

Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics



Bachelor Thesis

Comparative Analysis of Eli Lilly and AbbVie Stocks

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BACHELOR THESIS ASSIGNMENT

Umm e Farwa

Business Administration

Thesis title

Comparative Analysis of Eli Lilly and Abbvie Stocks

Objectives of thesis

This thesis focuses on discovering which pharmaceutical company has the best potential in 2023-2024. The author considers two giants from the pharmaceutical industry – Abbvie and Eli Lilly and conducts a comparative analysis to come up with the decision of which stock is most preferred for investments made into the stock exchange market.

Methodology

Quantitative methods represent the core of the thesis, where techniques of correlation analysis, trend analysis and valuation ratios are being calculated and processed. In addition to all mentioned earlier, the thesis also incorporates a DDM model to identify if those companies' stocks are undervalued or overvalued.

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Eli Lilly, NYSE, Abbvie, valuation, pharmaceuticals, financials, earnings, investment

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- Kaufmann, R., Gadmer, A., & Klett, R. (2001). Introduction to dynamic financial analysis. ASTIN Bulletin: The Journal of the IAA, 31(1), 213-249.
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Declaration

I declare that I have worked on my bachelor thesis titled "Comparative Analysis of Eli Lilly and AbbVie Stocks" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 16.03.2024

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Comparative Analysis of Eli Lilly and Abbvie Stocks

Abstract

This thesis focuses on discovering which pharmaceutical company has the best potential in 2023-2024. The author considers two giants from the pharmaceutical industry – Abbvie and Eli Lilly and conducts a comparative analysis to come up with the decision of which stock is most preferred for investments made into the stock exchange market and pharmaceuticals industry. Quantitative methods represent the core of the thesis, where techniques of correlation analysis, trend analysis and valuation ratios are being calculated and processed. In addition to all mentioned earlier, the thesis also incorporates a DDM model to identify if those companies' stocks are undervalued or overvalued.

It was concluded that both stocks have had a really good performance over the period of the last five years having positive returns and being relatively undervalued. It is suggested that Eli Lilly is somewhat more beneficial than AbbVie, but the portfolio diversification where a particular minoritarian amount will be allocated to AbbVie is likely to be the best strategy yielding the most profitable and less risky results.

Keywords: Eli Lilly, NYSE, Abbvie, valuation, pharmaceuticals, financials, earnings, investment

Komparativní analýza akcií Eli Lilly a Abbvie

Abstrakt

Tato práce se zaměřuje na zjištění, která farmaceutická společnost má nejlepší potenciál v letech 2023-2024. Autor zvažuje dva giganty z farmaceutického průmyslu-Abbvie a Eli Lilly a provádí srovnávací analýzu, aby přišel s rozhodnutím, které akcie jsou nejvýhodnější pro investice do burzovního trhu a farmaceutického průmyslu. Jádrem práce jsou kvantitativní metody, kde se vypočítávají a zpracovávají techniky korelační analýzy, analýzy trendů a oceňovacích poměrů. Kromě všech výše uvedených, práce také zahrnuje model DDM k identifikaci, zda jsou akcie těchto společností podhodnocené nebo nadhodnocené.

Byl učiněn závěr, že obě akcie měly za posledních pět let opravdu dobrý výkon, měly pozitivní výnosy a byly relativně podhodnocené. Předpokládá se, že Eli Lilly je poněkud výhodnější než AbbVie, ale diverzifikace portfolia, kde bude AbbVie přidělena určitá minoritářská částka, bude pravděpodobně nejlepší strategií, která přinese nejziskovější a méně rizikové výsledky.

Klíčová slova: Eli Lilly, NYSE, Abbvie, ocenění, léčiva, Finance, zisk, investice

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1 Introduction

The stock market is an essential venue for investors who want to increase their wealth by generating profits and expanding their holdings. Investors are always looking for profitable investment possibilities in a variety of industries, and the pharmaceutical and healthcare industries frequently garner a large amount of interest from these investors. This bachelor's thesis will attempt to offer a detailed comparison and contrast of two well-known pharmaceutical powerhouses, namely Eli Lilly and AbbVie. Both Eli Lilly and Company, which is more generally known as Eli Lilly, as well as AbbVie Inc. have established themselves as important participants in the pharmaceutical sector on a worldwide scale (Scherer, 2000). Both of these firms have a long tradition of innovation, a track record of doing ground-breaking research, and a dedication to enhancing the quality of medical care available to patients all around the world. Both Eli Lilly and AbbVie are dominant players in their respective industries, making them interesting and relevant companies to compare and contrast (Cockburn, 2004).

The fundamental purpose of this thesis is to examine the performance of Eli Lilly and AbbVie stocks over a given time period, focusing on important financial indicators and measures, and then compare and contrast those two companies' results. The investigation will include a wide range of aspects, such as stock prices, market capitalization, financial ratios, and any other important elements that impact investing decisions. Investors and other stakeholders can acquire significant insights into the financial stability of the firms, the development potential of the companies, and the overall investment attractiveness of the companies by studying these characteristics.

This study is very important for many different stakeholders, such as investors, financial analysts, and industry specialists. The comparative examination of the stocks of pharmaceutical industry titans Eli Lilly and AbbVie will give significant insights into the financial performance, market dynamics, and investment possibilities of each of these companies. The results of this study can provide investors with useful information that can aid them in making educated decisions on the allocation of their portfolios and investing strategies. In addition, the investigation may be of assistance to industry experts and financial

analysts in developing a more in-depth comprehension of the pharmaceutical sector and the elements that drive the performance of important market participants.

This thesis is organised in such a way that it will offer a detailed examination of the stocks held by Eli Lilly and AbbVie. In the next chapters, the author will go into further depth about the past stock performance, financial analysis, market dynamics, and development potential of both firms. The study approach that will be used will comprise the collecting and analysis of several types of data, including market reports, financial data, and relevant literature. The investigation will result in a definitive assessment of the investment attractiveness of Eli Lilly and AbbVie stocks, delivering insights and suggestions for those who are considering making financial investments in these companies.

2 Objectives and Methodology

2.1 Objectives

This thesis focuses on discovering which pharmaceutical company has the best potential in 2023-2024. The author considers two giants from the pharmaceutical industry – AbbVie and Eli Lilly and conducts a comparative analysis to come up with the decision of which stock is most preferred for investments made into the stock exchange market. In the analysis, the author is interested in identifying a potential strategy of investing. Therefore, it is possible to formulate the goals and objectives of the thesis in the following series of research questions:

1. An investment in which stock – AbbVie or Eli Lilly will be more beneficial?
2. Can stocks of both companies be considered risky investments?
3. What can be the potential strategy of investing in either company's stocks?

2.2 Methodology

The research questions are answered with the help of mainly quantitative techniques, which are largely based on the analysis of time series secondary data obtained from Yahoo Finance. To be more specific, the author considers the time period of 5 years – between 2019 and 2023 for making predictions and projections about the future development of the prices of stocks. The analysis is carried with the help of Eviews application, which is traditionally used for similar kinds of studies involving a technical analysis.

When it comes to techniques applied in the analysis, it is essential to mention that the author implements a wide variety of different empirical techniques, where the simplest one is the descriptive analysis involving the following measures from statistics:

Formula 1. Mean.

$$\bar{x} = \frac{\sum x_1, x_2 \dots x_n}{n}$$

Formula 2. Median.

$$\tilde{x} = \begin{cases} \frac{n+1}{2}, & \text{for odd } N \\ \frac{\left(\frac{n}{2}\right) + \left(\frac{n}{2} + 1\right)}{2}, & \text{for even } N \end{cases}$$

Formula 3. Range.

$$\text{Range} = \text{Max} - \text{Min}$$

Formula 4. Standard deviation.

$$\partial = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$$

Formula 5. Coefficient of variation.

$$\text{C.V} = \frac{\partial}{\bar{x}}$$

Alternatively, the author also relies on the correlation analysis, where a linear kind of correlation coefficient is taken into consideration – Pearson correlation coefficient that takes the value between -1 and 1. Whenever values are closer to -1 and 1, it is possible to consider correlation strong. In addition to the correlation coefficient calculation, a subsequent verification and hypothesis testing at the level of 5% of significance is run. Both formulas are presented below.

Formula 6. Coefficient of correlation.

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

Formula 7. T-value.

$$t - \text{value} = \frac{r_{xy}\sqrt{n-2}}{\sqrt{1-r^2}}$$

Finally, the author will implement the ordinary least squares (OLS) technique for the construction of trends predicting the development of stocks' prices. Continuing to the financial domain, the author implements two fundamental ratios of market valuation, which are P/E and P/B ratios, which can be calculated according to the following formulas:

Formula 8. Price-to-earnings ratio.

$$\text{Price – to – earnings} = \frac{\text{Price of Stock}}{\text{EPS}}$$

Formula 9. Price-to-book value ratio.

$$\text{Price – to – Book Value} = \frac{\text{Price of Stock}}{\text{Book Value per Share}}$$

Additionally, the author uses a DDM model to identify if the stock is overvalued or undervalued, which is largely based on the computation of the intrinsic value of the stock. For the calculation of a DDM model, it is essential to find a required rate of return and the growth rate, the formulas for which are presented below.

Formula 10. Intrinsic value.

$$\text{Intrinsic Value} = \frac{D_0 * (1 + g)}{r - g}$$

Formula 11. CAPM.

$$r = R_f + \beta(E(R_m - R_f))$$

Formula 12. Growth rate.

$$g = \frac{P_0 * r - D_0}{P_0 + D_0}$$

The last but not least, the author also considers returns as a useful indicator for the analysis, where the normal returns (chain indices) and geometric ones are calculated. Also, the author calculates the WACC, which is a useful indicator for understanding the situation with a given companies in the business context.

Formula 13. WACC.

$$\text{WACC} = W(D) * C(D) + W(K) * C(K)$$

Formula 14. Chain index.

$$\text{Chain Index (Return)} = \frac{X_t}{X_{t-1}}$$

Formula 15. Geometric return.

$$\text{Geometric Return} = \sqrt[n]{(r_1 + 1) + (r_n + 1)} - 1$$

3 Literature Review

3.1 Pharmaceutical Industry

The pharmaceutical business is a vital component of today's healthcare system, since it is responsible for the creation, manufacturing, and distribution of many essential drugs and treatments. Pharmaceutical businesses place a premium on research and development in order to meet unmet medical needs, boost patient outcomes, and improve people's quality of life all over the globe. This subchapter examines the pharmaceutical sector from every angle, including its salient features, contributions, problems, and future possibilities (Lakdawalla, 2018). Herbal medicine and other natural cures were widely employed by ancient cultures, marking the beginning of what would become the pharmaceutical business. The pharmaceutical business as one knows it now evolved as a result of scientific discoveries, technological innovations, and the prevalence of modern medicine. Major turning points in the development of the pharmaceutical business occurred in the 19th and 20th centuries, when giants like Merck, Pfizer, and Roche were founded (Schwartzman, 1978).

The pharmaceutical sector is dominated by large corporations. They put a lot of resources into R&D to find new medicines and treatments. In order to assure the safety and effectiveness of proposed treatments, it is necessary to undertake thorough preclinical investigations and clinical trials. Research and development is difficult, costly, and fraught with setbacks. Very few medications make it through the whole development process and are eventually approved by regulators. The pharmaceutical sector relies heavily on the protection of intellectual property, especially via patents. Pharmaceutical corporations may recover their costs and turn a profit thanks to patents that provide them exclusive rights for a certain time period (Horrobin, 2000). Because of this, businesses are encouraged to innovate, and they are better equipped to keep their edge in the market. When patents on drugs expire, however, generic drug producers may begin making and selling drugs that are chemically and functionally comparable. This increases competition and drives down costs, as one can assume (DiMasi et al., 1991).

Pharmaceutical production and quality control are cornerstones of the industry. Unfortunately for the industry, pharmaceutical companies consistently face issues with price

and market access. Research and development expenditures, manufacturing costs, regulatory constraints, and market demand all have a role in setting drug prices. Maintaining pharmaceutical company profitability while keeping prices down is a difficult balancing act (Comanor, 1986).

The pharmaceutical market is dynamic, changing in response to consumer demand and new technologies. Genomic and molecular diagnostics have paved the way for personalised medicine, which improves therapeutic results by customising therapies for specific patients. With the advent of biotechnology and gene therapy, hitherto impossible biologics and treatments are now within reach (Abraham, 2002). Telemedicine and other forms of digital health technology have revolutionised healthcare delivery by allowing for remote patient monitoring and consultations and expanding patients' access to medical professionals. By analysing large datasets for patterns, artificial intelligence (AI) and big data analytics have the potential to significantly improve drug development, clinical trial design, and healthcare operations (Malerba & Orsenigo, 2015).

3.2 Stock Markets

Stock exchanges, where buyers and sellers of securities meet, play an essential role in the global economy. They are crucial in the processes of allocating capital, providing liquidity, and establishing prices. The stock market's development across time, essential roles, major players, and influential influences are all covered in this subchapter. Stock markets may be traced back to the ancient marketplaces when traders and merchants met to buy, sell, and barter. These trading venues eventually developed into regulated stock exchanges. The issuance of shares to support the Dutch East India Company's activities in the 17th century was a watershed moment in stock market history. Since then, stock exchanges have evolved into sophisticated, centralised marketplaces with worldwide reach and cutting-edge trading technology (Smith, 2004).

The stock market performs various crucial roles for the economy as a whole. To begin with, they facilitate capital creation by giving businesses a means to issue stocks and therefore raise cash. Companies may use the proceeds from an IPO to finance growth, innovation, and acquisitions by selling shares to the public for the first time. Second, traders in the stock market have access to liquidity. They make it possible for investors to turn their

holdings in securities into cash whenever they want to. Because of this liquidity, money is allocated more effectively, and the market functions better overall. Additionally, stock markets provide the function of price discovery processes. Market pricing for stocks are set by the competition between buyers and sellers. Fair values for securities may be inferred from these prices, which represent investors' opinions on the worth and potential of the underlying firms. Finally, the stock market is useful because it allows for the transfer of risk. Individuals may get exposure to the upside potential and downside risk of a company's performance by purchasing shares in that company. Investors with varying comfort levels with risk may strike a healthy balance between reward and risk by selecting equities that best fit their goals (Teweles & Bradley, 1998).

There are many people who contribute to the smooth operation of the stock market. Individuals, corporations, and other organisations all participate as investors in the stock market because of the potential profits it offers. Different investors' risk tolerances, investing styles, and time horizons all influence market movement. The trading of securities occurs mostly on stock exchanges. Market players are able to carry out transactions because of the infrastructure, trading platforms, and regulatory framework they supply. The New York Stock Exchange (NYSE), the National Association of Securities Dealers Automated Quotations (NASDAQ), the London Stock Exchange (LSE), and the Tokyo Stock Exchange (TSE) are all examples of prestigious stock exchanges. In the stock market, brokers and dealers both mediate transactions between buyers and sellers. Investors rely on them for trade execution, transaction facilitation, and expert advice. When it comes to buying and selling stocks, dealers may have their own inventory, whereas brokers often act on the investors' behalf. It is the responsibility of regulatory agencies to keep stock markets transparent, fair, and safe for investors. They set standards, monitor the market, and make sure everyone is playing by the book. The Securities and Exchange Commission (SEC) of the United States and the Financial Conduct Authority (FCA) of the United Kingdom are two examples of regulatory agencies (Cattaneo et al., 2015).

3.3 Factors influencing Stocks

In fact, as in the case with any other economic variables, there is a very huge list of factors that might in one way, or another influence the current valuation of stocks. It is essential to briefly mention the most important and frequent ones (Zapata et al., 2012).

According to scholars interested in the question, this is the list of the most important factors that influence the valuation of stocks:

1. Financial situation of a particular company. Of course, as in the case with any other market, the current valuation should be underpinned by a specific asset. When it comes to the valuation of commodities and other economic objects, the objects themselves support the valuation that they have. The history knows quite many situations, when a particular asset was not fully underpinned by a particular asset, or the price was not reflecting the real value (Demirgüç-Kunt & Levine, 1996).. There were two particular situations in the recent history – the dot com bubble and the Great Recession that was partially caused by worthless mortgages having triple A valuation being traded between banks and traders. When it comes to stocks, one of the best ways to send a powerful signal to potential investors and other traders that the stock is good would be improving the company's financials, which serve as a basis for ensuring that the stock is worth the value (Esqueda et al., 2012).
2. Current economic environment. The current economic environment is one of the main factors that influence stocks valuations. Stocks themselves are linked to companies who in the economic language represent one of the key actors of economic relations – firms. Alongside with the three other actors (households, foreigners and the government), firms are inevitably influenced by specific tendencies and phenomena happening, such as inflation, unemployment and interest rate (Naik & Reddy, 2021). The effect of the last indicator is traditionally regarded as one of the most influential, whereas during periods when the domestic Central Bank raises the interest rate, it is likely to result in the loss of capitalization for the whole market since firms will not be so active when it comes to long-term projects (Taylor & Poon, 1991).
3. Market psychology and culture. Stocks, in a sense, can be regarded as products that are bought by a particular group of consumers, so it is quite likely to suggest that different consumers (investors, in that case) might have different perception of particular industries and generally of individual corporations (Wamae, 2013). On the other hand, one of the most recent situations when the market psychology had

an effect on the valuation of companies from a particular industry was the pandemic of coronavirus that gave a powerful impetus to the pharmaceutical industry thus raising expectations of investors that this sector is likely to generate high yields in the nearest future (Phan & Zhou, 2014).

4. Geopolitical factors. Geopolitical factors and especially political instability play a huge role in attractiveness of stocks. Domestic instability almost certainly results in economic instability, which is in turn harmful for the valuation of stocks (Butt et al., 2010). Henceforth, it is vital to mention that investors tend to avoid investing in stock markets which are situated in highly politically instable regions where the risk of war or other economic disaster is quite high. One of the most recent examples for that is the response that Moscow Exchange Market gave when the war in Ukraine started and the first sanctions were applied to the Russian Federation (Federle et al., 2022).

4 Practical Part

4.1 Descriptive Analysis

The first part of the analysis is concerned with the implementation of measures of explanatory or descriptive statistics, which were briefly mentioned in the methodology of the work. In the same manner as for the rest of techniques implemented in the analysis (with the exception of the financial ones), the author relies on Eviews for the computation of the earlier mentioned indicators related to central tendency and variability. Those measures will be calculated two times for two different datasets, where the first dataset represents weekly prices (260 observations from the 17th of April 2019), and the second dataset represents weekly returns (259 observations from the 18th of April 2019). The first table containing descriptive statistics is introduced in Table 1.

Table 1. The table of descriptive statistics of price.

	LLY	ABBV
Mean	206.2332	100.4896
Median	178.0565	95.17601
Maximum	468.9800	165.1768
Minimum	88.53712	53.65136
Std. Dev.	99.84711	32.49009
Skewness	0.721296	0.395415
Kurtosis	2.426518	1.724167
Jarque-Bera	26.10786	24.40926
Probability	0.000002	0.000005
Sum	53620.64	26127.29
Sum Sq. Dev.	2582086.	273402.0
Observations	260	260

Source: own elaboration in Eviews based on Yahoo Finance

Based on the mean values, it is possible to say that the average value of Eli Lilly significantly exceeds the average price of AbbVie, which is on one hand a good result, but on the other hand it suggests that investors would have to pay more for getting one stock of Eli Lilly. Medians for both stocks are just slightly smaller than the averages, which is a pretty

common situation. What is, indeed, interesting are maximal values for both stocks, where the absolute maximum of Eli Lilly was 468.98 USD, while the absolute maximum of AbbVie was 165.17 USD. Seemingly, the variability of Eli Lilly's price was apparently much higher than for the case with AbbVie.

Continuing with the measures from the same domain, the minimum value of Eli Lilly was 88.53 USD, which is largely different from the maximum of 468.98 USD identified earlier. On the other hand, there is also a high visual disparity between the AbbVie's maximum value of 165.17 USD and the absolute lowest one, which is 53.65 USD. Yet, after calculating ranges for both, Eli Lilly has an astonishingly variable range of 380.45 USD, while the figure of AbbVie is relatively moderate and equal to just 111.52 USD.

According to Jarque-Bera statistic, it is possible to suggest that both variables are not distributed normally, which is pretty common for stocks that are very dynamic and non-stationary at all. Finally, by using the standard deviation measure and by performing the transformation of the indicator into the coefficient of variation, it is calculated that the volatility of Eli Lilly is equal to 48.41%, which is extremely high, whilst the volatility of AbbVie is equal to just 32.3%, which is still a lot, but significantly lower than the volatility identified for the case with Eli Lilly. All in all, a more comprehensive overview of whether the volatility was caused by an upward pointed curve or downward will be generated after performing the time series analysis. However, before continuing with the time series analysis, it is vital to perform the descriptive analysis on return variables for both stocks. The overview of descriptive statistics is presented in Table 2.

Table 2. Summary statistics.

	LLY	ABBV
Mean	0.007416	0.003168
Median	0.007463	0.003616
Maximum	0.146385	0.139101
Minimum	-0.121762	-0.193862
Std. Dev.	0.040442	0.036526
Skewness	0.157886	-0.348407
Kurtosis	4.169431	6.879982
Jarque-Bera	15.89554	168.3479
Probability	0.000353	0.000000
Sum	1.928167	0.823560
Sum Sq. Dev.	0.423604	0.345541
Observations	260	260

Source: own elaboration in Eviews based on Yahoo Finance

When looking at the table with descriptive statistics for the return's variable, the first 4 rows are the most important ones. Based on the averages, it is possible to conclude that the return of Eli Lilly was slightly higher than of AbbVie – 0.7% compared to 0.3% for AbbVie. The absolute highest return of Eli Lilly was 14.6%, while the highest return of AbbVie was 13.91%, which is just slightly lower than the return of Eli Lilly. Nevertheless, what is quite interesting is that despite having a higher maximum return than AbbVie, Eli Lilly does also have a lower maximum loss, which was just -12.17% compared to -19.38% identified for AbbVie.

Therefore, it is possible to conclude that Eli Lilly was on average more profitable than AbbVie and above all, the maximum possible return for the first stock was higher, while the maximum possible loss was lower than of AbbVie, which is definitely a good sign for potential investors considering Eli Lilly over AbbVie. In addition to the normal return computed based on chain indices and averages, the author takes into consideration another more sophisticated technique involving the calculation of geometric returns, which can be found in Table 3.

Table 3. The table of returns.

	<i>LLY</i>	<i>ABBV</i>
Average Return	0.74%	0.32%
Geometric Return	0.66%	0.25%

Source: own elaboration based on Yahoo Finance

According to the calculated geometric returns, it is possible to conclude that the stocks of Eli Lilly are much more beneficial and profitable than the ones of AbbVie given the fact that the value of geometric returns over the period of 5 analyzed years is higher for Eli Lilly. On the other hand, the fact that both returns are positive provides a positive signal that both investment options are profitable and rather beneficial for potential investors interested in the pharmaceutical industry.

As the final part of the descriptive analysis, the author also calculates the correlation coefficient between the selected pair of stocks, which is expected to be statistically significant and high. The result of the correlation analysis, including the Pearson correlation coefficient itself, a subsequent t-value and probability of significance can all be found in Figure 1.

Figure 1. The correlation analysis.

Covariance Analysis: Ordinary
 Date: 07/17/23 Time: 21:49
 Sample: 7/16/2018 7/03/2023
 Included observations: 260
 Balanced sample (listwise missing value deletion)

Correlation	LLY	ABBV
t-Statistic		
Probability		
LLY	1.000000	

ABBV	0.929134	1.000000
	40.36352	----
	0.0000	----

Source: own elaboration in Eviews based on Yahoo Finance

Based on the result of the correlation analysis, it is possible to say that the correlation between Eli Lilly and AbbVie is positive and it is relatively strong – 0.92, which suggests that whenever the price of Eli Lilly increases, it is quite likely that the price of AbbVie will also be increasing and vice versa, since the correlation coefficient does not provide any information on the causal relationship in the pair. Nevertheless, it is possible to proceed to the hypothesis testing, where the significance of this coefficient will be identified:

- Null: Coefficient is not significant
- Alternative: Coefficient is significant
- $P = 0.00$; $0.00 < 0.05$; the null is rejected, and the alternative hypothesis is assumed.

Based on the result of the hypothesis testing, there is enough evidence to claim that the correlation between the stocks is statistically significant and strong, which was anticipated since both stocks are stocks of American companies listed on the same stock exchange market (NYSE) and both represent the same industry – pharmaceuticals. Now, it is possible

to proceed to the second subchapter of the bachelor thesis, where the time series analysis is implemented.

4.2 Time Series Analysis

The time series analysis starts with the description of Eli Lilly, where first the price variable will be analyzed with the subsequent estimation of a linear trend and an analysis of the return's variable. The time series plot is shown in Figure 2.

Figure 2. The time series plot of Eli Lilly's price.



Source: own elaboration in Eviews based on Yahoo Finance

According to the picture, it is pretty apparent that there is a particular trend that is present in the price variable of Eli Lilly. To be more specific, it is important to mention that over time, the price of the asset managed to improve over the course of those 5 years – starting from approximately 100 USD and reaching the figures around 500 USD, which accounts for an almost 5-fold increase in the value of the stock in 5 years' time. Clearly, based on the recent development of the stock, it is fair to assume that the stock is going through the bull stage, but the nearest future is one of the most important stages since the stock will either drop back to approximately 300 USD or continue with its bull tendency

even further. Now, it is important to estimate a trend that will help to potentially make a prediction about the future development of the asset and will also shed a brighter light on the weekly average increment in the price of the asset. The trend estimated with the help of Eviews is presented in Table 4.

Table 4. The trend's parameters of Eli Lilly.

Dependent Variable: LLY
 Method: Least Squares
 Date: 07/17/23 Time: 21:44
 Sample (adjusted): 7/16/2018 7/03/2023
 Included observations: 260 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	43.15241	3.921307	11.00460	0.0000
@TREND	1.259311	0.026198	48.06846	0.0000
R-squared	0.899555	Mean dependent var		206.2332
Adjusted R-squared	0.899166	S.D. dependent var		99.84711
S.E. of regression	31.70583	Akaike info criterion		9.758541
Sum squared resid	259357.0	Schwarz criterion		9.785931
Log likelihood	-1266.610	Hannan-Quinn criter.		9.769552
F-statistic	2310.576	Durbin-Watson stat		0.073911
Prob(F-statistic)	0.000000			

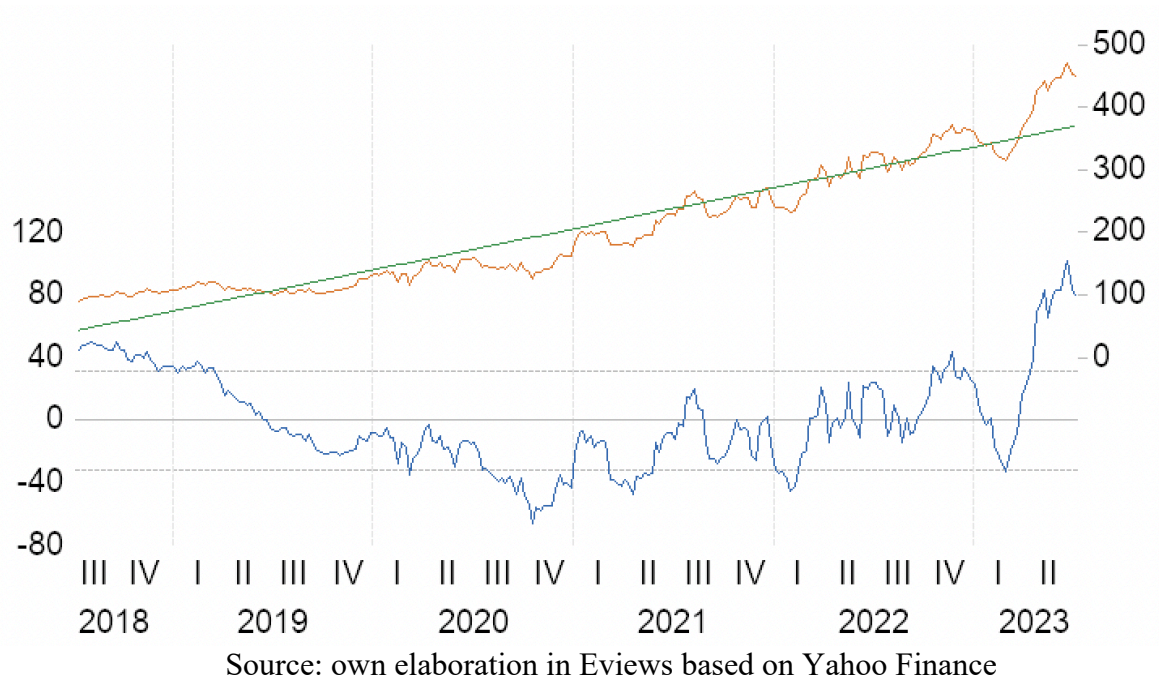
Source: own elaboration in Eviews based on Yahoo Finance

Based on the parameters estimated with the help of the OLS, it is possible to formulate the following model:

$$P(\text{Eli Lilly}) = 43.15 + 1.25t + \varepsilon$$

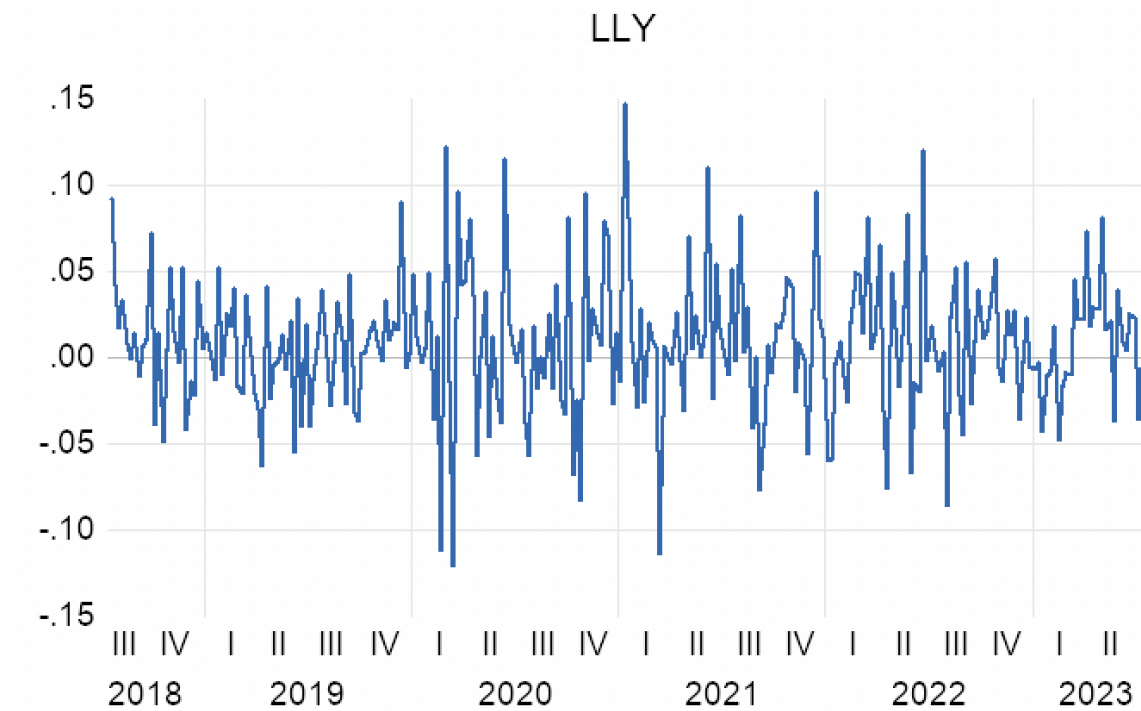
Henceforth, the projected weekly increment in the price of the asset was 1.25 USD, which is definitely a very good result and if no unexpected circumstances or obstacles will emerge, it is likely that the stock will continue its development even further. Additionally, the author will present the visual comparison of the fitted value with the observed one, as well as the residual plot, which all are presented in Figure 3.

Figure 3. The residual plot of Eli Lilly's trend.



In fact, it is pretty visible that the trend is somewhat near the actual value, which is also visible when looking at the R square equal to 0.89, which is a good result. Yet, if the price of the asset will keep on increasing, it will not be possible to model the development of the asset with the help of just one trend, because a structural change would occur and 2 trends will be needed, or a more comprehensive technique. Yet, the model was the most accurate between 2020 and the first quarter of 2022, when the value of residuals was at the lowest. All in all, the author also presents the development of the asset's returns over time with the help of the time series plot presented in Figure 4.

Figure 4. The time series of Eli Lilly's returns.



Source: own elaboration in Eviews based on Yahoo Finance

Based on the time series plot of Eli Lilly's returns, it is possible to conclude that the highest degree of volatility with the highest losses and returns was identified in the period between the first quarter of 2020 and the second quarter of 2021. Over time, the returns got steeper and steeper, which is especially noticeable in the recent development of the price of the stock, which is justified by its slow increment in the price that brought the asset to the level of approximately 500 USD. Now, the author will implement the same series of techniques but for the case of AbbVie, where the time series plot for the variable of price is presented in Figure 5.

Figure 5. The time series plot of AbbVie's price.



Source: own elaboration in Eviews based on Yahoo Finance

The development of AbbVie is definitely more unpredictable than the development of Eli Lilly. In fact, there is an apparent presence of the trend, but its accuracy is likely to be lower due to more frequent surges and drops in the price of the second asset. In addition to that, despite the fact that the company managed to achieve a substantial increase in the price of its stocks, where the stock in 2022-2023 costs almost 2 times more than in the beginning of 2018, the future development of the stock is less optimistic as the development in the second quarter is rather bearish than bullish, which is definitely not good for potential investors. The next step, just as it was done with the case of Eli Lilly, will be the estimation of a linear trend in Eviews, whose parameters are presented in Table 5.

Table 5. The trend's parameters of AbbVie.

Dependent Variable: ABBV
 Method: Least Squares
 Date: 07/17/23 Time: 21:46
 Sample (adjusted): 7/16/2018 7/03/2023
 Included observations: 260 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	48.50936	1.489585	32.56569	0.0000
@TREND	0.401392	0.009952	40.33303	0.0000
R-squared	0.863112	Mean dependent var		100.4896
Adjusted R-squared	0.862582	S.D. dependent var		32.49009
S.E. of regression	12.04408	Akaike info criterion		7.822686
Sum squared resid	37425.43	Schwarz criterion		7.850076
Log likelihood	-1014.949	Hannan-Quinn criter.		7.833697
F-statistic	1626.754	Durbin-Watson stat		0.088342
Prob(F-statistic)	0.000000			

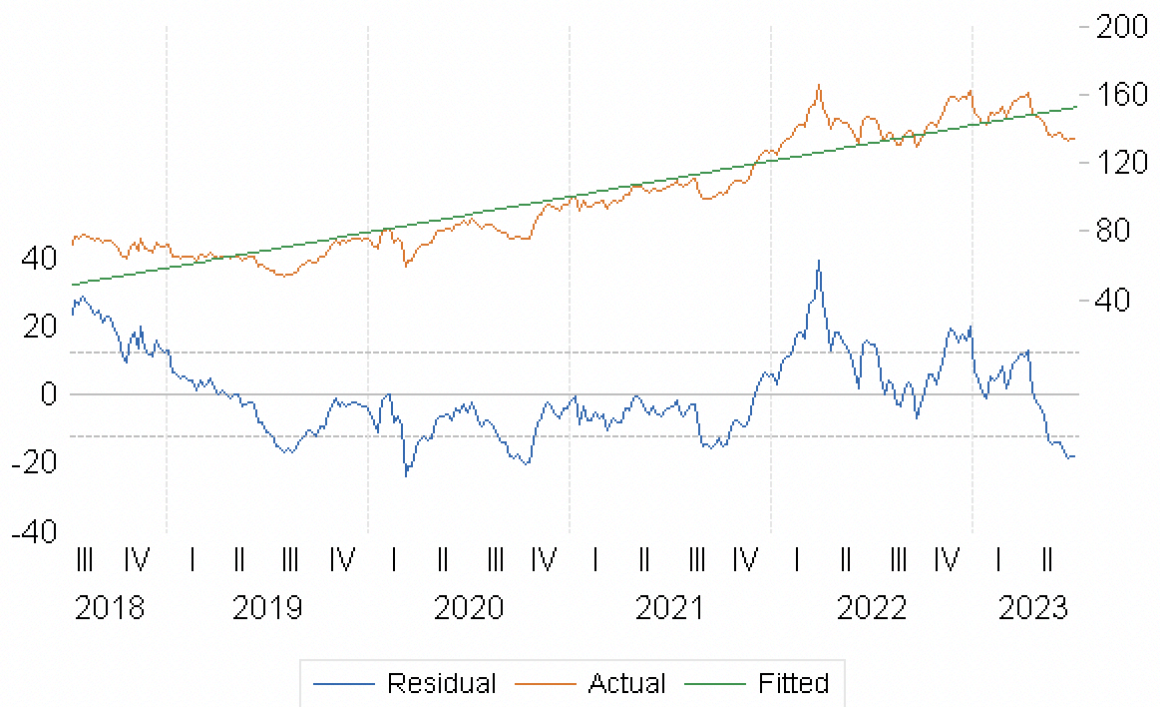
Source: own elaboration in Eviews based on Yahoo Finance

Based on the estimated parameters of the trend for AbbVie, the following trend function can be created:

$$P(\text{AbbVie}) = 48.5 + 0.40t + \varepsilon$$

According to the estimated trend that has the quality of 0.86 or 86%, which is still pretty good but lower than for the case with Eli Lilly, the weekly increment in the price of the asset is equal to 0.4 USD, which is significantly lower than the increment identified for Eli Lilly, but it is still a decent result, especially when considering that the price of the asset has been gradually increasing over time. In addition to that, the author presents the scatterplot containing the comparison between the fitted and observed values and also the residual plot. All that is presented in Figure 6.

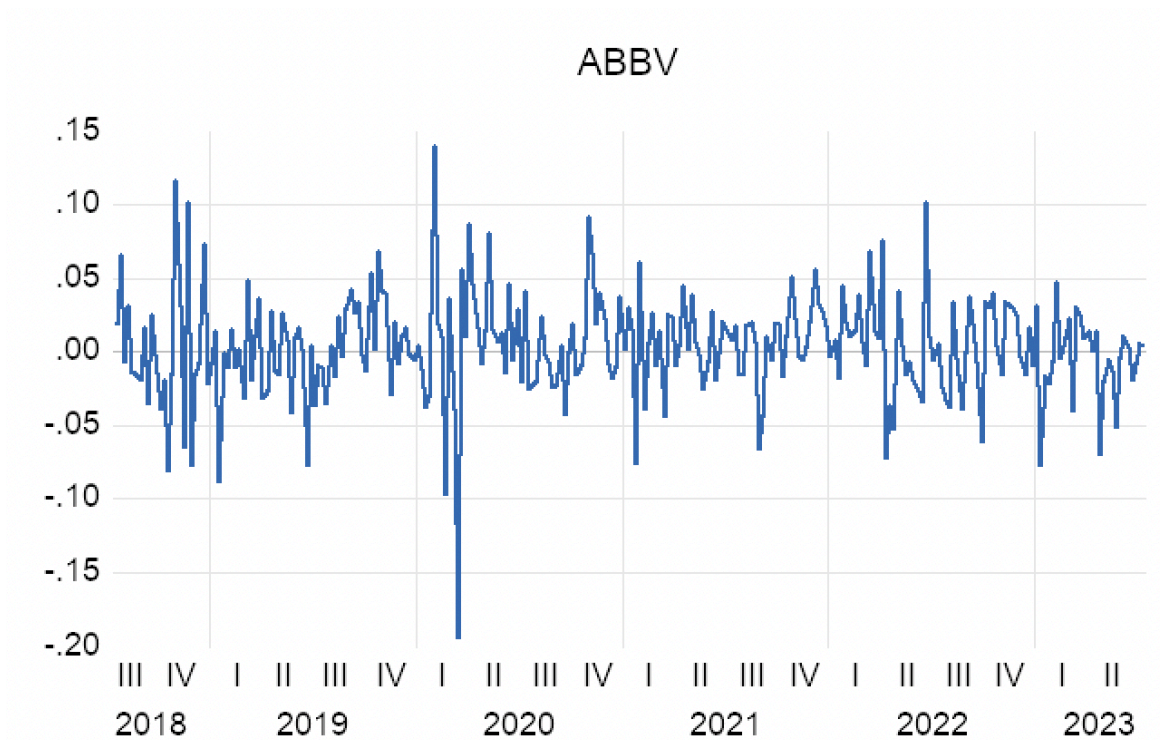
Figure 6. The residual plot of AbbVie's trend.



Source: own elaboration in Eviews based on Yahoo Finance

In fact, it is pretty visible that the highest precision of the trend was identified for the period between the third quarter of 2019 and the third quarter of 2021. However, the price of the asset surged quickly thus creating a fair amount of inaccuracy in the fitted value. On the other hand, the situation with AbbVie's stock is fully contradictory to the one spotted for Eli Lilly. In Eli Lilly's case, a potential surge in price was leading to a constantly increasing residuals, while in AbbVie's case, a potential drop in the price of the asset that might continue even further can also provide a series of negative implications for the estimated trend that will result in a need of creating 2 trends and splitting the studied time series data into two – before the structural change and after. However, the author believes that the price of the asset will stabilize. For the very final time series plot, the author indicates the returns of AbbVie's stock in Figure 7.

Figure 7. The time series plot of AbbVie's returns.



Source: own elaboration in Eviews based on Yahoo Finance

In fact, a quite similar situation is observed for the case of AbbVie, where the weekly returns are stationary as well. On the other hand, it is essential to note that the highest returns for the asset were identified in the period between the first quarter of 2020 and the first quarter of 2021, which could be linked to the pandemic of coronavirus that provided a series of benefits to pharmaceutical companies. All in all, the author continues with the next subchapter that is fully dedicated to the analysis of valuation ratios over time for two stocks.

4.3 Valuation Ratios

The first ratio that will be studied in the subchapter is the price-to-earnings ratio. The analysis of the ratio is based on Table 6, where the P/E ratio for both companies from 2019 to July 2023 is presented.

Table 6. P/E ratios.

	<i>P/E</i>	
	<i>Eli Lilly</i>	<i>AbbVie</i>
<i>2019</i>	15.3	14.18
<i>2020</i>	26.1	33.4
<i>2021</i>	46.7	19.61
<i>2022</i>	52.71	23.73
<i>2023</i>	71.46	32.15

Source: own elaboration based on Yahoo Finance

Based on the calculated P/E ratios, it is possible to say that at the beginning of 2019, both companies were one more or less the same level even despite the major disparity in the price of assets back at the time, which was identified in the descriptive analysis. In fact, the figures of 15 and 14 in the value of the ratio are quite good since investors had to pay just 15 and 14 dollars for Eli Lilly and AbbVie's stocks, respectively in order to get 1 USD in earnings. However, as the time progressed and both companies' popularity and importance rose due to the pandemic of the coronavirus, they became valued more and investors had to pay 26.1 for Eli Lilly's stocks in order to get 1 USD in earnings, and 33.4 for AbbVie's stocks. In fact, what is quite interesting to note is that despite the higher price of Eli Lilly, it was more affordable to investors due to the P/E ratio than AbbVie.

In 2021, the situation changed significantly, when the P/E ratio of Eli Lilly skyrocketed, and the value of the rate dropped for AbbVie thus making it more affordable to investors. In 2022, the tendency continued with the increase in the price of Eli Lilly without any substantial increase in the earnings, which caused the ratio to go up and make the stock even more overvalued. The situation for both stocks worsened in 2023, when they reached very high values, where the value of Eli Lilly's P/E ratio is quite high resulting in investors paying 71.46 USD for just 1 USD in earnings, which is definitely a sign of the stock being significantly overvalued. The situation of AbbVie is no better since the stock is quite likely to be overvalued, but the figure is still adequate, where investors would have to pay just 32.15 USD to get 1 USD in earnings. The next ratio is the P/B ratio. The overview of P/B ratios for 5 years for both companies can be found in Table 7.

Table 7. P/B ratios.

	<i>P/B</i>	
	<i>Eli Lilly</i>	<i>AbbVie</i>
2019	44.16	-13.55
2020	26.79	12.87
2021	28.22	14.49
2022	32.07	16.05
2023	37.77	18.03

Source: own elaboration based on Yahoo Finance

The situation with P/B ratios in 2019 could be categorized as very negative for AbbVie, which had a negative value for the ratio, which is a direct consequence of the fact that the company's book value was negative, meaning that the value of total liabilities was exceeding the value of the total assets. On the contrary to that, the situation Eli Lilly was slightly better, but the company was definitely trading at a very high value compared to its book value as it was exceeding it by 44.16 times. The situation for AbbVie improved in 2020, when the company recovered its positive book value and attained the figure of 12.87, while Eli Lilly managed to decrease it a bit.

All in all, the development of the indicator in upcoming years was quite straightforward – the P/B ratio for Eli Lilly was constantly increasing and it is likely that it will reach the figure of 40, while the value of AbbVie's P/B ratio was also increasing but at a relatively lower rate. It is quite likely that it will attain the level of 20 in the next year. All in all, it is possible to conclude that both stocks are overvalued and being traded at prices significantly exceeding their book values, which is definitely not so good for potential investors considering either of these investment options or both of them at the same time.

4.4 WACC Calculation

WACC is an important indicator that is useful for understand a given company's situation in the context. The calculation of WACC for Eli Lilly is presented in Table 8.

Table 8. WACC calculation for Eli Lilly.

<i>in millions USD</i>			
Cost of Debt			
Interest	332 USD		
ST Debt	1,501 USD		
LT Debt	14,738 USD		
Cost of Debt	2.04%		
Income Tax	562 USD		
EBT	6,806 USD		
Effective Tax	8.26%		
Cost of debt*(1-T)	1.88%		
Cost of Equity			
Risk Free Rate	3.83%		
Beta	0.36		
Market Return	13.00%		
Cost of Equity	7.13%		
Weight of Debt and Equity			
Total Debt	16,239 USD	3.69%	%
Capitalization	424,000 USD	96.31%	
Total	440,239 USD		
WACC	6.94%		

Source: own elaboration based on Yahoo Finance

According to the calculation, it was identified that the WACC for Eli Lilly is equal to 6.94%, meaning that this should be the discount factor used by the company for assessing all of their capital budgeting projects. It is essential to perform the same calculations but for AbbVie, which can be found in Table 9.

Table 9. WACC calculation for AbbVie.

<i>in millions USD</i>			
Cost of Debt			
Interest	2,346 USD		
ST Debt	4,302 USD		
LT Debt	59,889 USD		
Cost of Debt	3.65%		
Income Tax	1,632 USD		
EBT	13,477 USD		
Effective Tax	12.11%		
Cost of debt*(1-T)	3.21%		
Cost of Equity			
Risk Free Rate	3.83%		
Beta	0.39		
Market Return	13.00%		
Cost of Equity	7.41%		
Weight of Debt and Equity			
Total Debt	64,191 USD	21.25%	%
Capitalization	237,880 USD	78.75%	
Total	302,071 USD		
WACC	6.52%		

Source: own elaboration based on Yahoo Finance

Consequently, it was possible to identify the WACC value for AbbVie, which is equal to 6.52%, and this should be the figure used as a discount factor for the company's capital budgeting projects.

4.5 DDM Model

In this chapter, the author proceeds to the calculation of a DDM model, where it is first important to calculate the required rates of return for both investment options, the process of which is presented in Table 10.

Table 10. The required rate of return calculation.

	<i>Eli Lilly</i>	<i>AbbVie</i>
Risk Free Rate	3.83%	3.83%
Beta	0.36	0.39
Market Return	13.00%	13.00%
Required Rate of Return	7.13%	7.41%

Source: own elaboration based on Yahoo Finance

Based on beta and market return taken from Yahoo Finance and the reference risk free rate (10y U.S. treasury bonds), the required rates of return were calculated. The required rate of return for Eli Lilly is 7.13%, while it is slightly larger for AbbVie. Now, after calculating the required rates of return, it is essential to proceed to the calculation of the growth rate according to the formula mentioned in the methodology of the study. The calculation of growth rate is presented in Table 11.

Table 11. The calculation of the growth rate of dividends.

	<i>Eli Lilly</i>	<i>AbbVie</i>
Price	447.14	134.83
Last Year's Dividend	3.92	5.64
Required Rate of Return	7.13%	7.41%
Growth Rate	6.20%	3.09%

Source: own elaboration based on Yahoo Finance

Based on the calculated growth rate of dividends for Eli Lilly and AbbVie, it is identified that the growth rate of Eli Lilly's dividends is almost 2 times higher than the one of AbbVie. The growth rate of Eli Lilly is 6.2%, while the growth rate of AbbVie's dividends is just 3.09%. In fact, this might be a good justification for the reason of why Eli Lilly's stocks are so highly valued. All in all, it is finally possible to proceed to the final calculation, where the intrinsic values will be found and compared to the current value at which those stocks are being traded on the stock market. For the final piece of calculation, the DDM model will be created with the implementation of 2023's annual dividends for Eli Lilly and AbbVie. The result of the calculation can be found in Table 12.

Table 12. The DDM model for the selected stocks.

	<i>Eli Lilly</i>	<i>AbbVie</i>
Price	447.14	134.83
Required Rate of Return	7.13%	7.41%
Growth Rate	6.20%	3.09%
2023 Dividend	4.52	5.92
<i>Intrinsic Value</i>	515.58	141.52
Difference	68.44	6.69
Difference (%)	15.31%	4.96%

Source: own elaboration based on Yahoo Finance

Based on the computed intrinsic values with the help of the framework, it is identified that the intrinsic value of Eli Lilly is equal to 515.58 USD, while the intrinsic value of AbbVie is equal to 141.52 USD. After comparing the actual price at which both securities are being traded with the identified intrinsic values, it becomes pretty apparent that the intrinsic value is higher thus suggesting that both stocks are undervalued, and they are expected to go up in price quite soon. The difference between the intrinsic value and the actual price of Eli Lilly accounted for 15.31%, while the difference between the AbbVie's current stock price and the intrinsic value is 4.96%. Further reflections on these results, as well as on what has been identified earlier will be provided in the next major part of the thesis.

5 Results and Discussion

In this section of the diploma thesis, the author will come back to the two original hypotheses stated in the chapter dedicated to the goals and objectives of the thesis with the help of what has been identified. For sure, it is essential to start by saying that the pandemic definitely had a positive effect on the whole pharmaceutical industry by giving those companies a huge impetus driving their prices higher than the pre-pandemic levels. On the other hand, this unexpected popularity and emergence in the spotlight of the whole world has had a negative effect of both company's valuation – they started to become more and more overvalued due to the fact that the improvement in the financial situation was not catching up with the growing popularity of stocks, thus resulting in the fact that both P/E and P/B ratios rose drastically. Clearly, this is a bad sign for investors suggesting a relatively large overvaluation, but the author believes that this overvaluation is a consequence of the fact that the popularity of companies and a huge number of projects run during the pandemic almost certainly had a lagged effect on the company's book value and the earnings per share. Therefore, even despite a relatively negative tendency with the market valuation ratios, the author believes that those companies are not entirely overvalued, which was additionally identified with the help of the DDM model. In fact, the reason for a rapidly increasing market valuation partially lies in the fact that both companies have a very decent growth rate of dividends, which inevitably has its implications on the price of the assets. Therefore, it is definitely suggested to invest in the mentioned stocks from that point of view, which is also mentioned by Esparcia & Lopez (2022), who believes that the pharmaceutical industry is likely to have entered into a stage of an exponential growth rather than a linear one due to the impetus given by the pandemic of coronavirus.

In fact, another point in favor of investing into the selected stocks is the fact that despite having a relatively high volatility, this volatility is almost fully explained by an upward-moving trend, which resulted in the fact that both stocks managed to reach an increase in their prices by more than twice. Clearly, it comes as no surprise that both stocks are highly correlated with each other, which is obviously a consequence of the fact that both companies are based on the USA and that both of them represent the pharmaceutical industry which is currently in its highly efficient and beneficial stage of development. Therefore, the answer

to the second research question of whether those stocks can be considered risky investments is definitely not since the whole industry is rapidly developing and both companies have a very good stance. Additionally, their prices are likely to go up even further due to the fact that according to their intrinsic values, they are slightly undervalued.

However, when it comes to the first and the third research questions, the situation is not so simple since both stocks have a relatively good recent performance. Based on that, the author believes that the best strategy would not be selecting just one company, but investing into both would be a more beneficial and logical idea. Therefore, the author believes that the strategy of portfolio diversification, where the whole portfolio will be split between the two companies would be a sensible idea. There were many critical assessments of different investment strategies, and the strategy of diversification was also proposed by Leković (2018), Theron & Van Vuuren (2018) and Yu & Kim (2021), which is somewhat similar to what is being recommended by the author of this bachelor thesis. Yet, it is also essential to specify that the allocation of portfolio will not be fifty to fifty or half to half, as the author believes that the winning stock is pretty apparent out of the two.

In fact, the development of AbbVie could be considered beneficial and somewhat successful, but it is important to understand that the performance of Eli Lilly stock even despite its relative overvaluation was somewhat more impressive. In addition to that, the company was noticed to be engaged in active internationalization and globalization of its processes with branches opening all over the world, which is likely to yield even better results in terms of the financial performance and subsequently of the market performance of the company's stocks. The recent development of Eli Lilly's stocks suggests that the company's positive trend is not likely to be replaced by a bearish tendency due to the fact that the stock still remains to be undervalued, according to the DDM model. Apart from that, the overall development of the stock is more stable and logical, which is especially visible in the trend estimated for the security. Therefore, the answer to the question about the most beneficial stock out of the two is that Eli Lilly is somewhat superior to AbbVie. Henceforth, it is vital to reflect this superiority in the allocation of stocks in the potential portfolio. Due to the fact that the superiority is not so evident, and AbbVie's performance is also somewhat good and promising, it would be wise to dedicate a share of sixty per cent to Eli Lilly in an investment portfolio and the rest (forty per cent) to AbbVie. The author believes that this

strategy is likely to yield positive results in terms of returns, which were positive for both companies (both normal and geometric ones)

6 Conclusion

In the bachelor thesis, there were three main research questions:

1. *An* investment in which stock – AbbVie or Eli Lilly will be more beneficial?
2. Can stocks of both companies be considered risky investments?
3. What can be the potential strategy of investing in either company's stocks?

Based on the empirical analysis performed in the bachelor thesis, the author can answer all three questions and also provide additional comments on the performance of the two stocks from the pharmaceuticals industry. To begin with, it is essential to say that both stocks were rather volatile, but the volatility was explained by the fact that stocks were rapidly increasing in their prices, which resulted in positive normal and geometric returns. According to the trend analysis, it was additionally underpinned that both stocks were rapidly increasing, which is likely to continue in the nearest future, but it is more apparent for the case with Eli Lilly. Similar tendencies are identified in the DDM model creation and analysis of market valuation ratios. However, the author believes that Eli Lilly seems to be a more beneficial investment due to its stronger performance and a more predictable pattern of development, as well as due to its higher undervaluation identified during the DDM analysis. Therefore, an investment in Eli Lilly is likely to prove itself to be more beneficial than the investment in AbbVie.

For the second question, the stocks cannot be considered risky investments because the recent pandemic has given the whole pharmaceuticals industry a very powerful impetus resulting in the increase in the number of running projects that might not all have yielded their results since the effect of those projects on companies from the industry financial is a lagged one. Therefore, the author does not consider AbbVie and Eli Lilly's stocks risky and she does not also consider any other companies' stocks from the same industry to be risky.

When it comes to the potential strategy of investing in either company's stocks, the author believes that the best strategy would be portfolio diversification, where sixty per cent will be allocated to Eli Lilly and the rest (forty per cent) will be allocated to AbbVie. By

diversifying the portfolio, it can help potential investors to avoid higher losses resulting from unexpected and unique circumstances happening with just one company.

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8.4 List of abbreviations

- **WACC** Weighted Average Cost of Capital
- **DDM** Dividend Discount Model
- **OLS** Ordinary Least Squares
- **NYSE** New York Stock Exchange
- **USA** United States of America
- **USD** United States Dollar
- **P/B** Price-to-book value
- **P/E** Price-to-earnings
- **EPS** Earnings per Share
- **C.V.** Coefficient of Variation
- **AI** Artificial Intelligence
- **IPO** Initial Public Offering
- **NASDAQ** National Association of Securities Dealers Automated
Quotations
- **R&D** Research and Development
- **LSE** London Stock Exchange
- **TSE** Tokyo Stock Exchange
- **FCA** Financial Conduct Authority

- **SEC** Securities and Exchange Commission