during the 2009 and 2011. In 2009 the highest volatility is reached in the portfolio BA (WIG20+SAX) while the lowest volatility in the portfolio DC (PSE+BUX). However, during 2011 the portfolio with the lowest risk level stands when PSE joins BUX. The portfolio with the highest risk during 2011 is comprised when WIG20 joins SAX.

The highest average volatility (std) from 2009 till 2017 stands for the portfolio BA where WIG20 joins SAX. Moreover, the lowest average volatility (std) from 2009 till 2017 stands for the portfolio CA where BUX joins with SAX.

Table 39 Average volatility of the Visegrad Stock Exchanges from different pooling's

	2009	2010	2011	2012	2013	2014	2015	2016	2017	Avg.std 2009-2017
Std- Portfolio DC (PSE+BUX)	4.95	2.51	4.05	1.94	1.76	1.42	2.49	1.31	2.87	2.59
Std- Portfolio DA (PSE+SAX)	9.3	4.02	5.28	3.17	2.71	2.55	3.77	2.71	4.54	4.23
Std- Portfolio CB (BUX+WIG20)	14.41	7.51	8.93	23.25	48.97	23.59	20.17	19.02	32.07	22.94
Std- Portfolio DB (PSE+WIG20)	19.9	10.34	11.83	29.41	59.22	28.65	23.79	21.88	37.67	26.97
Std- Portfolio CA (BUX+SAX)	3.16	1.69	2.9	1.72	1.38	1.37	2.37	1.49	1.52	1.81
Std- Portfolio BA (WIG20+SAX)	22.4	10.98	11.84	32.54	67.73	33.32	27.78	26.8	44.62	31.95
Std-Portfolio DCB (PSE+BUX+WIG20)	13.29	6.89	8.41	19.15	38.97	18.98	16.28	14.8	25.42	18.61
Std-Portfolio CBA (BUX+WIG20+SAX)	13.36	6.91	8.17	20.3	42.31	20.94	17.86	16.84	27.96	20.16
Std- Portfolio DCA (PSE+BUX+SAX)	5.26	2.582	3.93	2.159	1.863	1.68	2.779	1.74	2.827	2.45
Std- Portfolio DCBA (PSE+WIG20+SAX)	18.01	9.14	10.37	24.77	49.74	24.74	20.58	19.01	32.18	23.82
Std- Portf. DCBA (PSE+BUX+WIG20+SAX)	12.46	6.47	7.85	17.23	34.74	17.38	14.89	13.57	22.91	16.88

*Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)***.**

Correlation coefficient indicates the short run relationship within listed companies in the individual Stock Exchanges. Table 40 shows the average correlation coefficient from pooling's of the Visegrad stock indexes. During 2009 it appears that average positive correlation increases within pooling's of the Visegrad Stock Exchanges. Minimum positive correlation during 2009 stands for portfolio BA (WIG20+SAX) while the maximum one for the portfolio DC (PSE+BUX). However, during the European debt crisis of 2011, the maximum positive correlation appears in the portfolio CB where BUX pools with WIG20 and the minimum positive correlation stands for the portfolio DA where PSE joins with SAX.

Table 40 Average correlation coefficient from diverse pooling's within Visegrad Stock Exchanges

	2009	2010	2011	2012	2013	2014	2015	2016	2017	Avg.Cor 2009-2017
Correl- Portfolio DC (PSE+BUX)	0.72	0.19	0.6	0.24	0.1	0	0.11	0.07	0.27	0.2
Correl- Portfolio DA (PSE+SAX)	0.53	0.17	0.31	0.18	0.11	-0.05	0.03	0.01	0.21	0.12
Correl- Portfolio DB (PSE+WIG20)	0.69	0.25	0.55	0.2	0.12	0.02	0.11	0.08	0.28	0.2
Correl- Portfolio CB (BUX+WIG20)	0.6	0.16	0.64	0.15	0.04	0.05	0.2	0.1	0.18	0.19
Correl- Portfolio CA (BUX+SAX)	0.46	0.21	0.49	0.19	0.03	0.04	0.3	0.09	0.09	0.18
Correl- Portfolio BA (WIG20+SAX)	0.37	0.31	0.44	0.14	0.17	0.07	0.16	0.1	0.15	0.19
Correl- Portfolio DCB (PSE+BUX+WIG20)	0.67	0.16	0.58	0.17	0.07	0.02	0.11	0.08	0.25	0.18
Correl- Portfolio CBA (BUX+WIG20+SAX)	0.49	0.15	0.53	0.12	0.04	0.04	0.16	0.09	0.13	0.16
Correl- Portfolio DCA (PSE+BUX+SAX)	0.59	0.17	0.47	0.19	0.06	0.001	0.12	0.06	0.19	0.16
Correl- Portfolio DCBA (PSE+WIG20+SAX)	0.56	0.23	0.43	0.17	0.11	0.01	0.06	0.07	0.23	0.16
Correl- Portf. DCBA (PSE+BUX+WIG20+SAX)	0.58	0.16	0.5	0.15	0.06	0.01	0.09	0.08	0.2	0.16

Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018)

Table 41 shows weighted average returns of the different pooling's within stock exchanges in the Visegrad countries. The portfolio that generates the highest War from 2009 till 2017 is a portfolio CA (BUX+SAX), followed by portfolio CB (BUX+WIG20), portfolio DC (PSE+BUX) etc. However, the lowest War from 2009 till 2017 stands for the portfolio DA where PSE joins with SAX. During 2009, the highest weighted average return was generated from the portfolio DCB (PSE+BUX+SAX) while the lowest in the portfolio DB (PSE+WIG20). In contrast, during 2011 almost all portfolios generated negative returns where portfolio DC (PSE+BUX) was characterized with lowest War.

Table 41 Weighted average returns from diverse pooling's between Visegrad Stock Exchange from 2009 till 2017

	2009	2010	2011	2012	2013	2014	2015	2016	2017
War- Portfolio DC (PSE+BUX)	1.2	0.3	-0.9	0.6	-0.4	-0.3	0.5	0.7	1
War- Portfolio DA (PSE+SAX)	0.8	0.4	-0.7	0.2	-0.2	0.1	0.7	0.5	-0.3
War- Portfolio DB (PSE+WIG20)	0.1	0.3	-0.2	0.1	0.1	-0.1	0.2	0.6	0.4
War- Portfolio CB (BUX+WIG20)	0.7	0.2	-0.6	0.5	-0.2	-0.4	0.01	0.8	1.2
War- Portfolio CA (BUX+SAX)	1.5	0.3	-0.8	0.7	-0.4	-0.3	0.4	0.9	0.8
War- Portfolio BA (WIG20+SAX)	0.2	0.3	-0.1	0.1	0.01	-0.2	-0.1	0.7	0.5
War- Portfolio DCB (PSE+BUX+WIG20)	0.7	0.2	-0.6	0.5	-0.1	-0.3	0.1	0.7	0.9
War- Portfolio CBA (BUX+WIG20+SAX)	0.8	0.2	-0.5	0.5	-0.2	-0.3	0.01	0.8	0.6
War- Portfolio DCA (PSE+BUX+SAX)	1.5	0.3	-0.8	0.6	-0.4	-0.2	0.4	0.7	0.5
War- Portfolio DCBA (PSE+WIG20+SAX)	0.2	0.3	-0.2	0.1	0.02	-0.1	0.01	0.6	0.1
War- Portf. DCBA (PSE+BUX+WIG20+SAX)	0.8	0.2	-0.5	0.5	-0.1	-0.3	0.1	0.7	0.4

Source: Authors own elaborations based on the Thomson Reuters Eikon database (Eikon, 2018).

Standing on the received results, risk level of the PSE declines from $\boldsymbol{\sigma}$=1.28 to the $\boldsymbol{\sigma}$=1.09 when it operates under hypothetical common Visegrad Stock Exchange. Moreover, the average risk level from 2009 till 2017 would have been reduced for 17.5%, if PSE would operate under the hypothetical Visegrad Stock Exchange.

5. DISCUSSION

5.1 Discussions concerning the first objective of the work

The stock markets of the Visegrad countries reopened after the communism falls apart in 1990s.The Budapest Stock Exchange was the first one that re-opened (21.05.1990), followed by the Warsaw Stock Exchange (16.03.1991) and the Prague Stock Exchange (06.03.1993) (Gilmore and MCmanus, 2003). The major concern for individual and institutional investors for the Visegrad Stock Exchanges was linked with the efficiency level of the markets. Moreover, level of efficiency is determined by the reaction of the investors on the firm specific information's and macroeconomic events. Fama (1968) claims that stock prices should adjust very fast to the equilibrium (intrinsic value) since the market mechanism does not allow arbitrage in the long time interval. Moreover, the present value of stocks reveals its expected future values (Fama, 1976). In contrast, Shiller (1981) claims that stock prices contain a psychological element where market tend to overprice or underprice financial assets from their intrinsic value. Moreover, the study by (Shiller, 1981; Shleifer and Summers, 1990) claim that is difficult to determine if the market is efficient. The idea stands that efficiency is reflected in the stock price equilibrium (intrinsic value of the company). However, according to the Shiller (1981) is quite hard to determine intrinsic value since different analysts stand on different approaches. Analyst's approach the intrinsic value of the company standing on diverse information's, methodologies and risk level that does not generate unique value for the company.

The study by Gilmore and MC Manus (2003) used weekly data from July 1995 till September 1997 to test efficiency level of the Czech, Polish and Hungarian stock markets. The results of their work confirm that the three stock markets stand as weak efficient markets. Moreover, the results confirm no integration within three stock exchanges. The

reasons for no integration from the authors is considered lack of economic relations and different privatization models conducted from the Visegrad countries. Stock prices of these countries do not follow the random walk process.

Hanousek and Kocenda (2011) measured the level of co-integration from 2004 till 2007 within the stock exchanges of the western countries and stock exchanges of the Czech Republic, Poland and Hungary.Frankfurt Stock Exchange delivers the highest spillover effect while the New York Stock Exchange influence in the lower scale. The study by Dragotă and Tilica (2014) claims that abnormal returns can be realized in the stock markets of the Eastern Europe if the appropriate financial instruments are used. Pošta (2008) confirms weak efficient form of the Prague Stock Exchange with the data from January 1995 till June 2007. Moreover, the work of Pošta (2008) use E-GARCH model to test the volatility of the daily returns within the PSE. Moreover, other scholars have also confirmed the weak efficient form of the Prague Stock Exchange in the different intervals (Smith, 2012; Todea and Lazar, 2012; Stoica and Diaconasu, 2011; Dritsaki, 2011). Previous studies concerning the efficiency level confirm the weak efficient form of the PSE since it reopened in 1993. Weak efficiency within the PSE confirm that stock prices didn't experience random walk which create space for arbitrage (abnormal returns in the long run). The results on the efficiency level of the PSE shows that stock prices of the companies were constantly followed by the information asymmetry. In contrast, the results of my work tend to find the estimated intrinsic value (equilibrium level) of the listed companies in PSE based on my estimations. However, based on the estimated results concerning the intrinsic value of the companies listed in the PSE, Czech listed companies were closer to their intrinsic value than international companies. Czech listed companies based on my estimated results show that average market prices deviate from intrinsic value 58.17% while international companies for 301%.

The methodologies used for the testing the stock markets for the efficiency level. The test used for this process, are such as: auto-correlation of the returns, runs test, variance ratio tests, GARCH model, etc. In contrast, to the methods used for testing the efficiency level of the PSE, my work uses DCF model with the help of a Monte Carlo simulation technique. Moreover, my work stands for the past data, but the results are generated based on the expectations for the future cash flows. In contrast, the data used for testing the efficiency level of the Visegrad stock exchanges, stand on the historical stock prices of the listed companies.

Standing on the Fama (1976) theory that efficient markets in the long run tend toward equilibrium (intrinsic value). Assuming that my estimates are the best estimates for appraising the intrinsic value of the companies listed in the PSE than five companies were in almost at the equilibrium level. Moreover, companies such as: Moneta Bank, Unipetrol Orlen Group, Stock Spirit PLC, CEZ and Kofola Ceskoslovensko confirm the Fama (1976) theory that stock prices are in the equilibrium. The results of my work, obtain the position of selected companies within the PSE solely in 2017. However, the results cannot observe the phenomena of equilibrium (estimated intrinsic value) in the time interval.

5.2 Discussions concerning the third and the fourth objective of the work

Brands and Gallagher (2005) studied the mean variance of the different equity funds. Their study was not focused on the selected stocks, but observed the diversification risk from the 30 randomly selected portfolios. Their work confirms that maximum diversification is achieved when six actively equity funds are involved in the portfolio. The results of the work confirm that an increasing number of equity funds (number of shares) decreases the risk level or increase diversification benefits. Moreover, standard deviation of returns

declines from portfolio with one equity fund to the portfolio with 30 equity funds. My work considers stock markets of the Visegrad countries as individual portfolios. However, stock markets are comprised solely of common stocks that stands with the sample size selected from Brands and Gallagher (2005). Equity funds spread financial investments in different stock markets while stock market of Visegrad countries are comprised with stocks of national registered companies. The results of my work do not consider the diversification benefits as a static moment, but observes the phenomena on the time interval, from 2009 till 2017.

The study conducted by Tang (2004) observes diversification benefits from diverse portfolios with equal weights. Moreover, the work of Tang (2004) confirms that portfolio with 20 stocks eliminate 80% of the risk while portfolio with 80 stocks eliminate 95% of the portfolio risk. Pioneering work of Fisher and Lorie (1970) on the NYSE listed stocks between 1926 and 1965 confirms that portfolio with 30 stocks fully eliminates diversification risk. A profound work of Evans and Archer (1968) claims that no more than 15 stocks are needed to reach full diversification benefits.

Minimum variance within the portfolio with a diverse number of stocks is also influencedby the concentration level (weights of each stock within the portfolio). Newbould and Poon (1993) consider that number of stocks to reach minimum risk in the portfolio is diverse from the methods with equal and changeable weights. However, their empirical results confirm that portfolio with 20 stocks eliminate unsystematic risk. Wagner and Lau (1971) indicated that portfolio with 20 stocks, leave the portfolio only with the systematic risk. The study done by Campbell et al. (2001) from 1962 till 1997 indicate that portfolio with 50 stocks, stands for well diversified portfolio. However, adding more stocks within the portfolio carries higher management costs. The study by Statman (2004) consider that unsystematic risk is

eliminated in the portfolio with 100 stocks. His work measured beside diversification benefits also financial costs involved when number of stocks increase in the portfolio.

The results of my work confirm that in general, portfolios (stock exchanges) with higher number stocks (number of listed companies) hold lower risk level. In contrast, in my work BUX contain a lower number of listed companies than WIG20 but has higher diversification benefits (lower risk level). Average volatility (std) of the individual stock exchanges is diverse since WIG20 is characterized with higher volatility than other stock exchanges of the Visegrad countries. Moreover, higher volatility within the WIG20 does not necessarily contain higher risk than PSE, SAX and BUX. However, WIG20 is characterized with higher turnover than other Visegrad stock exchanges. The work of Brands and Gallagher (2005) confirms that moving toward portfolios with higher number of equity funds declines risk level. The results of my work show that during the European debt crisis of 2011, average correlation coefficient increase of the Visegrad stock exchanges. Low (2015) reached identical results where during the crisis periods, stocks tend to move together and increase correlation coefficient.

Hanousek and Kocenda (2011) on their study concerning the influence of the international stock markets on the Polish, Czech and Hungarian Stock Markets show that Frankfurt Stock Market delivers the highest influence. Moreover, the results of their study confirm that Budapest Stock Exchange (BUX) obtains higher spillover effects of international stock markets than Prague Stock Exchange (PSE) and Warsaw Stock Exchange (WIG20). Hanousek and Kocenda (2011) justify these results for Budapest Stock Exchange from the trade volume realized by international investors on BUX. Smith (2012) by using variance ratio test measured the efficiency level of the 15 European stock markets. His study concluded that Budapest Stock

Exchange is one the most efficient stock exchanges. The results of the Hanousek and Kocenda (2011) and Smith (2012) stand in line with the results of my work that Budapest Stock Exchange is most well diversified index. However, their work used GARCH model for testing their results while my work has used diversification model of the Markowitz (1959) to test the risk level of the Visegrad Stock Exchanges.

6. CONCLUSION

Stock markets are an important element of the financial system. Moreover, stock markets stand as a substitute for the banking industry in channelizing the unutilized funds. However, efficiency level within the stock markets is an additional factor that attracts investors. Strong efficiency within the stock markets not only raise confidence in the financial investors, but also create proper signals for the financial situation of the listed companies. In contrast, the stock markets of the Visegrad countries are prone to low trade volume and inadequate number of the companies listed. Moreover, the stock markets of V4 countries are categorized with lower efficiency level, which shows that stock prices do not reveal the financial position of the listed companies. Standing on these premises, the work observes risk benefits of the Prague Stock Market on the micro and the macro perspective. The study uses valuation techniques to determine the estimated intrinsic value of the companies listed in PSE. Moreover, the results of the work provide information on the extent of deviation within market prices on the PSE and the company's intrinsic value. The literature review indicates factors that cause the deviation of stock market prices in the PSE from their intrinsic value. The ultimate result capture risk benefits when stock markets of V4 countries operate together. Moreover, the work identifies the risk of the Visegrad stock markets by considering them as independent portfolios.

The first objective of the work tends to identify if the listed companies within the PSE were undervalued or overvalued in 2017.According to the estimated results, average market price of Czech listed companies was closer to the estimated intrinsic value than of the international listed companies. The average deviation of the Czech listed companies between average market price and estimated intrinsic value was in the range of 58% (350 CZK). International companies in 2017 had a deviation in the level of 301% (3183 CZK).

However, from the 10 selected companies within the PSE in 2017, the average deviation was 180 %. From the Czech listed companies the company that had the lowest deviation within average market prices and estimated intrinsic value was Moneta Bank, with 6.5% (5 CZK). However, from international listed companies Stock Spirit PLC had the deviation of 43.3% (22 CZK).

The second objective identifies factors that influence stock prices in the PSE to deviate from their intrinsic value. However, the second objective is reached from the results generated from different scholars that conducted research concerning factors influencing stock prices in the PSE. The mechanism that determines stock prices to move is influenced from the investor's behavior. Moreover, buying and selling stocks from investors, define equilibrium price in the stock market. However, investor's attitude is driven from psychological and real economic elements. Macroeconomic factors that influence PSE stock prices, stand in line with theoretical expectations. Factors that have a positive relationship with the movements in the PSE stock prices, are: money supply, employment level, and economic growth rate. In contrast, inflation measured through GDP deflator and CPI tends to have a negative relationship with the PSE stock prices. However, concerning the co-integration between PSE and other stock markets, the results are not clear. Some studies show a certain level of integration within PSE and other western stock markets in the short run. In contrast, the other studies found no integration with PSE and western stock markets.

The third objective of the work identifies diversification benefits linked with stock markets of the Visegrad countries. Stock markets are considered as portfolios based on the existing listed companies. The work uses portfolio diversification model to determine risk reward trade of each portfolio (stock market). Bratislava Stock Exchange (SAX) is considered as Portfolio A, Warsaw Stock Exchange stands

for Portfolio C while Budapest Stock Exchange is named as Portfolio C and Prague Stock Exchange as Portfolio D. Based on the trade volume and a number of listed companies WIG20 stands as the biggest portfolio of the Visegrad countries while SAX the smallest one. Results from 2009 till 2017 show that SAX on average is the riskiest portfolio and offer the lowest diversification benefits. In contrast, the least risky portfolio that offers the highest diversification benefits on average is BUX. During the European debt crises of 2011 stock exchanges of the V4 countries experienced increases in the risk level. Moreover, intensification of risk is mainly caused by an average decline in the overall stock prices that has affected average correlation coefficient to rise in the each V4 stock exchanges. The most volatile stock exchange on average was WIG20 while BUX was characterized by the lowest volatility on average. Average correlation coefficient shows movements of the stock prices in each of the V4 stock exchanges, stands as an important indicator of risk. The highest average correlation from 2009 till 2017 followed PSE while the lowest one for SAX. However, WIG20 and BUX had almost identical average correlation coefficient. Moreover, the results confirm that the risk level of the Prague Stock Exchange (PSE) would decline for 17.5% if it would have operated under the hypothetical Visegrad Stock Exchange.

The results of the work tend to confirm risk level of the PSE from two risk dimensions, such as from: micro and macro perspective. The results of the micro view are constrained solely in 2017 that tend to identify if the selected companies within the PSE are overvalued, undervalued or properly valued. The estimated results show that Czech listed companies are closer to the equilibrium price (estimated intrinsic value) than international companies. The results of the work from a macro perspective, identify risk level of the PSE if it would operate under hypothetical Visegrad Stock Exchange. Moreover, the results of the work show that average risk level of the PSE would have declined if it would operate within hypothetical Visegrad Stock Exchange.

6.1 Limitations of the work

The work is divided into three main objectives and each objective stand on its unique methodology. DCF Model used for the first objectives, consider certain assumptions that make the model to certain level unrealistic. Moreover, the assumptions linked with the DCF model stand on the future growth rate, future cash flow and future discount rate. The future is difficult to predict since stands on elements that are unidentified. However, still there is no consensus among scholars and valuators concerning the methodological steps that must be conducted on the valuation. Standing on these limitations, the results of my work identify the intrinsic value of the listed companies in the PSE based on my estimations. Moreover, other scholars or evaluators might identify other estimated values of the companies listed on the PSE. The work cannot identify if the selected companies are in the equilibrium, since there is no threshold that shows to what extent of deviation within intrinsic value and market prices the equilibrium exists. Additional limitation of the method is that it does not take into consideration lifespan of the companies and the possibility of the bankruptcy. Lack of financial and legal due diligence provides a biased outlook on the legal and financial issues which are not revealed in the annual reports. However, financial and legal due diligence is mainly conducted from the specialized financial institutions since they deal with sensitive documents of the companies.

The third objective of the work has identified certain limitations. The returns of the stock exchanges have been calculated based on the capital gains and do not consider dividends that shareholders received. Since the work propose hypothetical Visegrad Stock Exchange, it does not consider that each country has a diverse tax structure imposed on corporations. Monetary policy is unique within each country which complicates the issue of joining stock markets even more. Slovakia is operating under a Eurozone monetary system while the Czech Republic, Hungary and Poland operate under their own currency

regime. Unique currency regime among selected countries cause extra limitation for joining the stock exchanges.

7. CONTRIBUTION

7.1 Contribution to the theory

The contributions of the first objective lie within microeconomic and finance theories. If the valuation of the companies is not proper, it delivers wrong price signals in the market. Incorrect valuation guides incorrect evidences for investors, lenders, government, employees, etc. and it distorts preliminary price signals while it provides unrealistic information for financial investors. Moreover, incorrect valuation lies within the theoretical concept of the markets with asymmetric information. However, the neoclassical paradigm stands on the assumptions that markets (in our case Stock Market Prices) reach the equilibrium in interference with financial analyst, insiders, lenders, suppliers and buyers. There is a general paradigm that stock prices reflect equilibrium prices when they contain all available information's. Moreover, Fama (1968) confirmed that stock prices adjust toward intrinsic value since prices contain all available information. This work sheds, small light on the overall complexity of the stock markets. Moreover, sometimes stock prices fail to reach equilibrium (intrinsic value) if the inputs injected in the initial process are wrongly driven. My contribution to the theory lies within the concept of Fama (1968) that markets adjust very fast toward equilibrium (estimated intrinsic value). However, the results of my work suggest that stock prices might be prone to disequilibrium, even we don't know the exact reasons for this disequilibrium.

Asymmetric information is linked with the concept when one party has less information than the other party involved in the transaction (buyers or sellers). Pioneering work of Akerlof et al. (2001) on the market with a lack of information indicate the concept of market disequilibrium, where one part of the market has more information than the other part of the market. All these problems involved within the markets lead to disequilibrium and also to speculations concerning

particular prices. Moreover, Liu and Wang (2016) concluded that due to market power, information asymmetry cause welfare loss.

A second objective tends only to describe influential factors that deviate prices from intrinsic value to market prices. However, this part completes the whole picture of the research work since it shows why the stock prices are deviating from their intrinsic value.

The third objective tends to observe diversification risk linked with individual stock markets by considering them as individual portfolios. Moreover, it observes the possibility of having a common stock market (Visegrad stock market). The added scientific benefit of the work stands on implementation of the portfolio management techniques into the stock markets. The work stands in the line with the overall concept of the financial and economic integration of the European Union. The results of the study show that stock market integration reduces the risk level of the Prague Stock Exchange.However, I suggest the portfolio diversification technique can be taught as metric for measuring the risk level of the stock indexes.An additional objective of the work observed diversification benefits (risk level) when PSE operates under common hypothetical Visegrad Stock Market. Risk level on average would have been 12% less for the PSE, if it would operate under hypothetical Visegrad Stock Market.

The results of the study show risk level of the portfolios (stock exchanges) within different pooling of the Visegrad Stock Exchanges from 2009 till 2017.Moreover, the results of the work show that on average the riskiest portfolio exists when PSE (Portfolio D) pools with WIG20 (Portfolio B), named as Portfolio DB. In contrast, the lowest risk appears when PSE (Portfolio D) pool with BUX (Portfolio C), named as Portfolio DC.

7.2 Practical applications

The work will tempt to change the way investment banks implement valuation techniques in the Czech republic. The results of the work

provideestimated intrinsic value on the PSE stock prices. It will make more efficient the way IPO process is conducted in the Czech Republic. Moreover, it generates less uncertainty among investors in capturing the risk, since the risk will be more visible. The results of the workshow new insights into the way valuation has been taught in the university. Moreover, it provides ecidence that valuation techniques can be used to determine estimated equilibrium price of the listed companies.Outcomes from the third objective, deliver signals to the governments of Visegrad countries on the risk-reward benefits of having a common stock market. Index funds will get an overview on the risk reward trade-off linked with stock markets of Visegrad countries. However, institutional investors (hedge funds, pension funds, index funds, etc.) will obtain new insights on the diversification risk linked to the stock markets of Visegrad countries.

Figure 35 shows that demand for stock prices is driven by multiple factors, such as: macroeconomic factors, firm specific factors, psychological factors. Moreover, risk linked to specific listed company is important element that influence demand for stocks. The results of the work will provide information on beta coefficient, discount rate and WACC, which are key elements of the company's risk profile.

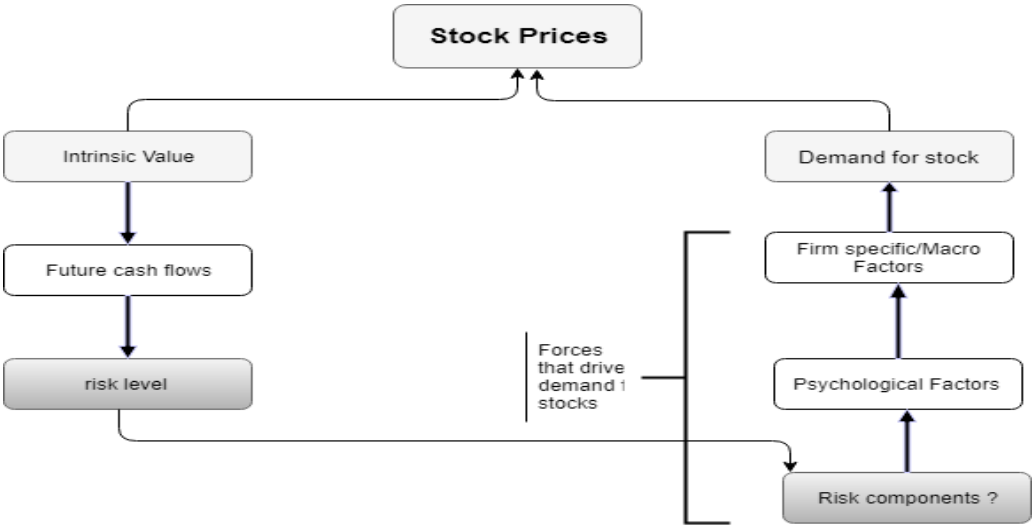

Figure 35 Excepted effects of the study in the market place (Source: Authors own elaborations)

Figure 36 indicates the case when companies are overvalued it will push shareholders to get released from the stocks of the company. In addition, this effect creates more supply and push stock prices toward estimated intrinsic value. In contrast, when stocks of the particular company are undervalued it will push investors to buy cheap shares (less risky), as a consequence it will drive prices to increase toward estimated intrinsic value. The results of the study are expected to help Prague Stock Exchange to move toward estimated equilibrium (estimated intrinsic value). Moreover, in order to observe this phenomenon in a time interval, the valuation must be conducted on the regular basis. Constant valuation of the listed companies proves or disprove the Fama (1968) theory that stock prices might deviate from the intrinsic value on the short run but will be adjusted to the equilibrium in the long run. In addition, the speed of the adjustment depends on how investors react to the regular (6 month or 1 year) reports on the estimated intrinsic value of the companies listed on the PSE. Standing in the results of the work, the government should create binding rules for the listed companies to publish annual valuation reports.

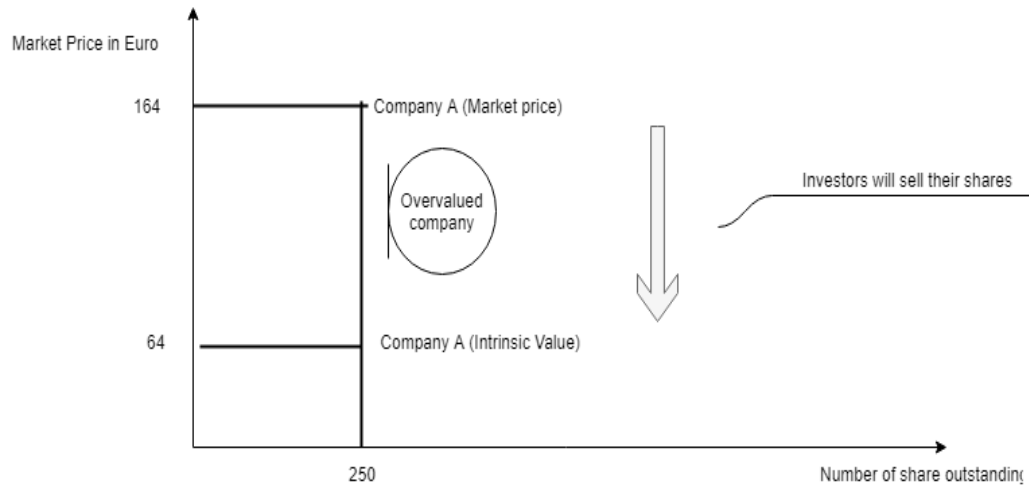

Figure 36 Investors reaction from the information's on the estimated intrinsic value of the companies listed on the PSE (Source: Authors own elaboration)

7.3 Further Research

The stock markets are considered as one of the most complex frameworks within the financial system. The work tends to identify problems linked to the Prague Stock Exchange from two risk perspectives, such as: diversification risk and estimated equilibrium price. Since the methods used in the valuation do not comprehend a wide consensus among scholars, bringing a robust conclusion is difficult. Standing on the assumption that this is the only work that shows results concerning the intrinsic values of the companies listed in the PSE, numerous improvement can be achieved. Fama (1968) considered that stock prices tend toward equilibrium, but his work did not identify how to measure the equilibrium level in the stock markets. Investors are interested to buy stocks at their fair value where the stock price indicates the intrinsic value of the company. Future research might identify other justified assumptions on the DCF model that carry closer financial reality of the listed companies. The results of the work concerning the estimated intrinsic value of the companies are

constrained exclusively within the PSE. However, observing the phenomena into other eastern European countries would generate a broader outlook concerning which of the stock exchanges are closer to their estimated equilibrium price. Moreover, using other valuation techniques such as option methods would bring the estimated intrinsic values of the companies within diverse scenarios.

The second objective of the work stands on the results generated from other scholars. Since the second objective identifies factors influencing stock prices in the PSE. The work of the other scholars is done on the integration of the PSE with regional and international stock markets. Moreover, scholars identified to what extent the macroeconomic indicators are influencing stock prices in the PSE. In contrast, no work appears on the influential capacity of the firm specific factors on the PSE stock prices. Frim specific factors are linked with internal performance of the company, such as: profits, debts, turnover, ROE, ROA etc. that would generate extensive viewpoint of the phenomena. To the best of my knowledge future direction can examine to what extent firm specific factors influence stock prices. Building model on firm specific factors might lead on generating overall picture on this phenomenon.

The third objective shows the risk level of the PSE under hypothetical Visegrad stock exchange. The work considers each stock exchange of the Visegrad countries as individual portfolio. The results only identify diversification benefits for the PSE if it would operate within Hypothetical Visegrad Stock Exchange. The other scholars might show diversification benefits or diversification losses of each country under Hypothetical Visegrad Stock Exchange. Moreover, extending the results of the work on overall eastern European countries will show if there are risk benefits that these countries to operate under common stock exchange.

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APPENDIX

Table 42 Accounting items from the audited financial statements of the CEZ Group from 2013 till 2017

In CZK millions	**2013**	**2014**	**2015**	**2016**	**2017**
Interest expenses	-4,307	-3,677	-2,728	-2,481	-3,511
Property, plant and equipment's	426,560	426,542	421,364	426,895	428,019
Depreciation	-27,944	-27,705	-28,619	-28,978	-29,305
Total equity	263,125	265,851	272,155	261,360	254,322
Total liabilities	358,787	362,019	330,531	369,481	371,885
Cash flow from operation	84,199	80,568	78,647	57,179	52,824

Source: Authors own elaborations based on the CEZ as audited financial statements (CEZ, 2018).

Table 43 Accounting items from the audited financial statements of the Kofola ČeskoSlovensko a.s. from 2013 till 2017

In thousands (000) CZK	**2013**	**2014**	**2015**	**2016**	**2017**
Interest expenses	-57180	-85362	-78460	-77900	-73550
Property, plant and equipment's	2700020	2823390	3508993	3442624	3384892
Depreciation	-451887	-471995	-513201	-523003	-565228

Total equity	2520224	2576829	2859421	2739896	1973986
Total liabilities	3346879	3383033	5631593	5280415	4604882
Cash flow from operations	686880	724076	935241	655330	719995

Source: Authors own elaborations based on the Kofola ČeskoSlovensko a.s. audited financial statements (KCS, 2018).

Table 44 Accounting items from the audited financial statements of the Stock Spirit PLC from 2013 till 2017

In thousand (000) CZK	**2013**	**2014**	**2015**	**2016**	**2017**
Interest expenses	-45604	-12324	-12638	-2668	-3169
Property, plant and equipment's	66439	62152	59603	55705	50871
Depreciation	-7557	-9055	-9423	-9739	-9894
Total equity	320072	343504	364862	348879	354309
Total liabilities	452169	385368	314697	318428	328516
Cash flow from operation	126113	-3482	54622	60905	53619

Source: Authors own elaborations based on the Stock Spirit PLC audited financial statements (PLC, 2018).

Table 45 Accounting items from the audited financial statements of the Unipetrol Orlen Group from 2013 till 2017

In million (000000) CZK	**2013**	**2014**	**2015**	**2016**	**2017**
Interest expenses	-233	-104	-38	-7	-180
Property, plant and equipment's	10	9	9	9	22
Depreciation	-1	-1	-51	-2	-2
Total equity	26,357	26,686	28,829	27,875	26,341
Total liabilities	3,342	6,244	2,757	2,755	1,618
Cash flow from operations	-150	-138	-114	-1,874	1,954

Source: Authors own elaborations based on the Unipetrol Orlen Group audited financial statements (Unipetrol, 2018).

Table 46 Accounting items from the audited financial statements of the Erste Group Bank (EGB), from 2013 till 2017

In CZK million	**2013**	**2014**	**2015**	**2016**	**2017**
Interest expenses	-76960	-50065	-53754.4	-40312.0	-32396
Property, plant and equipment's	120807	134459	136364.7	137944	129200
Depreciation	-64532	-71665	-71505.0	-71131	-68397

Total equity	404183	372699	399998.8	447995	466046
Total liabilities	5061289	5069072	4995788.7	5170893	5157083
Cash flow from operation	-11840.1	-46880	78417	71859	63983
Net cash flow from operations	90452	85685	160190	166655	88656

Source: Authors own elaborations based on the Erste Group Bank audited financial statements (EGB, 2018).

Table 47 Accounting items from the audited financial statements of the O2 Company from 2013 till 2017

In million CZK(000000)	**2013**	**2014**	**2015**	**2016**	**2017**
Interest expenses	-23	-64	-124	-68	-99
Property, plant and equipment's	41,857	36,200	4,638	5,075	5,636
Depreciation	-11,032	-8,324	-2,015	-1,042	-1,122
Amortization		2,412	2,550	2,400	2,226
Total equity	55,749	54,153	18,344	17,505	15,475
Total liabilities	18,200	20,137	11,924	15,801	19,367
Cash flow from operations	17,302	12,976	11,643	9,192	8,451

Source: Authors own elaborations based on the O2 Company audited financial statements (O2, 2018).

Table 48 Accounting items from the audited financial statements of the Komercni Banka from 2013 till 2017

In CZK million	**2013**	**2014**	**2015**	**2016**	**2017**
Interest expenses	-11025	-9801	-8168	-5692	-5842
Property, plant and equipment's	18269	13513	16595	16438	17612
Depreciation	-10397	-8366	-9751	-9772	-10208
Total equity	96538	109494	106229	105401	100346
Total liabilities	767442	843767	785327	817336	903693
Cash flow from operation	17746	17643	16692	17724	17685

Source: Authors own elaborations based on the KB bank audited financial statements (KB, 2018).

Table 49 Accounting items from the audited financial statements of the Vienna Insurance Group from 2013 till 2017

In CZK million	**2013**	**2014**	**2015**	**2016**	**2017**
Interest expenses	(12,343)	(12,891)	(12,235)	(13,621)	(17,977)
Property, plant and equipment's	84,761	54,891	56,217	198,115	193,104
Depreciation	(23,659)	(16,826)	(15,086)	28,894	(28,352)
Total equity	137,388	146,302	136,629	154,385	154,020

Total liabilities	1,011,419	1,083,860	1,082,980	1,197,419	1,163,822
Cash flow from operation	32,397	29,139	27,013	24,658	22,464

Source: Authors own elaborations based on the Vienna Insurance Group audited financial statements (VIG, 2018).

Table 50 Accounting items from the audited financial statements of the Phillip Morris CR from 2013 till 2017

In CZK million	**2013**	**2014**	**2015**	**2016**	**2017**
Interest expenses	-19304.0281	-24105.002	-25020.9792	-22777.4349	-19392.2466
Property, plant and equipment's	276902	292353	292085	315969	309045
Depreciation	-142885	-153245	-150076	-160950	-154777
Total equity	-124474	-256699	-284861	-278	-217048
Total liabilities	881715	1062957	1127731	1220701	1128696
Cash flow from operation	268133	268133	263688	276473	244058

Source: Authors own elaborations based on the Phillip Morris CR audited financial statements (PMC, 2018).

Table 51 Accounting items from the audited financial statements of the Moneta Bank from 2013 till 2017

In CZK million	**2013**	**2014**	**2015**	**2016**	**2017**

Interest expenses	(559)	(330)	(295)	(306)	(290)
Property, plant and equipment's	3,210	2,601	2,560	2,705	2,845
Depreciation	(2,470)	(1,982)	(2,049)	(2,056)	(1,974)
Total equity	37,250	42,583	27,839	27,268	25,763
Total liabilities	98,492	100,820	112,198	122,111	173,971
Cash flow from operation	13,574	12,631	12,102	11,058	10,335

Source: Authors own elaborations based on the Moneta Bank audited financial statements (PMC, 2018).

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CURRICULUM VITAE

Personal Information's

First name/Surname Florin Aliu

Email aliu@fame.utb.cz

Place of birth Vranje (Serbia)

Work Experience

Macroeconomic analyst within the Ministry of Finance, Republic of Kosovo. January 2011 till March 2012.

Researcher on the Center for Documentation and Publication, Pristina (Republic of Kosovo). January 2015 till June 2015.

Lecturer, Department of Finance and Accounting, Tomas Bata University in Zlin. October 2015-present. Corporate Finance with master students.

Education

Ph.D., Department of Finance and Accounting Tomas Bata University in Zlin, 2015 –present

Ing., Masaryk University, Faculty of Economics and Administration. September 2010- June 2013.

B.A., University of Prishtina, Faculty of Economics, Department of Finance. September 2006- September 2009.

Research projects

Methodology of Developing a Predictive Model of Sector and Company Performance in the Macroeconomic Context (No. 16-25536S) – funded by Czech Science Foundation (GACR) - member of the team

Enterprise Risk Management and Company's Value: A cross Industry analysis of Companies in Czech Republic (IGA FaME UTB IGA/FaME/2016/018) – funded by Internal Grant Agency – main investigator of the project

Languages

Albanian (Mother language)

Croatian

English

Czech

Florin Aliu

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