

Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Languages



Bachelor Thesis

**Analysis of Investing into Facebook and Google
Stocks**

Timur Esenbekov

© 2024 CZU Prague

BACHELOR THESIS ASSIGNMENT

Timur Esenbekov

Business Administration

Thesis title

Analysis of Investing into Facebook and Google Stocks

Objectives of thesis

The main aim of the bachelor thesis is to analyze which investment option is better – Facebook or Google stocks.

Methodology

The work consists of two parts – theoretical and practical. The theoretical part will be based on the study of secondary sources. The empirical part will be compiled on the basis of outputs from quantitative/qualitative research.

The proposed extent of the thesis

30 – 40 pages

Keywords

Google, Facebook, stock, price, volatility, profitability, NYSE, NASDAQ, valuation

Recommended information sources

- FLAŠÁROVÁ, Lenka, Miloslav HEJNÁK a André MACQ. Company analysis in Emerging market economies: evaluating Performance and future prospects. Prague: Institute of Economics of the Czechoslovak Academy of Science, 1992.
- GUERARD, John B. Introduction to financial forecasting in investment analysis. New York: Springer, [2013]. ISBN 978-1-4614-5238-6.
- SCHLOSSBERG, Boris. Technical analysis of the currency market: classic techniques for profiting from market swings and trader sentiment. Hoboken, New Jersey: John Wiley & Sons, [2006]. ISBN 0-471-74593-6.
- VAHL, Andrea, John HAYDON a Jan ZIMMERMAN. Facebook marketing all-in-one for dummies. 3rd ed. Hoboken: John Wiley, c2014. For dummies. ISBN 978-1-118-81618-9.
- YOUNG, S. David, Jacob COHEN a Daniel A. BENS. Corporate financial reporting and analysis. Fourth edition. Hoboken: Wiley, [2019]. ISBN 978-1-119-49457-7.
-

Expected date of thesis defence

2023/24 SS – PEF

The Bachelor Thesis Supervisor

Ing. Kristýna Kučírková, MSc

Supervising department

Department of Languages

Electronic approval: 19. 6. 2023

PhDr. Mgr. Lenka Kučírková, Ph.D.

Head of department

Electronic approval: 3. 11. 2023

doc. Ing. Tomáš Šubrt, Ph.D.

Dean

Prague on 08. 03. 2024

Declaration

I declare that I have worked on my bachelor thesis titled "Analysis of Investing into Facebook and Google 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 15.03.2024

Acknowledgement

I would like to thank doc. Ing. Kristyna Kučírková, MSc. and all other persons, for their advice and support during my work on this thesis.

Analysis of Investing into Facebook and Google Stocks

Abstract

The main aim of the bachelor thesis is to analyze which investment option is better – Facebook or Google stocks.

The work consists of two parts - theoretical and practical. The theoretical part will be based on the study of secondary sources. The empirical part will be compiled on the basis of outputs from quantitative/qualitative research. In the conclusion, it is identified that Google is suitable for more risk-averse and long-term oriented investors, while Facebook is a perfect match for investors aiming to gain profit in the short-term perspective.

Keywords: Google, Facebook, stock, price, volatility, profitability, NYSE, NASDAQ, valuation

Analýza investic do akcií Facebook a Google

Abstrakt

Hlavním cílem bakalářské práce je analyzovat, která investiční varianta je lepší – Facebook nebo Google.

Práce se skládá ze dvou částí teoretické a praktické. Teoretická část bude založena na studiu sekundárních zdrojů. Empirická část bude sestavena na základě výstupů z kvantitativního/kvalitativního výzkumu. V závěru je zjištěno, že Google je vhodný pro investory s větší averzí k riziku a dlouhodobě orientované investory, zatímco Facebook je perfektní volbou pro investory, kteří chtějí získat zisk v krátkodobé perspektivě.

Klíčová slova: Google, Facebook, akcie, cena, volatilita, ziskovost, NYSE, NASDAQ, ocenění

Table of Contents

1	Introduction	9
2	Objectives and Methodology	11
2.1	Objectives.....	11
2.2	Methodology	11
3	Literature Review	13
3.1	Tech Industry	13
3.2	Stock Exchange Markets and Stocks	16
3.3	Facebook	19
3.4	Google.....	21
4	Practical Part	25
4.1	Recent Performance Comparison.....	25
4.2	Returns	32
4.3	P/E and P/B Ratios.....	37
5	Results and Discussion	39
6	Conclusion.....	41
7	References	43
8	List of Supplements	50
8.1	List of Figures	50
8.2	List of Tables	50
8.3	List of Abbreviations	50
8.4	List of Appendices	51

1 Introduction

In the contemporary financial landscape, the stock market plays a pivotal role in channeling investments and shaping the global economy. Investors, analysts, and researchers consistently seek to understand the dynamics of individual stock performance to make informed decisions and capitalize on potential opportunities. Among the myriad of companies listed on stock exchanges, few have been as influential and transformative as Facebook and Google, which prompts to consider conducting a comparative analysis involving these two giants from the technology industry.

Facebook and Google, two of the most prominent technology giants, have redefined the digital era and transformed the way people interact, communicate, and access information. As key players in the technology sector, they have garnered significant attention from investors and the financial community. The stocks of both companies have captured immense interest due to their substantial market capitalization, widespread user base, and continuous innovation. Therefore, it does not come as a surprise that many investors around the globe consider investing in either of them or both, thus creating a logical questions of which investment option out of the two is better, depending on the objectives of investors interested in making a move in the financial market.

The primary objective of this bachelor thesis is to conduct a comprehensive comparative analysis of the stocks of Facebook and Google. Through rigorous research, this bachelor thesis aims to provide valuable insights into the underlying factors that have shaped their stock performances over a specified period. The investigation will encompass a range of financial metrics, historical trends, and key events that have influenced the stock prices of both corporations. By examining the distinct market behaviors of Facebook and Google stocks, this bachelor thesis intends to shed light on the key drivers that contribute to their respective successes and challenges.

Methodologically, this study will adopt a combination of quantitative and qualitative approaches. Utilizing financial ratios, historical price data, and statistical tools, a comparative assessment of the two stocks will be conducted. In conclusion, this bachelor thesis seeks to contribute to the growing body of knowledge within the domain of financial

analysis and technology stocks. By presenting a rigorous comparative analysis of Facebook and Google, it aspires to offer valuable insights for investors, analysts, and researchers alike, aiding them in making more informed decisions and understanding the complexities of the stock market in the context of these two tech giants.

2 Objectives and Methodology

2.1 Objectives

The main aim of the bachelor thesis is to analyze the recent performance of two selected companies specializing in the technology industry – Google and Facebook. The ultimate objective that is pursued during the comparative analysis is to come up with a particular strategy related to investment in the aforementioned industry. Additionally, the goal to project the future performance of the selected companies is pursued alongside the other two mentioned earlier.

2.2 Methodology

The methodology of the bachelor thesis is represented by mixed-methods technique, which inevitably incorporates the utilization of both fundamental approaches – the quantitative and qualitative ones. The qualitative approach in the bachelor thesis is mainly represented by the study of current state of knowledge generated by prominent scholars and academists specializing in the domain of investment and stock markets. In other words, the main technique used for the qualitative approach is the literature review, which serves as the foundation for further research carried in the practical part of the bachelor thesis.

Alternatively, the quantitative approach is represented by a variety of different techniques that are applied to the time series data, which concerns the financial and stock market performances of the selected organizations during the time period between 2014 and 2023. The Yahoo Finance platform is used as the main source of data for carrying the study forward and applying techniques of statistical analysis involving: time series analysis, where graphs and charts, as well as trend functions will be created for the purpose of properly addressing the development of selected indicators over time; return analysis, where techniques of descriptive statistics are implemented, which help to draw the most important insights about the analyzed data; correlation analysis, where the relationship between the selected stocks will be evaluated; market valuation ratio analysis, where it will be identified if the stocks are undervalued or overvalued and hypothesis testing, which will help to understand if the returns of Facebook and Google are significantly different from each other.

Overall, the selected methodology is expected to ensure that the goals and objectives of the bachelor thesis will be met.

3 Literature Review

3.1 Tech Industry

The technology industry encompasses not only the current condition and achievements in this field, but also the entire historical progression of humanity, which has undergone many stages leading up to the present time. Currently, humanity is on the cusp of the fourth technological revolution. The core of any revolution lies in a scenario where the existing cause-and-effect connections can no longer be replicated (Nisbet, 2017). The industrial revolution is not an exception; however, it possesses its own distinct characteristics. An illustration of this may be seen in the primary catalyst of every subsequent industrial revolution, which is science and its practical application, rather than finance or the condition of society. An additional crucial aspect is the endeavour to combat the monopolistic control held by manufacturing enterprises (including entire nations) or the pursuit of achieving dominance. However, the author will address these aspects of the technological revolution at a later point, as it is crucial to initially emphasize its origins and subsequent outcomes (Wyatt III, 2008).

The onset of the 21st century was marked by the advent of the third industrial revolution, also known as "*Industry 3.0*". This revolution entailed the shift towards renewable energy sources, the extensive implementation of automated control systems in manufacturing, the advancement of communication systems, and the adoption of additive manufacturing. It is important to acknowledge that a revolution is not a singular occurrence, and it manifests differently and progresses through many stages in different countries. The third industrial revolution occurred between 1970 and 2011, before the concept of the ongoing fourth industrial revolution (Schwab, 2017). Industrial revolutions do not develop in secret; they are preceded by a gradual transformation in the surrounding environment of industrial systems. In this instance, the concept of "*evolutionary development*" is frequently employed, attributing the characteristics of the biosphere to the techno sphere. In this case, the guide and the internal system are fulfilled by data transmission networks. This marks a significant advancement in industrial systems, as the tasks of data generation, transportation management, and data consumption are now carried out by machines rather than humans (Hahn, 2020).

The emergence of the "*Internet of Things*" can be attributed to the increasing demand for distributed control systems and the widespread use of gadgets that rely on data networks. This phenomenon refers to the interaction between machines and the integration of these devices into human life (first mentioned in 1999) (Ahmed et al., 2017). The shift from the era of the "*Internet of People*" to the era of the "*Internet of Things*" (also known as the *Internet of Thoughts* or *IoT*) occurred gradually and without much notice. It happened when the number of devices linked to the Internet surpassed the number of human users, which happened around 2008-2009 (Miranda et al., 2015).

Emphasizing all the phases of the Industrial Revolution, each marked by precise dates, is crucial as they correlate with numerous technological advancements that benefited an increasing number of individuals:

- The initial industrial revolution, occurring from the late 18th to early 19th centuries, was triggered by the shift from an agrarian economy to one centered around industrial production. This transformation was facilitated by the introduction of steam power, mechanical apparatuses, and advancements in metallurgy (Stearns, 2020).
- The second industrial revolution, which occurred from the second half of the 19th century to the beginning of the 20th century, was characterized by the advent of electrical energy and the following implementation of mass production and division of labor (Kanji, 1990).
- The third industrial revolution, which began in 1970, refers to the incorporation of electronic and information technologies into manufacturing, resulting in the widespread automation and robotization of production processes (Siebenhüner et al., 2013).
- The term "fourth industrial revolution" was coined in 2011 as part of the German effort known as Industry 4.0 (Philbeck & Davis, 2018).

It is crucial to acknowledge the current stage of the global technology sector, which is on the verge of the next revolution known as "Industry 4.0". The name of this effort was derived from the collaboration between the financial-industrial complex and academia in Germany. Its purpose was to enhance the competitiveness of the country's industry by utilizing "*cyber-physical systems*" (CPS) (Schroeder, 2016). Hailing from Germany, the

project swiftly amassed a global following. As part of this initiative, it has become evident that businesses will transition to a novel form of process management. In this new approach, networked machines will independently and collaboratively modify production processes to align with a shared objective. This will be done swiftly, effectively, and without the need for configuration or errors (Brettel et al., 2014).

Another aspect of the fourth industrial revolution involves the incorporation of the concept of "*service-oriented design and manufacturing*." The main characteristic of this concept is the correlation between "intelligent machines" and "*intelligent objects*". "*Intelligent devices*" will autonomously instruct "*advanced machines*" to manufacture new copies of themselves as they become worn out or assess the requirements of the user (Kumar et al., 2019). The advancement of technology offers various pre-existing platforms for the industry to gather and analyse data, such as Microsoft AZURE, Intel IoT Platform, IBM Big Data, Amazon AWS, Google Cloud Platform, and Open Stack (Hung, 2019). The provided environments offer a diverse array of computing services that are readily available for users to create intricate and heavily burdened technological data processing services. This includes the development of intricate mathematical models for production facilities and data storage, both in the conventional relational model and in alternative formats (Gökalp et al., 2021). There is a vast quantity of PC-compatible controllers constructed using ARM, x86, and x64 architecture worldwide. These controllers serve as a pre-existing foundation for creating connections to cloud-based data storage and processing environments, both local and diverse. Significant endeavours are being undertaken by major software manufacturers to cultivate a community of "*makers*" - as they are the ones who, by experimenting with certain technologies today, will construct novel forms of manufacturing in the future (Wang, 2021).

It is worth mentioning that the world is approaching a significant milestone in the technology industry by 2024, commonly referred to as the fifth industrial revolution. However, it is premature to delve into this topic. Nonetheless, it is crucial to emphasize the potential concerns that could impact the global economy and potentially hinder technological progress (Khasawneh, 2024). Halting their progress is quite unlikely, as daily efforts are dedicated to researching and exploring potential modifications to current procedures. Currently, with the rise of virtual money and the ability to do essential life tasks through

mobile devices, along with the emergence of cryptocurrencies, there has been a substantial increase in concerns and security risks (Allioui & Mourdi, 2023).

3.2 Stock Exchange Markets and Stocks

The significance of stock exchanges (SEs) in economic life is immense. The fluctuations in the market value of assets, such as stocks, bonds, and their derivatives, serve as a clear and unambiguous indicator of the economic health of a certain country or the world markets in general. The origins of SE can be traced back several centuries. It commenced concurrently with the documentation of the most ancient safeguard - the invoice. A subject of commerce necessitates the existence of a corresponding platform (Woo et al., 2020). This location is the stock exchange. If the author briefly examines the historical background of the stock market's establishment, it may be traced back to the 13th to 15th century. Mediaeval Europe's business landscape was filled with occurrences known as bill fairs. The venues consisted of the primary commerce and financial hubs during that era, namely Venice, Genoa, and Florence. The exchange of promissory notes (bills of exchange) occurred within a designated city plaza in Bruges. The home, which belonged to the esteemed trade family of van der Bourse, failed to receive attention. Shortly after, its innovative representative establishes a hotel specifically catering to traders. Subsequently, the practice of trading bills on the square in Bruges has acquired the name of trading on the Bourse. In 1406, they established the municipal exchange, serving as its precursor (Kuvshinov & Zimmermann, 2022).

The Amsterdam stock market was founded in 1602 with the active involvement of the preeminent corporation of that era - the Dutch East India Company (VOC) (p). The stockbrokers were situated in a building that was directly across from the company's primary headquarters. The Commodity Exchange commenced its operations in Amsterdam after a span of six years. The stock exchange listing appeared commendable, even according to contemporary criteria. Securities issued by the East India and West India Companies, as well as sovereign bonds from Britain, Portugal, and the Netherlands (Gelderblom et al., 2013). European monarchs obtained financing for extended military expeditions by procuring loans in Amsterdam. The Amsterdam Bourse, functioning as an independent trading platform, endured for nearly three centuries. The magnitude of events that occurred in the evolution

of the exchange market is substantial; it is crucial to highlight the historical periods that are more recognisable and proximate to the present year (Hermans & de Wit, 2004).

The primary exchanges for trading derivatives are the American exchanges, namely the Chicago Board of Trade and the Chicago Mercantile Exchange. The introduction of financial futures trading on the Chicago Mercantile Exchange in the early 1970s brought about significant transformations in the derivatives market. Financial futures quickly surpassed commodity futures in terms of their share in the overall derivatives turnover. Presently, the turnover of financial futures is several times greater than that of commodity futures (Algieri, 2018). Indeed, in the 1970s. The American exchanges held a monopoly in the market for exchange derivatives. The formation of the first non-American options exchange, the European Options Exchange in Amsterdam, occurred in 1979. This exchange ultimately amalgamated with the Amsterdam Exchange. The London International Financial Futures Exchange commenced operations in 1982. In 1992, it consolidated with the options market of the London Stock Exchange (Weber, 2009).

During the 1980s, the emergence of derivatives exchanges disrupted the dominant position of American trading platforms by introducing organised trading of derivative financial instruments in other nations (King et al., 2012). Nevertheless, American exchanges continue to represent nearly 50% of the exchange derivatives market. The German EUREX is the biggest derivatives exchange outside of the United States. By merging with the Swiss SOFFEX, it assumed a prominent position in the worldwide derivatives market (Cheung & Chinn, 2001). Prior to this, the preeminent non-US derivatives exchange was the London International Financial Futures and Options Exchange. Within Europe, it is worth mentioning the presence of the Parisian options exchanges, namely MONEP and MATIF. Derivatives exchanges in emerging nations have surfaced relatively lately, specifically in the 1990s. During the 1990s (Sundaram, 2012). The prevalence of cross-border exchange cooperation has provided investors with additional avenues to engage in securities transactions. For instance, individuals involved in trading can initiate a contract on one exchange that is legally connected through a partnership agreement and subsequently terminate it on a different exchange. Once a security has successfully completed the listing process on one exchange, it is instantly authorised for trading on other trading platforms. Trading platforms that are obligated by a contract can utilise a solitary trading method.

Simultaneously, the exchanges encompassed within this group maintain their autonomy and adhere to their respective regulatory framework. An instance of collaboration can be observed in the consolidation of the Paris, Amsterdam, and Brussels exchanges in the year 2000 (Engelen & Grote, 2009).

The newly consolidated entity was designated as Euronext, and thereafter referred to as Euronext Amsterdam in 2019. Originally, exchanges served as a designated location where buyers, sellers, and middlemen (brokers) convened at a predetermined time to conduct deals. Stock exchange trading in the 21st century occurs through internet platforms. The Internet is a convenient tool for establishing extensive trading platforms (Eijkelenboom & Nieuwesteeg, 2021). However, the exchange of goods or services between the seller and the buyer still involves the involvement of middlemen, known as brokers. These brokers are now fully-fledged businesses that have the authority to engage in trading activities on exchanges. A significant number of the current leading technology companies, which are listed on the Nasdaq or New York Stock Exchange, were formerly thriving technology startups that investors invested in. In the late 20th century, notable companies like as Microsoft, Apple, and Amazon emerged. In the early 21st century, Google, the owner of the renowned brand Alphabet Corporation, entered the scene (with its shares being publicly listed) along with Facebook (Khan et al., 2022).

The US stock market is widely utilized by companies across various sectors, particularly in high-tech industries, pharmaceuticals, medicine, engineering, and the financial and banking sector. These industries are integral to the industrial, financial, and technological foundation of the American economy (Cowling et al., 2021). The American stock market offers a diverse range of economic sectors, such as the technology sector, which are listed on prominent US stock exchanges and accessible to all types of investors, including institutional and individual investors, including those from other countries. The US stock market is subject to extensive regulation, with issuers and professional participants such as brokers, dealers, and trade organizers being bound by stringent rules established by the Securities and Exchange Commission (SEC) and exchanges (Zetzsche et al., 2021).

While the US stock market is slightly behind other countries like China and Japan in terms of this metric, it surpasses the market capitalization of many developing countries. For

instance, if taxes are raised for major firms, the state, as the majority shareholder, may start to impede actions such as dividend payments, as was observed in the summer of 2022 with Gazprom, a prominent Russian equities issuer. Conversely, in the American stock market, majority ownership is frequently diluted, so facilitating the ability of minority shareholders to have their opinions heard during public meetings (Rehman et al., 2023).

3.3 Facebook

Facebook, a worldwide social network originating from the United States, is renowned for its exponential expansion. The company's consistent implementation of new ideas and advancements enables it to maintain its financial stability. Rival companies are ultimately either purchased through mergers and acquisitions or merely replicated. This is one of the reasons why, since 2011, there has been a lack of significant launches of social networks or messengers, except for the potential cases of Russian Telegram and Chinese TikTok (Kolhar et al., 2021). The FaceMash project, created by Mark Zuckerberg, a student at Harvard University, was released on October 28, 2003. At first, FaceMash exhibited greater similarities to Tinder rather than contemporary Facebook. Site users assessed images of female students sourced from a paper archive and established an internal ranking of the university based on their physical appeal. Despite the limited access to the service, a total of 450 individuals successfully registered and produced nearly 22,000 ratings within a span of 4 hours. Shortly thereafter, the FaceMash service was terminated. University officials attempted to press charges against Zuckerberg for disseminating personal images of pupils, but the charges were ultimately dismissed (Levy, 2020).

The FaceMash website served as a substitute for the initial version of the social network's product, commonly known as the Minimum Viable Product (MVP). The history of the famous social network commenced with the assessment of images. Despite initially starting as a non-serious endeavour without any business aspect, TheFacebook Inc. was officially established in June 2004 (Levy, 2020). Profits were derived from the number of views of subtle advertisements. Nevertheless, advertising remains the primary source of revenue for Facebook, despite not being widely recognised as such. This is likely why the New Product Experimentation (NPE) division was established in 2019. Ime Archibong, the former vice president of partnerships at Facebook, oversees leading the experimentation of our new product. The primary objective of the division is to initiate new commercial ventures, which

can subsequently be assimilated into the Facebook ecosystem or, conversely, pursue autonomous development outside of it (Dobson, 2021). Prior to the initiation of NPE, most of the Facebook's revenue was derived from advertising. The establishment of the new division aims not only to execute novel initiatives within the social network ecosystem, but also to broaden revenue streams. By the year 2020, the corporation achieved a dominant position as the unquestioned leader in the market. The most recent estimates indicate that there are approximately 2.7 billion users on Facebook. Facebook's primary strategy in the M&A deals involving WhatsApp and Instagram is to discern forthcoming trends in the realm of social networking and subsequently procure potential rivals or imitate their functionalities. Consequently, Facebook has faced criticism for its absence of genuine innovation (Wu, 2020). Emphasising the most widely used items that Facebook possesses is of utmost significance and the products most frequently purchased by Facebook include:

- **WhatsApp** was acquired by Facebook in 2014 for a staggering \$19 billion. This programme is a widely used messaging platform that enables users to send messages and make calls to anyone in their contact list who have also downloaded the app, using the mobile Internet without any cost (Hazlett, 2023).
- **OculusVR** was acquired in 2014 for a sum of \$2 billion. The company is actively involved in researching virtual reality technologies (Egliston & Carter, 2023).
- **Instagram** was launched in 2012 and has already reached a user base of 1 billion. A widely used global service specifically created for sharing and distributing photo and video material (Frier, 2021).

Several factors contributed to Facebook's rise as one of the most widely used and expansive social networks globally:

- Facebook engineers have implemented stringent regulations and limits to prevent the random sending of spam to users of the platform, resulting in a minimal amount of spam (Pallivalappil et al., 2021).
- There are abundant chances for contact and accessing information about users - now, one out of every three individuals on Earth have their own Facebook account. Indeed, Zuckerberg's idea has played a significant role in eliminating any limitations within the virtual realm. Individuals can locate their co-worker, family member, or casual associate on a social network to obtain the required information about them (Haupt, 2021).

- Rapid and efficient business promotion - advertising a product on the Internet no longer requires owning a personal website.
- Facebook holds the 10th position in BCG's 2020 rankings of the Most Innovative Companies (Dobrinić et al., 2021).

According to numerous experts, the potential cessation of Facebook might disrupt interpersonal connections among friends and relatives and deprive millions of individuals worldwide of the chance to establish and manage their own businesses. Furthermore, the information contained in the Facebook archive possesses cultural and historical significance and serves as valuable material for future generations to analyse. The historical narrative surrounding the inception and evolution of Facebook captivates not just the general populace, but also entrepreneurs aspiring to emulate the triumph of this social networking platform. Undoubtedly, Facebook is the greatest triumphant undertaking of our era. The shares are experiencing consistent growth, resulting in a reliable source of income for its owners. While certain pundits forecast the imminent demise of the corporation within a few years, attributing it to waning user interest in the platform, others eagerly observe Zuckerberg's successful implementation of increasingly innovative and audacious concepts that were formerly deemed fantastical.

3.4 Google

Google is widely recognised by individuals who have even a minimal connection to computers and utilise the internet for information retrieval. The monumental trajectory of the giant commenced in 1995, when Sergey Brin and Larry Page crossed paths at Stanford University. Sergei's birthplace is Moscow. His parents were mathematics educators with Jewish ancestry. At the age of 5, Sergei was brought to the United States by his parents, for which the author of the ground-breaking algorithm later expressed his thanks publicly on multiple occasions. Larry's parents instructed in programming (Morales, 2023). By 1996, proficient young individuals were pursuing relevant subjects. Sergey Brin investigated the domain of information retrieval and analysis, whereas Larry Page focused on the structuring of data on the network (Evans & Robertson, 2020). They encountered one other during an outing where Brin was giving a tour of the Stanford University campus to younger pupils. Following a span of 2 years, determined graduate students made the decision to astonish

university professors with their study endeavour - the Page Rank search engine. Indeed, search engines were already in existence at that period; however, two students identified their limitations and sought to exploit them to develop a novel solution (Sarfi et al., 2021). The organisational basis bore resemblance to a website directory and was fundamentally distinct from the services provided by Google in the present day. Subsequently, the process of including a website in the Yahoo database necessitated manual intervention. Consequently, the speed at which queries were processed was negatively impacted, leading to uneven results (Nigam & Biswas, 2021). The top positions in the search results were dominated by writings that contained the highest number of keywords, yet these texts were frequently lacking in useful information. The user's queries remained unanswered, resulting in a wastage of time spent on perusing superfluous information. Larry Page, recognising the incorrectness of the circumstance, established a goal to alter it, undoubtedly in collaboration with his closest companion. Larry contemplated the establishment of authority among scientists as a rudimentary version. As a scientist becomes more contemporary, they tend to produce a greater number of distinctive scientific writings, which in turn leads to their papers being cited more frequently by their colleagues in their own research. The new search engine Page Rank, which marked the beginning of Google's history, operated on a similar basis. The material was categorised based on the quality of the texts and the number of connections to them, rather than the frequency of terms used, as the main criterion for determining its relevance (Davis, 2021).

The novel method significantly enhanced the ultimate outcome. Google's experience demonstrates that small companies in the IT sector should not be underestimated, as any one of them has the potential to swiftly emerge as a dominant force, overtaking well-established industry leaders. Examining tiny organisations that exhibit a high degree of proficiency in emerging technologies is worthwhile (Jacobides, 2020). 2004 is regarded as a significant milestone in the history of Goggle Inc. as it marked the company's transition to a publicly traded entity by listing on the NASDAQ stock exchange. The corporation made available 19,605,052 shares for purchase, with each share being valued at \$85 (Borneklint, 2021). An online auction, distinguished by its distinctive format, was arranged to facilitate the sale of securities. The initial public offering (IPO) generated \$1.67 billion in funds, resulting in a stock market valuation of \$23.1 billion. Currently, Google shares are listed on both the American NASDAQ and the Frankfurt Stock Exchange (Hynes & Hynes, 2021).

Penguin administered penalties for the substandard quality of the inbound link profile, while Panda addressed the issue of excessively optimised content. Hence, the author's analysis of the genesis of Google search results reveals that attaining the top position in rankings has become utterly capricious. However, the implementation of novel technology has enhanced the calibre of rankings. For inquiries that are extremely competitive, the top positions will be held by resources that have been in existence for a considerable duration - a fact that the search engine has complete confidence in. Regarding regional categories, one can reach the highest ranks within around 2 months. This is caused by the systematic lack of some filters or their suboptimal functioning. However, it is crucial to emphasise that there exists a degree of rivalry between Facebook and Google. Initially, it may appear that the rivalry between Facebook and Google emerged unexpectedly, given that these technology behemoths operate in distinct market areas - one primarily focuses on search, while the other specialises in the creation of social networks and virtual communication. However, the interests of companies continue to coincide, as both Google and Facebook are extremely interested in capturing the attention of people, along with advertisers (Wit & Altbach, 2021).

A public clash between the firms ensued after Mark Zuckerberg definitively declined Google's offer to purchase a portion of the social network and grant access to search functionality within Facebook. As a reaction to this, the Page and Brin brand unveiled its own social network called Google+. This platform enables users to connect with their peers in the digital realm by organising them into groups based on different criteria such as family, co-workers, or college pals (Jenny, 2021). Google+ was implemented using an impressive array of resources, making it one of the largest projects in the company's history. However, Facebook is not eager to relinquish its current position. The social network undergoes regular updates, continuously expanding the possibilities for users to engage in unrestricted communication. Currently, the user base of the social network created by Zuckerberg amounts to 1.5 billion individuals, which means that approximately one-fifth of the global population possesses a personal account on Facebook (Frenkel & Kang, 2021).

The need for advertising, a primary revenue stream for the two industry leaders, consistently exacerbates their already strained relationship. Therefore, up until December 2017, Facebook held a dominant position in terms of the quantity of advertising clicks generated

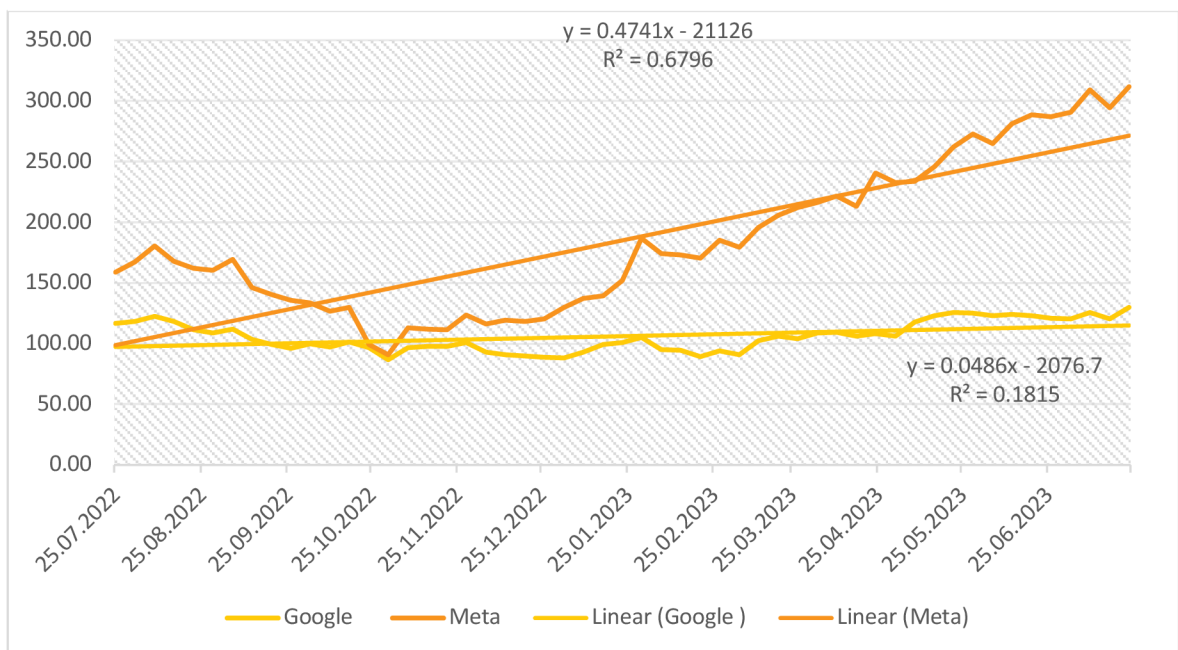
by links placed in the feed. Nevertheless, due to the continuously growing user-generated content on Google, by the end of 2018, the search engine managed to surpass social networks significantly in terms of the quantity of user interactions. Facebook management promptly implemented stricter criteria for the content and quality of posts and adverts, resulting in a decrease in the campaign's expenses (Crain, 2021). Nevertheless, experience has demonstrated that engaging in competition can incur significant expenses, prompting Google and Facebook to prioritise the pursuit of mutually agreeable solutions. Google has faced numerous allegations in recent years, including spying on competitors, unfair search performance, pressuring advertising, and attempting to secure the loyalty of customers and partners (Norris, 2023). In autumn 2020, the US Department of Justice initiated an antitrust case against the search engine, alleging that the firm employed anti-competitive tactics to uphold its dominating position in the advertising and search market. Presently, just as in previous years, Google persists in its efforts to provide improved solutions and offerings for its clientele. The company's search engine and other products have a user base of billions worldwide. According to the brand's founders, their creation is primarily a group of individuals that share the same beliefs and strive to improve our planet, even if it is only by a small margin, via their daily labour (Case, 2021).

4 Practical Part

4.1 Recent Performance Comparison

The very first part of the empirical analysis from this bachelor thesis is dedicated to the analysis of the recent performance of stocks based on the time series data covering weekly prices of Google and Facebook during the period between the 25th of July 2022 and 24th of July 2023. By understanding the recent performance of the stocks, it will be possible to hypothesize about their development in the nearest future. Based on the dataset collected from Yahoo Finance and presented in the list of supplements of this bachelor thesis in Table 12, a chart containing the development of Google and Facebook over the mentioned period of time is presented in Figure 1.

Figure 1, the time graph of prices



Source: Yahoo Finance, 2023

As a matter of fact, when using techniques of the time series analysis, it is always essential to first identify if a particular dataset is stationary or not. This is traditionally done by identifying if the time series plot can be characterized by two fundamental aspects: constant mean and constant variance. If this is not the case, then it means that a time series is non-stationary and there might be a trend function explaining the behaviour of an

indicator. In this case, it is definitely possible to suggest that the price of Facebook stock was non-stationary, and its price was developing in two different ways: until approximately the start of December 2022, the stock was rapidly diminishing, which is quite likely to have been caused by the contractionary policy of the United States' Federal Reserve, which was raising the interest rate quite often during the year. The next period – starting from the early December 2022 and continuing up to the present day is characterized by a rapid accumulation of price explained by an upward-sloping curve, which is definitely a good aspect for investors who made their choice to invest in Meta platforms. Furthermore, it is possible to identify a linear trend function that indicates that the price of the stock has been increasing by 0.47 USD per week, which is not a lot, but it is still a decent result indicating a bullish trend. The quality of the trend is not perfect, but it is still enough to claim that there is some sort of trend that can explain the behaviour of the price.

The situation with Google stock is entirely different since the price of the stock is likely to be stationary due to the fact that the time series does not really experience periods of high volatility and changes in the price over time. The suggestion about its stationary nature is also underpinned by the linear trend that is fitted to the plot, which suggests that Google's price was increasing by 0.0486 USD per week, which is almost 10 times lower than the case of Meta platforms. Yet, the tendency to move downwards until approximately the early December and move upwards until the present day is also identified for Google, but the magnitude is significantly lower than for the case with Meta Platforms.

Overall, based on the preliminary step of the time series analysis, it is possible to suggest that both stocks are quite likely to move in the same direction, which is quite common for companies from the same industry and based on the same country (The United States, in this case). On the other hand, the development of Meta Platforms' price is more vivid and active as the magnitude of change is significantly higher than for Google. On one hand, this is a good sign indicating higher returns, but higher risk always inevitably means higher losses, so there is no universal answer to the question of whether this is good or bad – it depends mostly on the risk-aversion of an investor.

Another aspect that is worth paying attention to is the correlation between the two investment options, which might help future investors to identify an investment strategy

involving the implementation of the two investment options. The result of the correlation analysis is presented in Table 1.

Table 1, the correlation analysis

	<i>Google</i>	<i>Meta</i>
Google	1	0.82
Meta	0.82	1

Source: Yahoo Finance, 2023

The correlation between Google and Meta stocks is 0.82, which means that it is a strong positive linear relationship identified between the two investment options. This is quite logical due to 2 main reasons: 1) both companies are based in the United States, so they are influenced by American economic business cycles and also by the monetary policy of the United States; 2) both companies specialize in the tech industry, so they are quite likely to be vulnerable towards issues happening specifically with the industry. Overall, using these two stocks as a way of diversification might not turn out to be a good idea due to the fact that there is a positive degree of association with them, so diversifying one's portfolio by investing simultaneously in Google and Meta might not yield the expected result. After the correlation analysis, it is essential to proceed to the descriptive analysis, where the main statistical measures will be calculated. The table with descriptive statistics is presented in Table 2.

Table 2, the descriptive analysis of Google

<i>Google</i>	
Mean	106.10
Standard Error	1.69
Median	104.00
Mode	#N/A
Standard Deviation	12.32
Sample Variance	151.81
Kurtosis	-1.19
Skewness	0.28
Range	43.17
Minimum	86.70
Maximum	129.87
COV	0.12
Sum	5623.28
Count	53.00

Source: Yahoo Finance, 2023

The average price of Google over the course of the previous year was 106.10 USD, which is pretty affordable for investors having a relatively small capital, which is definitely a good point that goes to Google. The standard deviation of Google is equal to 12.32 USD, which is not a huge number when comparing it to the average of 106.10 USD. As a matter of fact, the coefficient of variation that incorporates the two measures at once and showing the variation in percentage suggests that the variability of Google's price was not really high – just 12% around the mean, which is definitely a good sign indicating low volatility of Google's stock. Additionally, the range of Google is equal to 43.17 USD, which underpins the suggestion that the stock was not really volatile and was quite stationary. The maximum value of Google was just 129.87 USD, while the lowest was 86.70 USD, which indicates that the stock was constantly moving in the specified range. Now, the same analysis will be applied to Meta platforms' stock, which is presented in Table 3.

Table 3, the descriptive analysis of Meta Platforms

<i>Meta</i>	
Mean	185.04
Standard Error	8.54
Median	170.39
Mode	#N/A
Standard Deviation	62.17
Sample Variance	3865.58
Kurtosis	-0.85
Skewness	0.54
Range	220.92
Minimum	90.79
Maximum	311.71
COV	0.34
Sum	9807.28
Count	53.00

Source: Yahoo Finance, 2023

The average price of Meta Platforms was somewhat higher than the average price of Google by approximately 79 USD – 185.04 for Meta Platforms versus 106.10 for Google. Overall, the valuation of Meta Platforms was significantly higher, but so were volatility and variation of the stock. The standard deviation was equal to 62.17 USD, which is a relatively high value, especially when comparing it to the mean of 185.04 USD. Effectively, the coefficient of variation combining the two measures indicates the variability equal to 34%, which is a relatively high value. At the same time, when recalling the time series plot of Meta Platforms, it becomes evident that the biggest share of this volatility is caused by the upward-sloping trend of the price. The range of Meta Platforms is equal to 220.92 USD, which is a value blown out of proportion. In other words, the price of Meta Platforms was constantly moving in the interval between 90.79 USD and 311.71 USD, which is quite a huge range, especially when comparing it to the range of Google equal to just 43.17 USD. The next part of the analysis is concerned with the analysis of both market capitalizations and revenues of Google and Meta Platforms on the period between 2014 and 2023. The first dataset used for the analysis is presented in Table 4, which contains the market capitalizations of both companies.

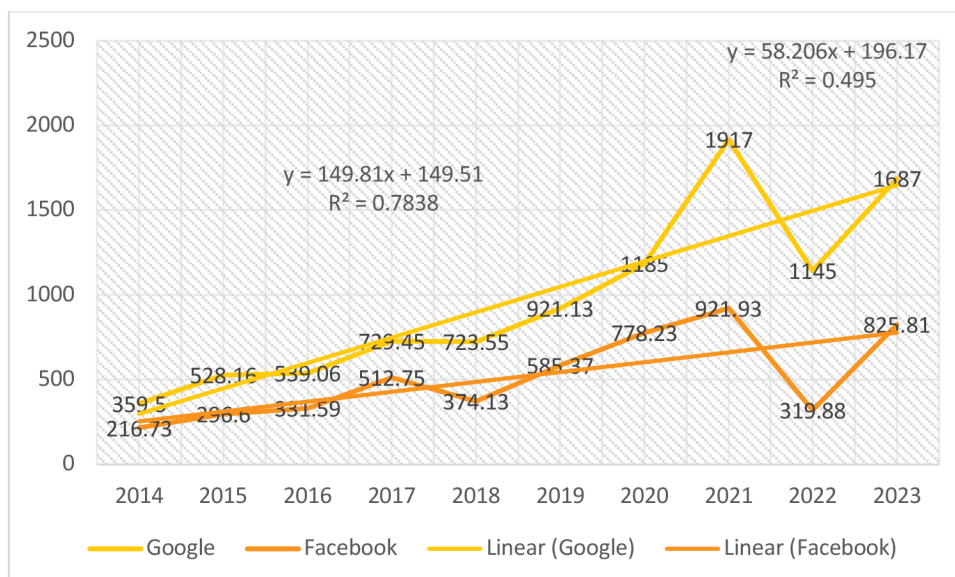
Table 4, the dataset with market capitalizations

Year	Market Cap, billion USD	
	Google	Facebook
2014	359.5	216.73
2015	528.16	296.6
2016	539.06	331.59
2017	729.45	512.75
2018	723.55	374.13
2019	921.13	585.37
2020	1185	778.23
2021	1917	921.93
2022	1145	319.88
2023	1687	825.81

Source: Yahoo Finance, 2023

Seemingly, there is a huge gap between the market capitalization of Google and Facebook, i.e., Meta Platforms. Despite the evident superiority of Meta Platforms' price, Google has a market capitalization almost 2 times exceeding the one of Facebook. The gap between the two is especially visible in the time series plot dedicated to the two companies and presented in Figure 2.

Figure 2, the time graph of market capitalizations



Source: Yahoo Finance, 2023

According to the time series plots, it is possible to conclude that the gap between the two companies was not so evident in the mid 10s, but the situation changed rapidly in 2017, when Facebook experienced a huge blow, whose magnitude was evidently larger than the one inflicted to Google. Overall, the market capitalization of Google was increasing by 149.81 billion USD annually, which is an outstanding result indicating a very strong market position of Google, if not the strongest. On the contrary, Facebook was also experiencing mostly positive moments with its capitalization, which is reflected in the annual increase in the market capitalization equal to 58.206 billion USD, according to the fitted trend. After addressing market capitalizations of both companies, it is essential to continue to the dataset containing revenues of the companies – presented in Table 5.

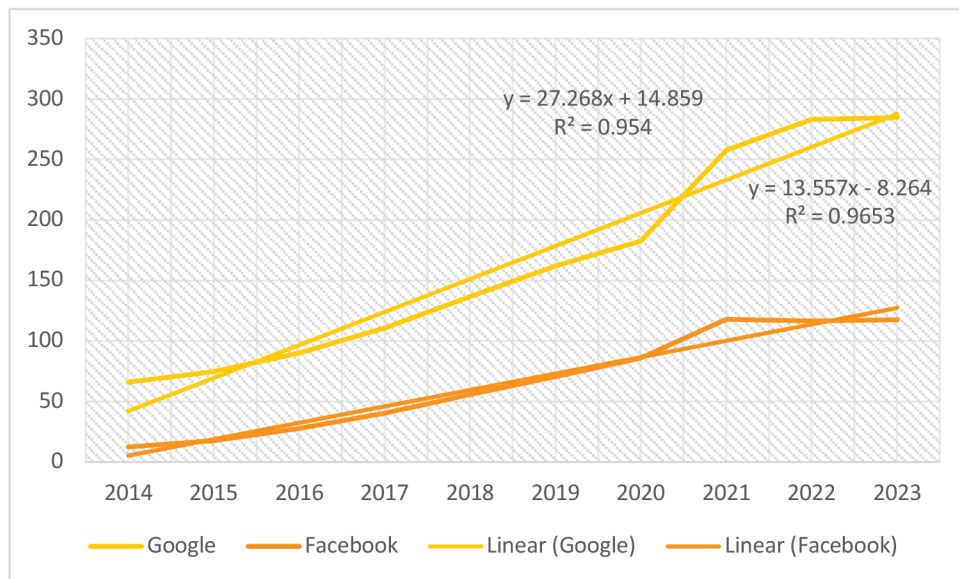
Table 5, the dataset with revenues

Year	Revenue, billion USD	
	Google	Facebook
2014	66	12.46
2015	74.98	17.92
2016	90.27	27.63
2017	110.85	40.65
2018	136.81	55.83
2019	161.85	70.69
2020	182.52	85.96
2021	257.63	117.92
2022	282.83	116.6
2023	284.61	117.34

Source: Yahoo Finance, 2023

Something similar to what has already been noticed before in the dataset containing market capitalizations of the companies is noticed in the dataset containing revenues. There is quite a huge gap between Google and Facebook and notably, the gap was already large in 2014. The time series plot containing both stocks is presented in Figure 3.

Figure 3, the time graph of revenues



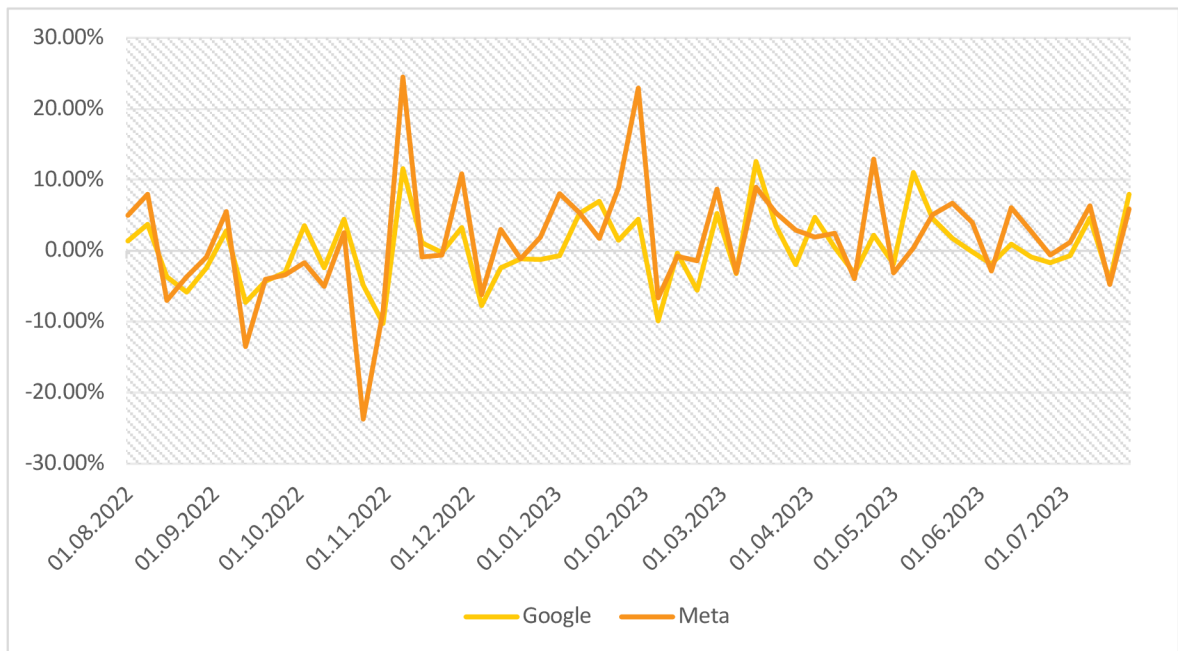
Source: Yahoo Finance, 2023

The gap was somewhat the same until approximately 2020, when Google significantly increased its revenues, which is quite likely to have been influenced by successful commercial projects of the company. Overall, the annual increase in revenue of Google is equal to 27.268 billion USD, which is more than 2 times higher than the annual increment in revenue of Meta Platforms – just 13.557 billion USD. Undeniably, the dynamic of both companies is quite positive and good, but the gap between Google and Facebook is quite huge.

4.2 Returns

After properly addressing all essential techniques and analytic approaches related to the prices of the stocks, it is essential to continue to the returns that both companies experience. Returns are calculated as the percentual difference in the price of stocks compared to the previous period, so the dataset used in this type of analysis essentially contains weekly returns. The dataset is presented in Table 13 available in the list of supplements. Based on the earlier mentioned dataset, a time series plot is created, which is presented in Figure 4.

Figure 4, the time graph of weekly returns



Source: Yahoo Finance, 2023

Based on the time series plot of weekly returns, it is possible to support the statement that has been produced earlier about higher degree of returns for Meta Platforms but also higher losses. The line of returns for Google is somewhat steeper than the one for Meta Platforms, which is quite logically influenced by the fact that Meta Platforms were experiencing a more rapid upward-pointed movement in the price. Additionally, it is important to pay attention once more to descriptive statistics, where the descriptive statistics for Google are presented in Table 6.

Table 6, summary statistics of Google returns

<i>Google</i>	
Mean	0.33%
Standard Error	0.69%
Median	-0.24%
Mode	#N/A
Standard Deviation	4.99%
Sample Variance	0.25%
Kurtosis	24.08%
Skewness	28.63%
Range	22.81%
Minimum	-10.23%
Maximum	12.58%
Geometric	0.21%
Sum	17.04%
Count	52

Source: Yahoo Finance, 2023

Based on the descriptive analysis of Google returns, it is possible to conclude that the average return of Google was positive – 0.33%, which is not a lot, but it is still a quite decent result indicating that investors investing in Google gained something. Furthermore, it is essential to pay attention to the range, which is quite high – 22.81%. This is mainly influenced by the spread between the minimum of negative 10.23% and the maximum of 12.58%. Additionally, it is vital to pay attention to the geometric mean of returns, which is also positive and equal to 0.21%, which is quite a decent result as well. Consequently, the returns of Meta Platforms are analyzed through the same lens – available in Table 7.

Table 7, summary statistics of Meta returns

<i>Meta</i>	
Mean	1.60%
Standard Error	1.08%
Median	1.85%
Mode	#N/A
Standard Deviation	7.78%
Sample Variance	0.61%
Kurtosis	291.47%
Skewness	10.30%
Range	48.18%
Minimum	-23.70%
Maximum	24.49%
Geometric	1.30%
Sum	83.04%
Count	52

Source: Yahoo Finance, 2023

The average returns of Facebook were significantly higher than the ones identified for Google – 1.6% compared to 0.33%, accounting for almost a 5-times higher returns for Meta Platforms. On the other hand, the range is significantly higher – 48.18%, which is explained by the minimum value of negative 23.70% and the maximum of 24.49%. The geometric returns are also positive – 1.3%, which indicates that Facebook’s stock was undergoing through a relatively good period of time. The final piece of analysis that will be implemented on the companies’ returns is the hypothesis testing, where the following hypothesis is tested:

- *Ho: there is no difference in the returns of two companies ($\mu_1 = \mu_2$).*
- *Based on the null, the alternative hypothesis is: there is a difference in the returns of two companies ($\mu_1 \neq \mu_2$).*

The hypothesis is tested at the significance level of 5%, where it is first essential to perform a test that will indicate if the variances of the two returns are equal or not. The decision is taken based on the output from Table 8.

Table 8, the Levene's test of variances

F-Test Two-Sample for Variances		
	<i>Google</i>	<i>Meta</i>
Mean	0.00	0.02
Variance	0.00	0.01
Observations	52	52
df	51	51
F	0.41	
P(F<=f) one-tail	0.00	
F Critical one-tail	0.63	

Source: Yahoo Finance, 2023

Based on the Levene's test, it is possible to conclude that the two variances are not equal ($0.00 < 0.05$). Therefore, the test that will help to identify if there is any difference in the average returns is Welch test, which is traditionally used for cases of unequal variances between samples. The result of Welch test is presented in Table 9.

Table 9, the Welch test

t-Test: Two-Sample Assuming Unequal Variances		
	<i>Google</i>	<i>Meta</i>
Mean	0.00	0.02
Variance	0.00	0.01
Observations	52	52
Hypothesized Mean Difference	0	
df	87	
t Stat	-0.99	
P(T<=t) one-tail	0.16	
t Critical one-tail	1.66	
P(T<=t) two-tail	0.32	
t Critical two-tail	1.99	

Source: Yahoo Finance, 2023

Based on the two-tail probability of 0.32, it is possible to say that the original null hypothesis about the equality of returns is not rejected. Therefore, for population means of the two companies, the returns are likely to yield the same financial results.

4.3 P/E and P/B Ratios

This chapter is concerned mainly with the comparison of both P/E and P/B ratios for both companies, which are quite useful tools in order to understand if the companies are overvalued or undervalued. First, the P/E ratio is analyzed, whose development in time is presented in Table 10.

Table 10, the dataset with P/E ratios

Year	Google	Meta
2014	19.8	69.7
2015	32.7	79.9
2016	27.3	34.7
2017	57.2	32.1
2018	23.4	17.1
2019	27	31.7
2020	29.6	26.7
2021	25.4	24

Source: Yahoo Finance, 2023

Based on the dataset with P/E ratios, it is possible that the price that investors pay in order to get 1 USD in earnings for Google and Meta Platforms is somewhat similar. However, at the beginning of the studied time period, it was significantly different – Meta was much more overvalued and investors had to pay around 70-80 USD to get just 1 USD in earnings, which is a very bad result indicating that the stock was not really attractive for investors back in the mid 10s. However, the situation changed by the end of the decade and in the new decade, both companies have more or less the same figures for the ratio. The next ratio discussed in the bachelor thesis is the P/B ratio, whose dataset can be found in Table 11.

Table 11, the dataset with P/B ratios

Year	Google	Meta
2014	3.44	6
2015	4.39	6.71
2016	3.88	5.6
2017	4.78	6.9
2018	4.07	4.45
2019	4.57	5.79
2020	5.33	6.07
2021	7.62	7.38

Source: Yahoo Finance, 2023

Based on the dataset with P/B ratios, it is possible to say that something quite similar to what has been observed earlier in the case with P/E ratios is observed here. Effectively, at the beginning of the studied time period, Meta was significantly more overpriced than Google but as the time progressed and Facebook tackled their problems with books and notably with the book value, their ratios became somewhat similar. Further interpretations and elaborations are presented in the next chapter of the bachelor thesis.

5 Results and Discussion

The comparative analysis of Google and Meta stocks reveals valuable insights for potential investors in the technology sector. While both companies share a similar valuation, their financial performance and characteristics differ significantly. Meta's stock exhibits higher volatility and returns, but it also comes with higher associated losses. On the other hand, Google's financial strength, superior capitalization, and revenue make it a more stable and secure investment option.

Investors seeking higher returns and willing to bear higher risks may find Meta stocks appealing. This is also associated with a potential short-term investment strategy, where investors will try to maximize their return in short-run – approximately 1 year or even 2. On the other hand, it is vital to suggest that investors not hurrying so much and willing to embrace periods of long waiting are likely to consider the Google option more seriously since it has lower level of returns but also a low level of losses associated with the investment option.

Effectively, it is wise to suggest that when constructing an investment portfolio and sticking to the strategy of diversification, it is not recommended to consider Google and Meta as alternatives to each other since despite their relatively different level of return and prices, they still develop in more or less the same direction, as it was revealed during the correlation analysis, where it was concluded that the correlation between the two investment option is strong and positive. Therefore, it is recommended to diversify one's portfolio by using either of the two companies' stocks and selecting other companies from other domains, such as, for example, pharmaceuticals or telecommunications, which both have been providing stable and promising returns for investors.

This research contributes to the existing body of knowledge on stock market performance and financial dynamics of technology giants, providing a foundation for further investigations into the evolving landscape of the technology sector and its implications for investors. It is recommended to expand the framework of the study by considering other companies from the tech industry and including them in the analysis. In addition to that, it

is recommended to conduct a similar kind of analysis in a certain period of time to capture the behavior of the companies during the whole 2023 year.

6 Conclusion

The bachelor thesis was focused on the comparative analysis of two investment options listed on the American Stock market and representing the technology industry – Facebook (Meta Platforms) and Google. In the analysis, the method methods approach was selected, where strong emphasis was put on qualitative and quantitative techniques at once. In the literature review, the current state of knowledge and tendencies associated with the financial market were identified. In the practical part, the main insights about the recent performance of both companies were drawn.

It was concluded that when comparing two companies between each other, there is no universal way of answering the question about the best investment option. On one hand, Google have a very good performance that resulted in the company significantly increasing its market capitalization and approaching the status of the world's biggest company – the same applied to Google's revenue. However, this did not result in investors experiencing incredible returns – the development of Google on the financial market can be categorized as rather stable, but bullish. Therefore, it is recommended to consider Google for investors, who do not demand instant returns now and do not mind wait for a couple of years. Henceforth, Google is a perfect match for long-term oriented and risk-averse investors.

On the other hand, Facebook, compared to Google, were experiencing periods of rapid increase in the capitalization and also decrement in the same indicator – the same applies to the price of the asset. Yet, the returns of Facebook were considerably higher than the one identified for Google. Therefore, it is suggested that investors aiming at maximizing their profit in the short-term perspective should prefer Facebook over Google, which yields higher returns, but it is more volatile and riskier.

It is recommended to expand the study by introducing more investment options in the analysis from the same industry. Additionally, a similar kind of research conducted in a couple of years can also be a wise decision since the stock market is a very dynamic environment, where everything can change in just a matter of months if not weeks. As of 2023, the performance of both companies can be considered to be favorable and quite

successful, but Facebook have to do a lot of job to achieve the level of capitalization of Google

7 References

- Ahmed, E., Yaqoob, I., Hashem, I. A. T., Khan, I., Ahmed, A. I. A., Imran, M., & Vasilakos, A. V. (2017). The role of big data analytics in Internet of Things. *Computer Networks*, 129, 459–471. <https://doi.org/10.1016/j.comnet.2017.06.013>
- Algieri, B. (2018). *A Journey Through the History of Commodity Derivatives Markets and the Political Economy of (De)Regulation* (SSRN Scholarly Paper 3301143). <https://doi.org/10.2139/ssrn.3301143>
- Allioui, H., & Mourdi, Y. (2023). Exploring the Full Potentials of IoT for Better Financial Growth and Stability: A Comprehensive Survey. *Sensors*, 23(19), Article 19. <https://doi.org/10.3390/s23198015>
- Borneklint, N. (2021). *Forecasting prices of Bitcoin and Google stock with ARIMA vs Facebook Prophet*. <https://urn.kb.se/resolve?urn=urn:nbn:se:hv:diva-17345>
- Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014). *How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape: An Industry 4.0 Perspective*. 8(1).
- Case, M. (2021). Google, Big Data, & Antitrust. *Delaware Journal of Corporate Law*, 46, 189. <https://heinonline.org/HOL/Page?handle=hein.journals/decor46&id=197&div=&collection=>
- Cheung, Y.-W., & Chinn, M. D. (2001). Currency traders and exchange rate dynamics: A survey of the US market. *Journal of International Money and Finance*, 20(4), 439–471. [https://doi.org/10.1016/S0261-5606\(01\)00002-X](https://doi.org/10.1016/S0261-5606(01)00002-X)
- Cowling, M., Liu, W., & Zhang, N. (2021). In the post-crisis world, did debt and equity markets respond differently to high-tech industries and innovative firms?

- International Small Business Journal*, 39(3), 247–288.
<https://doi.org/10.1177/0266242620947281>
- Crain, M. (2021). *Profit over Privacy: How Surveillance Advertising Conquered the Internet*. U of Minnesota Press.
- Davis, G. F. (2021). Corporate Purpose Needs Democracy. *Journal of Management Studies*, 58(3), 902–913. <https://doi.org/10.1111/joms.12659>
- Dobrinić, D., Gregurec, I., & Dobrinić, D. (2021). Examining the factors of influence on avoiding personalized ads on Facebook. *Zbornik Radova Ekonomskog Fakulteta u Rijeci: Časopis Za Ekonomsku Teoriju i Praksu*, 39(2), 401–428.
<https://doi.org/10.18045/zbefri.2021.2.401>
- Dobson, J. (2021). Envisioning the Aesthetic Firm. *Philosophy of Management*, 20(3), 355–368. <https://doi.org/10.1007/s40926-020-00159-5>
- Egliston, B., & Carter, M. (2023). Examining visions of surveillance in Oculus' data and privacy policies, 2014–2020. *Media International Australia*, 188(1), 52–66.
<https://doi.org/10.1177/1329878X211041670>
- Eijkelenboom, E. V. A., & Nieuwesteeg, B. F. H. (2021). An analysis of cybersecurity in Dutch annual reports of listed companies. *Computer Law & Security Review*, 40, 105513. <https://doi.org/10.1016/j.clsr.2020.105513>
- Engelen, E., & Grote, M. H. (2009). Stock exchange virtualisation and the decline of second-tier financial centres—The cases of Amsterdam and Frankfurt. *Journal of Economic Geography*, 9(5), 679–696. <https://doi.org/10.1093/jeg/lbp027>
- Evans, C., & Robertson, W. (2020). The four phases of the digital natives debate. *Human Behavior and Emerging Technologies*, 2(3), 269–277.
<https://doi.org/10.1002/hbe2.196>

- Frenkel, S., & Kang, C. (2021). *An Ugly Truth: Inside Facebook's Battle for Domination*. Hachette UK.
- Frier, S. (2021). *No Filter: The Inside Story of Instagram*. Simon and Schuster.
- Gelderblom, O., Jong, A. de, & Jonker, J. (2013). The Formative Years of the Modern Corporation: The Dutch East India Company VOC, 1602–1623. *The Journal of Economic History*, 73(4), 1050–1076. <https://doi.org/10.1017/S0022050713000879>
- Gökalp, M. O., Gökalp, E., Kayabay, K., Koçyiğit, A., & Eren, P. E. (2021). Data-driven manufacturing: An assessment model for data science maturity. *Journal of Manufacturing Systems*, 60, 527–546. <https://doi.org/10.1016/j.jmsy.2021.07.011>
- Hahn, B. (2020). *Technology in the Industrial Revolution*. Cambridge University Press.
- Haupt, J. (2021). Facebook futures: Mark Zuckerberg's discursive construction of a better world. *New Media & Society*, 23(2), 237–257. <https://doi.org/10.1177/1461444820929315>
- Hazlett, T. W. (2023). Populist Antitrust: The Case of FTC v. Facebook. *Antitrust Bulletin*, 68, 250. <https://heinonline.org/HOL/Page?handle=hein.journals/antibull68&id=245&div=&collection=>
- Hermans, J., & de Wit, O. (2004). Bourses and brokers: Stock exchanges as ICT junctions. *History and Technology*, 20(3), 227–247. <https://doi.org/10.1080/0734151042000287989>
- Hung, Y.-H. (2019). Investigating How the Cloud Computing Transforms the Development of Industries. *IEEE Access*, 7, 181505–181517. <https://doi.org/10.1109/ACCESS.2019.2958973>
- Hynes, M., & Hynes, M. (2021). The Digital Behemoths. In *The Social, Cultural and Environmental Costs of Hyper-Connectivity: Sleeping Through the Revolution* (pp.

19–37). Emerald Publishing Limited. <https://doi.org/10.1108/978-1-83909-976-220211002>

Jacobides, M. G. (2020). *Regulating Big Tech in Europe: Why, so What, and How Understanding Their Business Models and Ecosystems Can Make a Difference* (SSRN Scholarly Paper 3765324). <https://doi.org/10.2139/ssrn.3765324>

Jenny, F. (2021). *Competition Law Enforcement and Regulation for Digital Platforms and Ecosystems: Understanding the Issues, Facing the Challenges and Moving Forward* (SSRN Scholarly Paper 3857507). <https://doi.org/10.2139/ssrn.3857507>

Kanji, G. K. (1990). Total quality management: The second industrial revolution. *Total Quality Management*, *1*(1), 3–12. <https://doi.org/10.1080/09544129000000001>

Khan, W., Ghazanfar, M. A., Azam, M. A., Karami, A., Alyoubi, K. H., & Alfakeeh, A. S. (2022). Stock market prediction using machine learning classifiers and social media, news. *Journal of Ambient Intelligence and Humanized Computing*, *13*(7), 3433–3456. <https://doi.org/10.1007/s12652-020-01839-w>

Khasawneh, M. (2024). Beyond digital platforms: Gamified skill development in real-world scenarios and environmental variables. *International Journal of Data and Network Science*, *8*(1), 213–220. <https://m.growingscience.com/beta/ijds/6475-beyond-digital-platforms-gamified-skill-development-in-real-world-scenarios-and-environmental-variables.html>

King, M. R., Osler, C., & Rime, D. (2012). Foreign Exchange Market Structure, Players, and Evolution. In *Handbook of Exchange Rates* (pp. 1–44). John Wiley & Sons, Ltd. <https://doi.org/10.1002/9781118445785.ch1>

Kolhar, M., Kazi, R. N. A., & Alameen, A. (2021). Effect of social media use on learning, social interactions, and sleep duration among university students. *Saudi Journal of Biological Sciences*, *28*(4), 2216–2222. <https://doi.org/10.1016/j.sjbs.2021.01.010>

- Kumar, K., Zindani, D., & Davim, J. P. (2019). *Industry 4.0: Developments towards the Fourth Industrial Revolution*. Springer. <https://doi.org/10.1007/978-981-13-8165-2>
- Kuvshinov, D., & Zimmermann, K. (2022). The big bang: Stock market capitalization in the long run. *Journal of Financial Economics*, 145(2, Part B), 527–552. <https://doi.org/10.1016/j.jfineco.2021.09.008>
- Levy, S. (2020). *Facebook: The Inside Story*. Penguin UK.
- Miranda, J., Mäkitalo, N., Garcia-Alonso, J., Berrocal, J., Mikkonen, T., Canal, C., & Murillo, J. M. (2015). From the Internet of Things to the Internet of People. *IEEE Internet Computing*, 19(2), 40–47. <https://doi.org/10.1109/MIC.2015.24>
- Morales, U. R. (2023). *Philosophers in the Technological Age: The New Pythagoreans*. Océano.
- Nigam, H., & Biswas, P. (2021). Web Scraping: From Tools to Related Legislation and Implementation Using Python. In J. S. Raj, A. M. Iliyasu, R. Bestak, & Z. A. Baig (Eds.), *Innovative Data Communication Technologies and Application* (pp. 149–164). Springer. https://doi.org/10.1007/978-981-15-9651-3_13
- Nisbet, R. (2017). *History of the Idea of Progress*. Routledge.
- Norris, P. (2023). Cancel Culture: Myth or Reality? *Political Studies*, 71(1), 145–174. <https://doi.org/10.1177/003232172111037023>
- Pallivalappil, A. S., N, J. S., & K, K. P. (2021). Social Engineering Attacks on Facebook – A Case Study. *International Journal of Case Studies in Business, IT and Education (IJCSBE)*, 5(2), Article 2. <https://doi.org/10.47992/IJCSBE.2581.6942.0135>
- Philbeck, T., & Davis, N. (2018). The Fourth Industrial Revolution: Shaping a New Era. *Journal of International Affairs*, 72(1), 17–22. <https://www.jstor.org/stable/26588339>

- Rehman, M. U., Nautiyal, N., Vo, X. V., Ghardallou, W., & Kang, S. H. (2023). Is the impact of oil shocks more pronounced during extreme market conditions? *Resources Policy*, 85, 103899. <https://doi.org/10.1016/j.resourpol.2023.103899>
- Sarfi, M., Darvishi, M., Zohouri, M., Nosrati, S., & Zamani, M. (2021). Google's University? An Exploration of Academic Influence on the Tech Giant's Propaganda. *Journal of Cyberspace Studies*, 5(2), 181–202. <https://doi.org/10.22059/jcss.2021.93901>
- Schroeder, W. (2016). *Germany's Industry 4.0 strategy*.
- Schwab, K. (2017). *The Fourth Industrial Revolution*. Crown.
- Siebenhüner, B., Arnold, M., Eisenack, K., & Jacob, K. H. (2013). *Long-Term Governance for Social-Ecological Change*. Routledge.
- Stearns, P. N. (2020). *The Industrial Revolution in World History*. Routledge.
- Sundaram, R. K. (2012). *Derivatives in Financial Market Development*.
- Wang, S. P. (2021). *Computer Architecture and Organization: Fundamentals and Architecture Security*. Springer. <https://doi.org/10.1007/978-981-16-5662-0>
- Weber, E. J. (2009). A Short History of Derivative Security Markets. In W. Hafner & H. Zimmermann (Eds.), *Vinzenz Bronzin's Option Pricing Models: Exposition and Appraisal* (pp. 431–466). Springer. https://doi.org/10.1007/978-3-540-85711-2_21
- Wit, H. de, & Altbach, P. G. (2021). Internationalization in Higher Education: Global Trends and Recommendations for Its Future. In *Higher Education in the Next Decade* (pp. 303–325). Brill. https://doi.org/10.1163/9789004462717_016
- Woo, K.-Y., Mai, C., McAleer, M., & Wong, W.-K. (2020). Review on Efficiency and Anomalies in Stock Markets. *Economies*, 8(1), Article 1. <https://doi.org/10.3390/economies8010020>

Wu, T. (2020). *The Curse of Bigness: How Corporate Giants Came to Rule the World*. Atlantic Books.

Wyatt III, L. T. W. (2008). *The Industrial Revolution*. Bloomsbury Publishing USA.

Zetsche, D. A., Annunziata, F., Arner, D. W., & Buckley, R. P. (2021). The Markets in Crypto-Assets regulation (MiCA) and the EU digital finance strategy. *Capital Markets Law Journal*, 16(2), 203–225. <https://doi.org/10.1093/cmlj/kmab005>

8 List of Supplements

8.1 List of Figures

Figure 1, the time graph of prices.....	25
Figure 2, the time graph of market capitalizations	30
Figure 3, the time graph of revenues	32
Figure 4, the time graph of weekly returns.....	33

8.2 List of Tables

Table 1, the correlation analysis.....	27
Table 2, the descriptive analysis of Google.....	28
Table 3, the descriptive analysis of Meta Platforms.....	29
Table 4, the dataset with market capitalizations.....	30
Table 5, the dataset with revenues.....	31
Table 6, summary statistics of Google returns	34
Table 7, summary statistics of Meta returns.....	35
Table 8, the Levene's test of variances	36
Table 9, the Welch test	36
Table 10, the dataset with P/E ratios	37
Table 11, the dataset with P/B ratios.....	38
Table 12, the dataset with prices	51
Table 13, the dataset with returns.....	52

8.3 List of Abbreviations

USD	United States Dollar
COV	Coefficient of Variation
CPS	Cyber-Physical Systems
SE	Stock Exchanges
AFB	The Amsterdam FB

VOC	Dutch East India Company
SEC	Securities and Exchange Commission
NPE	New Product Experimentation
IPO	Initial Public Offering

8.4 List of Appendices

Table 12, the dataset with prices

Date	Google	Meta
25.07.2022	116.64	159.10
01.08.2022	118.22	167.11
08.08.2022	122.65	180.50
15.08.2022	118.12	167.96
22.08.2022	111.30	161.78
29.08.2022	108.68	160.32
05.09.2022	111.78	169.15
12.09.2022	103.63	146.29
19.09.2022	99.17	140.41
26.09.2022	96.15	135.68
03.10.2022	99.57	133.45
10.10.2022	97.18	126.76
17.10.2022	101.48	130.01
24.10.2022	96.58	99.20
31.10.2022	86.70	90.79
07.11.2022	96.73	113.02
14.11.2022	97.80	112.05
21.11.2022	97.60	111.41
28.11.2022	100.83	123.49
05.12.2022	93.07	115.90
12.12.2022	90.86	119.43
19.12.2022	89.81	118.04
26.12.2022	88.73	120.34
02.01.2023	88.16	130.02
09.01.2023	92.80	136.98
16.01.2023	99.28	139.37
23.01.2023	100.71	151.74
30.01.2023	105.22	186.53
06.02.2023	94.86	174.15

13.02.2023	94.59	172.88
20.02.2023	89.35	170.39
27.02.2023	94.02	185.25
06.03.2023	91.01	179.51
13.03.2023	102.46	195.61
20.03.2023	106.06	206.01
27.03.2023	104.00	211.94
03.04.2023	108.90	216.10
10.04.2023	109.46	221.49
17.04.2023	105.91	212.89
24.04.2023	108.22	240.32
01.05.2023	106.21	232.78
08.05.2023	117.92	233.81
15.05.2023	123.25	245.64
22.05.2023	125.43	262.04
29.05.2023	125.23	272.61
05.06.2023	122.87	264.95
12.06.2023	124.06	281.00
19.06.2023	123.02	288.73
26.06.2023	120.97	286.98
03.07.2023	120.14	290.53
10.07.2023	125.70	308.87
17.07.2023	120.31	294.26
24.07.2023	129.87	311.71

Source: Yahoo Finance, 2023

Table 13, the dataset with returns

Date	Google	Meta
01.08.2022	1.35%	5.03%
08.08.2022	3.75%	8.01%
15.08.2022	-3.69%	-6.95%
22.08.2022	-5.77%	-3.68%
29.08.2022	-2.35%	-0.90%
05.09.2022	2.85%	5.51%
12.09.2022	-7.29%	-13.51%
19.09.2022	-4.30%	-4.02%
26.09.2022	-3.05%	-3.37%
03.10.2022	3.56%	-1.64%
10.10.2022	-2.40%	-5.01%
17.10.2022	4.42%	2.56%

24.10.2022	-4.83%	-23.70%
31.10.2022	-10.23%	-8.48%
07.11.2022	11.57%	24.49%
14.11.2022	1.11%	-0.86%
21.11.2022	-0.20%	-0.57%
28.11.2022	3.31%	10.84%
05.12.2022	-7.70%	-6.15%
12.12.2022	-2.37%	3.05%
19.12.2022	-1.16%	-1.16%
26.12.2022	-1.20%	1.95%
02.01.2023	-0.64%	8.04%
09.01.2023	5.26%	5.35%
16.01.2023	6.98%	1.74%
23.01.2023	1.44%	8.88%
30.01.2023	4.48%	22.93%
06.02.2023	-9.85%	-6.64%
13.02.2023	-0.28%	-0.73%
20.02.2023	-5.54%	-1.44%
27.02.2023	5.23%	8.72%
06.03.2023	-3.20%	-3.10%
13.03.2023	12.58%	8.97%
20.03.2023	3.51%	5.32%
27.03.2023	-1.94%	2.88%
03.04.2023	4.71%	1.96%
10.04.2023	0.51%	2.49%
17.04.2023	-3.24%	-3.88%
24.04.2023	2.18%	12.88%
01.05.2023	-1.85%	-3.14%
08.05.2023	11.02%	0.44%
15.05.2023	4.52%	5.06%
22.05.2023	1.77%	6.68%
29.05.2023	-0.16%	4.03%
05.06.2023	-1.88%	-2.81%
12.06.2023	0.97%	6.06%
19.06.2023	-0.84%	2.75%
26.06.2023	-1.67%	-0.61%
03.07.2023	-0.69%	1.24%
10.07.2023	4.63%	6.31%
17.07.2023	-4.29%	-4.73%
24.07.2023	7.95%	5.93%

Source: Yahoo Finance, 2023