



VILNIUS UNIVERSITY
BUSINESS SCHOOL

INTERNATIONAL BUSINESS PROGRAMME

Martynas Jurgis, Bireta

Aivaras, Kuzmickas

BACHELOR THESIS

<i>AKCIJŲ PORTFELIO DIVERSIFIKAVIMO STRATEGIJOS</i>	<i>STOCK PORTFOLIO DIVERSIFICATION STRATEGIES</i>
--	--

Student _____

(signature)

Supervisor _____

(signature)

prof. Deimantė Vasiliauskaitė _____

Name, surname, and scientific degree of the
supervisor

Vilnius, 2023

SUMMARY

VILNIUS UNIVERSITY

BUSINESS SCHOOL

INTERNATIONAL BUSINESS STUDY PROGRAMME

MARTYNAS JURGIS, BIRETA

AIVARAS, KUZMICKAS

STOCK PORTFOLIO DIVERSIFICATION STRATEGIES

Supervisor – prof. Deimantė Vasiliauskaitė

Bachelor thesis prepared - 2023 Vilnius

The Bachelor thesis consists of 47 pages.

Number of tables at work - 10 pcs.

Number of figures at work - 23 pcs.

Number of literature and sources - 52 pcs.

A concise description of the academic paper:

Efficiency of stock portfolio diversification.

Aim and objectives of the academic paper:

To analyze and evaluate various stock portfolio diversification strategies to determine their effectiveness in reducing investment risk and improving return on investment for individual investors. The objective of the paper is to find the stock portfolio that would have the optimal risk and return rate.

Methods used in the academic paper:

Bachelor thesis paper consisted of systematic, logical, and comparative analysis for theoretical literature. The research was conducted by utilizing secondary data collected through analysis of publicly available data sources, while the results were obtained by calculation and optimization methods.

Research conducted and results obtained:

For the research, we chose a simulation-based method and made calculations and optimizations of seven portfolios, compiled by stocks sharing different characteristics.

Conclusions:

All constructed seven portfolios performed better than risk-free investments, according to the report. The “Growth”, “Sector mix”, and “Beta mix” portfolios had the highest returns across all periods, while the “Recession-proof” group had the greatest growth throughout the financial crisis with the overall lowest volatility. Portfolio, diversified by stocks across different sectors, has shown the best results. The optimization process revealed that focusing on discretionary equities during growth periods and consumer staples or healthcare businesses during market downturns further increases performance results.

SANTRAUKA
VILNIAUS UNIVERSITETAS
VERSLO MOKYKLA
TARPTAUTINIO VERSLO (ANGLŲ KALBA) STUDIJŲ PROGRAMA
MARTYNAS JURGIS, BIRETA
AIVARAS, KUZMICKAS
AKCIJŲ PORTFELIO DIVERSIFIKAVIMO STRATEGIJOS

Vadovas - prof. Deimantė Vasiliauskaitė

Darbas parengtas - 2023 m. Vilniuje

Akademinį darbą sudaro 47 puslapiai.

Įtrauktų lentelių skaičius - 10 vnt.

Įtrauktų paveikslų skaičius - 23 vnt.

Literatūros ir šaltinių skaičius - 52 vnt.

Trumpas darbo apibūdinimas:

Akcijų portfelių diversifikacijos efektyvumas.

Darbo tikslas ir uždaviniai:

Išanalizuoti ir įvertinti įvairias akcijų portfelio diversifikavimo strategijas, siekiant nustatyti jų veiksmingumą mažinant investavimo riziką ir didinant investicijų grąžą individualiems investuotojams. Straipsnio tikslas –rasti akcijų portfelį, kurio rizikos ir grąžos norma būtų optimali.

Darbe panaudoti metodai:

Bakalauro darbą sudarė sisteminė, loginė ir lyginamoji teorinės literatūros analizė. Tyrimas atliktas naudojant antrinius duomenis, surinktus analizuojant viešai prieinamus duomenų šaltinius, o rezultatai gauti taikant skaičiavimo ir optimizavimo metodus.

Atlikti tyrimai ir gauti rezultatai:

Tyrimui atlikti pasirinkome simuliacijos metodą ir atlikome spetynių portfelių, sudarytų iš skirtingomis savybėmis pasižyminčių akcijų, skaičiavimus ir optimizavimą.

Darbo išvados:

Tyrimas parodė, kad visų septynių sudarytų portfelių rezultatai buvo geresni nei investicijų be rizikos. “Growth”, “Sector mix” ir “Beta mix” portfelių grąža visais laikotarpiais buvo didžiausia, o “Recession-proof” grupės grąža buvo didžiausia per globalią finansų krizę bei turėjo mažiausią kintamumą visais laikotarpiais. Geriausius rezultatus parodė portfelis, diversifikuotas pagal akcijas iš skirtingų sektorių. Galiausiai, optimizavimo procesas atskleidė, kad orientavimasis į diskrecines akcijas augimo laikotarpiu ir į vartojimo prekių ar sveikatos priežiūros įmonių akcijas rinkos nuosmukio laikotarpiu dar labiau didino veiklos rezultatus.

TABLE OF CONTENTS

INTRODUCTION	10
1. CLASSIFICATIONS OF STOCKS.....	12
1.1 Dividend stocks	13
1.2 Growth.....	15
1.3 Value.....	16
1.4 Cyclical and non-cyclical stocks	17
1.5 Risks while investing in stocks	19
1.5.1 Risk in economic factors.....	20
1.5.2 Industry effect on stocks	21
1.5.3 Risk of stocks in specific	23
1.6 The role of diversification in portfolio creation	25
1.7 Stocks portfolio creation and management	30
2. RESEARCH METHODOLOGY	34
3. RESEARCH DISCUSSION AND FINDINGS.....	42
3.1. Returns of portfolios.....	42
CONCLUSIONS AND RECOMMENDATIONS	56
REFERENCES	59
ANEXES.....	64

LIST OF ABBREVIATIONS

- U.S. – United States
- GICS – Global Industry Classification Standard
- MSCI – Morgan Stanley Capital International
- S&P 500 – the Standard and Poor's 500
- EPS – earnings per share
- P/E – price to earnings
- FDA – Food and Drug Administration
- ECB – European Central Bank
- EV – electric vehicle
- OLS – Ordinary least squares
- SD – standard deviation
- R_x – Expected portfolio return
- R_f – Risk-free rate of return
- StdDev R_x – standard deviation of portfolio return
- MPT – Modern Portfolio Theory
- CAPM – Capital Asset Pricing Model
- NYSE or XNYS – New York Stock Exchange
- XNAS – Nasdaq

TABLES

Table 1. Classification of cyclical and non-cyclical stock sectors and their characteristics....	18
Table 2. Share dilution effect on shareholder’s ownership	23
Table 3. Different studies regarding optimal number of stocks in portfolio	28
Table 4. Stock portfolio types and historical periods for measure.....	40
Table 5. Annual returns of portfolios during different historical periods	42
Table 6. Standard deviation of portfolios during different historical periods	44
Table 7. Sharpe ratio of portfolios during different historical periods.....	46
Table 8. Annual returns of optimized portfolios during different historical periods	49
Table 9. Standard deviation of optimized portfolios during different historical periods	51
Table 10. Sharpe ratio of optimized portfolios during different historical periods.....	53

FIGURES

Figure 1. Stock classification scheme	12
Figure 2. Dividend yield formula.....	14
Figure 3. Risk classifications	19
Figure 4. The effect of diversification on portfolio volatility	27
Figure 5. Construction of stock portfolio.....	32
Figure 6. Sharpe ratio formula	40
Figure 7. Beta Mix portfolio calculations and results, 2007-2009	64
Figure 8. Beta mix portfolio calculations and results, 1991-1994.....	65
Figure 9. Sector mix portfolio calculations and results, 1991-1994.....	66
Figure 10. Beta mix portfolio calculations and results, 2020-2023	67
Figure 11. Optimized Value portfolio calculations and results, 1991-1994.....	68
Figure 12. Optimized Beta mix portfolio calculations and results, 1991-1994.....	69
Figure 13. Optimized Sector mix portfolio calculations and results, 1998-2002	70
Figure 14. Optimized Dividend portfolio calculations and results, 1998-2002.....	71
Figure 15. Optimized Sector portfolio mix calculations and results, 2007-2009	72
Figure 16. Optimized Mix portfolio calculations and results, 2010-2015.....	73
Figure 17. Optimized Growth portfolio calculations and results, 2020-2023	74
Figure 18. Optimized Growth portfolio calculations and results, 1998-2002	75
Figure 19. Optimized Beta mix portfolio calculations and results, 2007-2009.....	76
Figure 20. Optimized Dividend portfolio calculations and results, 2020-2023.....	77
Figure 21. Optimized Beta mix portfolio calculations and results, 2020-2023	78
Figure 22. Optimized Sector mix portfolio calculations and results, 1991-1994	79
Figure 23. Optimized Growth portfolio calculations and results, 2007-2009	80

INTRODUCTION

The problem of the paper:

What is the most optimal diversification strategy for the stock portfolio?

The object of the paper:

Stock portfolio diversification strategies, encompassing various stock types.

The aim of the study:

To ascertain the effectiveness of diversification in minimizing investment risk and maximizing return.

The tasks of the study:

1. To disclose problem analysis of stock portfolio diversification.
2. To analyze scientific literature, methodology of constructing stock portfolio, and importance of diversification
3. To establish a research methodology to assess the effectiveness of diversification.
4. To analyze results from the research on the outcome of various stock portfolios and provide conclusions and recommendations.

Methods applied:

Methods of systematic, logical, and comparative analysis are used to study theoretical literature by Lithuanian and foreign authors. Simulation and optimization were used as research methods to assess the risk-adjusted performance of stock portfolios. Secondary data is collected through analysis of publicly available data sources, mostly Yahoo! Finance.

Structure of the paper:

The course paper is divided into four main sections, each of which highlights one of the four objectives. The first section presents a problem analysis focusing on investment in stocks, the main risks while investing, the definition of diversification, and portfolio construction theories. The second section of the thesis justifies the case study research methodology and describes data collection and organization. In the third section, seven diversified portfolios were analyzed and the findings of a study were presented. The fourth section is filled with conclusions, limitations and recommendations for further findings on this thesis.

Research paper results:

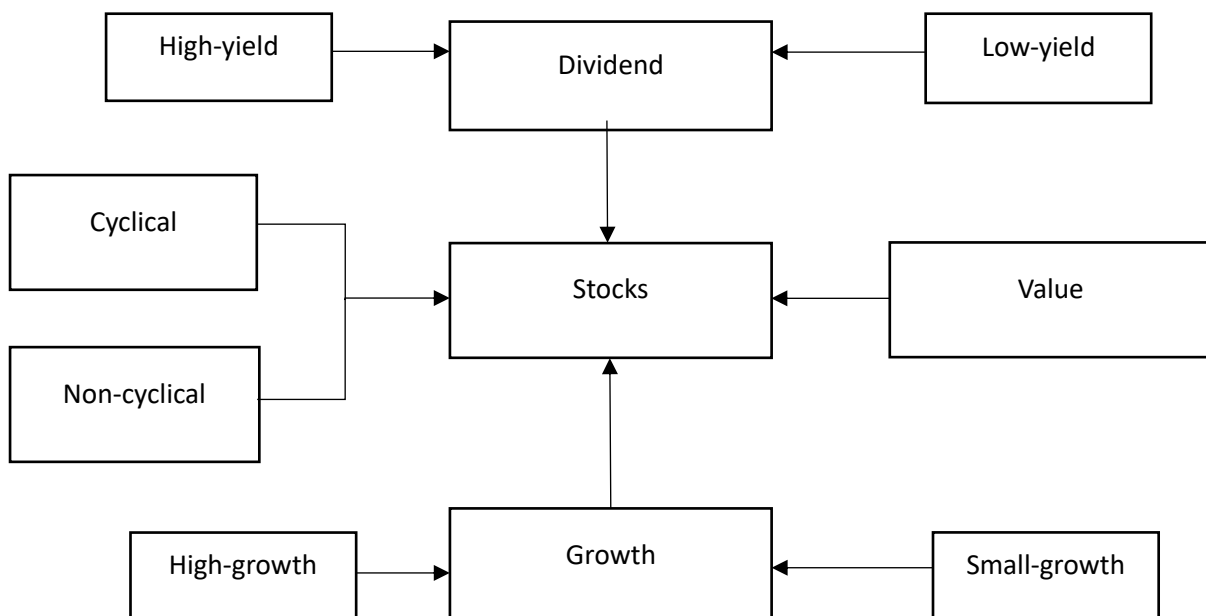
According to the analysis, all seven portfolios, “Growth”, “Recession-proof”, “Dividend”, “Value”, “Mix”, “Sector mix” and “Beta mix”, have shown a performance better than alternative risk-free investment. The “Growth”, “Sector mix” and “Beta mix” portfolios presented the highest returns throughout all periods. “Recession-proof” had one of the lowest returns, but it had the lowest volatility and the highest growth throughout the financial crisis. Sharpe ratio showed the highest performing groupings, including “Growth”, “Sector mix” and “Beta mix”, with sector-focused portfolios outperforming, proving that diversifying with equities from multiple sectors works best. Finally, optimising portfolios showed that reallocating assets by taking advantage of economic cycles, such as focusing on discretionary stocks during growth and consumer staples or healthcare companies during market downturns, was beneficial.

1. CLASSIFICATIONS OF STOCKS

The stock market has always been a significant part of the economy, allowing companies to conveniently raise money to support future growth. However, lack of financial literacy prevented people from actively participating in financial markets (Rahim Khan et al., 2020). In 2020, when most of daily activities were moved indoors due to the COVID-19 pandemic, a combination of increased amount of finance videos on social media platforms and granted stimulus checks surprisingly resulted in massive growth of investment volume between retailers. According to Schwab study in 2021, about 15 percent of all current U.S. stock market investors began investing in 2020. Although such behaviour can benefit the economy, the absence of proper education can leave people with heavy financial losses.

The financial market can be seen as a very complicated system for a beginner investor. There are over 55000 listed companies in the world or more than 10000 just in the U.S. market (The WFE Research Team, 2022). Therefore, choosing and picking the right stock for your portfolio could be an arduous task, which often leads to making rash decisions. However, some public companies have similarities with each other, whether it is in their daily operations, policies, or even valuation. Knowing how to distinguish these traits can facilitate the searching process. This chapter will discuss different types of stocks and their characteristics.

Figure 1. *Stock classification scheme*



Source: made by author

The Global Industry Classification Standard (GICS) is one of the tools that put businesses into the economic area and industry group that best describes how they do business. There are two methods that investors, researchers, and economists use to compare companies. Standard & Poor's and Morgan Stanley Capital International (MSCI) worked together to make GICS. Many professionals in the field of financial management, as well as the MSCI indexes, which include both U.S. and foreign stocks, use the GICS method. There are 11 economic areas at the very top of the GICS order. These are further divided into 24 industry groups, then into 68 industries, and finally into 157 sub-industries. At all four of these stages, each stock can be found by its code.

1.1 Dividend stocks

Dividend stocks are shares of corporations that pay out dividends regularly, as a portion of their earnings. Regular dividend payments are a crucial consideration when choosing stocks for investment portfolios if it is believed that profits “belong” to shareholders, and they have a right to receive them. For many shareholders, the cash flow from dividends is a popular choice of additional source of income, whereas cash retained in the company may not have the same tangible value. (Buła & Jabłoński, 2022)

Compared to a similar no-dividend stock, dividend-paying investment presents a lower market beta with less volatile return. This is mainly because such stocks are more likely to be treated as long-term holdings, with the thesis to profit primarily from received dividends rather than price appreciation. Therefore, investors don't pay as much attention to daily stock price changes, hence dividend-paying stocks are less commonly sold (Hartzmark et al., 2018). For the same reason, dividends become much more attractive, outperforming non-dividend stocks during declining markets, which even further increases divergence the bigger decrease is in the market (Fuller & Goldstein, 2011). However, during bull markets, they may lag behind growth stocks, which offer higher potential returns.

Dividend stocks can be further categorized based on their dividend yield, which can be calculated using the following formula:

Figure 2. *Dividend yield formula*

$$\text{Dividend yield} = \frac{\text{Annual Dividend per Share}}{\text{Current Price per Share}}$$

Source: made by author

The average dividend yield varies by market and sector but typically ranges from 2% to 4%, according to Nasdaq's provided data on "S&P 500 Dividend Yield by Month". This average can fluctuate based on economic conditions, interest rates, and company policies. For context, the S&P 500, a broad market index, has historically averaged around a 2% dividend yield.

High-yield dividend stocks are those with a higher-than-average yield, often sought by income-focused investors. These stocks can provide substantial cash flow, but they may carry higher risks, including the potential for dividend cuts if the high yield is unsustainable when the pay-out exceeds the earnings for a continuous time. In contrast, low-yield dividend stocks might offer smaller dividends but are often associated with more stable companies with consistent growth. These stocks might appeal to investors looking for a balance between modest income and long-term capital appreciation.

While dividend stocks are generally considered less risky than non-dividend stocks, they are not without their risks. One significant risk is the reaction to dividend cuts. Research that covered the Indian equity market found that the announcement of dividend reduction negatively affects abnormal returns (Chatterjee & Tiwari, 2022). A reduction in dividends can signal financial distress or a shift in company strategy, often leading to a negative reaction in the stock market. This is particularly pronounced in high-yield dividend stocks, where the expectation of high dividends is a primary reason for investment. Hence, investors need to be vigilant about the sustainability of dividends when selecting such financial instruments.

In summary, dividend stocks are a key component of many investment strategies, valued for their income generation and lower volatility, which usually become treated as an investment that can continuously generate cash flow without changing asset price. However, investors must carefully consider the types of dividend stocks, their yields, and the associated risks to align them with their investment goals and risk tolerance.

1.2 Growth

Growth stocks represent shares in companies characterized by their potential for above-average growth in earnings or revenues. Distinct from dividend stocks, which offer regular income through dividends, growth stocks attract investors for their potential for significant capital appreciation. The investment appeal in growth stocks is primarily based on the expected rise in stock prices, as these companies often do not pay dividends but rather use the money to reinvest their profits into business expansion. Usually, money from earnings is allocated towards investments in research and development, mergers and acquisitions, or expanding operations.

Most of the stocks in this category can be identified as companies with small market capitalization, of course, there are bigger companies with the same growth rate. Although the majority of them are in the technology sector, ultimately companies with a patent or innovative product/service are the ones that offer a big room for growth and can often be found among sectors of healthcare, financial, or communication services. As MSCI (2023) has shown in their financial index sheet, they identify growth large and mid-cap securities having 5 of the following characteristics:

- Long-term forward EPS growth rate;
- Short-term forward EPS growth rate;
- Current internal growth rate and long-term;
- Historical EPS growth trend;
- Long-term historical sales per share growth trend.

Such stocks are typically more volatile compared to dividend-paying stocks, categorizing them as higher-risk assets. While this heightened volatility can potentially lead to substantial returns over a short period, it also implies greater risk. Contrary to the common perception that growth stocks are always a viable long-term investment option, Emm and Trevino (2014) conducted an extensive study covering the period from 1940 to 2012. Their research revealed that growth stocks, while riskier, actually yielded lower returns compared to the S&P 500 benchmark. Additionally, stocks with small market capitalization, often found within the growth category, are particularly vulnerable. These smaller stocks tend to face the most significant downturns during economic declines, highlighting the additional risk factors inherent in investing in this segment. This behavior occurs from their valuation being heavily

dependent on future earnings potential, which can be uncertain. In bullish market period, growth stocks typically thrive, due to investor optimism, higher tolerance for risk, and good economic conditions to support accelerated growth. However, such behavior leads to increased valuations and stock prices, which, during a bear market, are the most vulnerable stock category that sees the biggest correction in their valuation.

To conclude, growth stocks are important security if an investor is seeking large gains in his portfolio. If such holding is successful it can lead to a higher performance than the benchmark. On the other hand, it is crucial to limit the exposure to these assets to prevent big financial losses during economic decline.

1.3 Value

Differently from growth stocks, value stocks have considerably low price-to-earnings ratios, characterized as shares of companies that appear to be undervalued in the market. They are typically priced lower than stocks of similar companies in the same industry, often due to market overreaction to certain events or unfavourable news affecting the company. These stocks are considered undervalued based on fundamental analysis metrics that show their intrinsic value to be above their current stock price.

Value investing strategy is grounded in the idea of purchasing stocks at a price lower than their intrinsic value and holding them until the market reflects their true worth. This approach requires a thorough understanding of the company's fundamentals, screening financial statements, and a patient investment approach. Value stocks are often associated with companies in mature industries, and they can include large, well-established companies that have temporarily fallen out of favour with investors.

Value stocks are categorized purely through their financial number not accurately reflecting their stock price. Many financial metrics can be utilized to find such assets, such as price-to-earnings (P/E) ratio, book value, or intrinsic value scoring much higher than its current price. However, in the reports of MSCI (2023) and S&P (2023), these globally recognized institutions use the following metrics to find value stocks for their indices:

- Book value to price;
- 12-month forward earnings to price;
- Dividend yield;

- Sales to price.

These methods offer guidance on identifying value stocks, yet they must fulfil specific criteria. As explained in an “Investopedia” article, key indicators like the price-to-book and sales-to-price ratios should be below 1, indicating the stock is trading below its book value. Additionally, whether it's the PE ratio or the 12-month trailing PE ratio, it needs to be significantly lower than that of its industry peers. Lastly, value stock can be identified by having a high dividend yield. It shows that the company is willing to give out a big portion of its earnings, making this stock value, as most of the profit can be made through dividends. On the other hand, it's important to find out if the company's dividend yield is sustainable for the long run by analysing its balance sheet and income statement. (Smith, 2023)

One of the main attractions of value stocks is their potential for significant returns when the market corrects its undervaluation. However, this strategy also involves risks. For instance, a company's stock might be undervalued due to fundamental issues within the company, such as poor management or declining industry prospects. Therefore, distinguishing between genuinely undervalued stocks and those cheap for a reason is a critical skill for value investors.

In summary, value stocks present an opportunity for investors to buy into companies at prices lower than their perceived true value, with the expectation of profit when their actual value is recognized by the market. However, finding value stock requires thorough due diligence, as there can be many hidden reasons for a company's unproportionate valuation.

1.4 Cyclical and non-cyclical stocks

Understanding the distinction between dividend, value, and growth stocks can help investors to have at least an idea of how to diversify them in the portfolio to keep it healthy during economic surprises. Knowing how to sort them into securities that are vulnerable to economic cycles or stable is even more valuable. As it was explained previously, growth companies are sensitive to declines, however, there can be some exceptions to that. For example, a healthcare firm can have a recently approved drug by the FDA, which opens room for high growth, as they can capture a big portion of the market. In this case, the business does have a growth trait, but it will also be resilient during periods of recession, having constant demand for its products, as humans put health a priority for their needs.

The following table will help better discern cyclical and non-cyclical, or defensive, stocks by presenting their traits and sectors.

Table 1. Classification of cyclical and non-cyclical stock sectors and their characteristics

Cyclical	Non-cyclical
The earnings rates of stocks of companies in cyclical sectors tend to rise rapidly during economic growth, but the earnings rates of stocks fall rapidly when the economy slows down.	The profit margins of defense sector companies remain relatively stable as macroeconomic factors change.
“They follow all the cycles of the economy from expansion, peak, and recession all the way to recovery.”	“Defensive industries generally maintain their values during market declines”
<ul style="list-style-type: none"> • consumer discretionary; • technology; • communication services; • financials; • industrials; • real estate. 	<ul style="list-style-type: none"> • healthcare; • consumer staples; • utilities.

Source: Lisa Emsbo-Mattingly et al., 2021; Taulbee, 2001; The Investopedia Team, 2022

Cyclical and non-cyclical stocks represent two distinct categories in the stock market, each responding differently to economic changes. Cyclical stocks are those whose performance is strongly tied to the economic cycle. They belong to sectors, such as consumer discretionary, financials, industrials, and more. One noticeable behavior of cyclical securities is their vulnerability during economic downturns, as reduced consumer spending directly impacts their revenue and profits. As an example, authors of “Fidelity Investments” have found that sectors like information technology and communication services are extremely sensitive during a recession or late economic cycle, scoring a decline in their value by 10-20 %. On the other hand, such equities tend to perform well during economic upswings when consumer confidence and spending are high. During mid cycle, the same sectors report an increase in the price of 10-15 %, while consumer discretionary stocks have a positive 15 % geometric average in the early cycle. As there is more risk involved in such securities, they also play an important role in the portfolio by taking advantage of the recovering market.

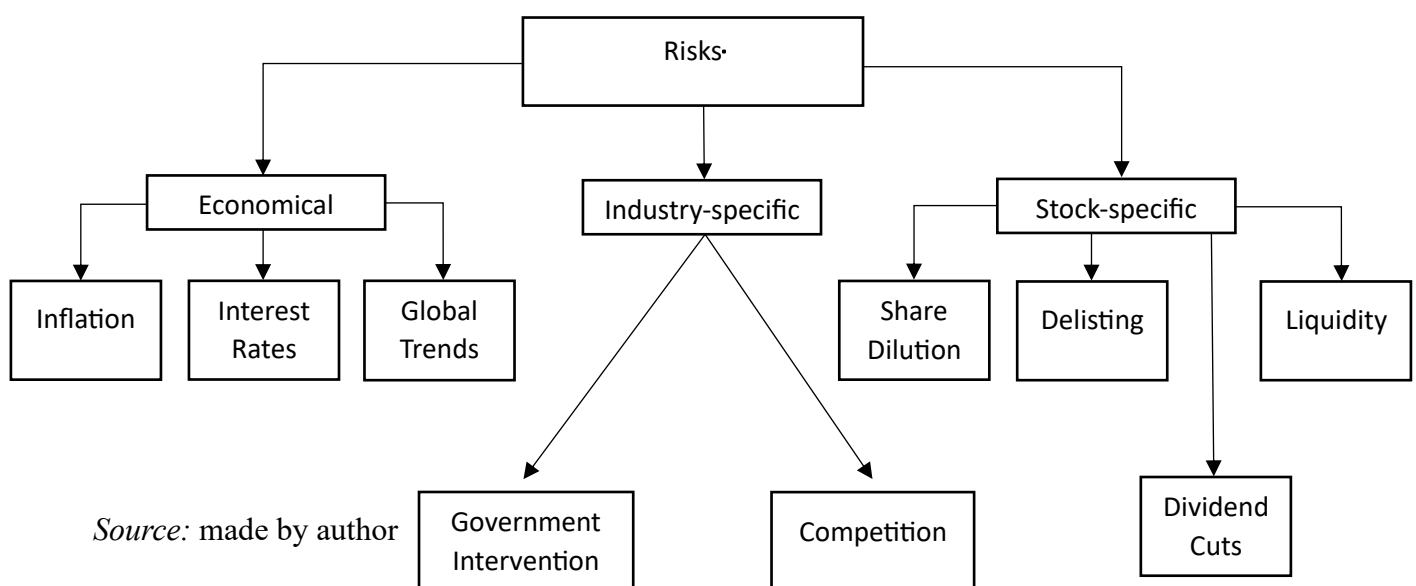
In contrast, non-cyclical stocks, often referred to as defensive stocks, belong to industries that are less sensitive to economic cycles. These include sectors like utilities, healthcare, and consumer staples - industries providing essential services or products that remain in demand regardless of economic conditions. Surprisingly, these sectors have even a positive performance during bad times demonstrating a return of 7-15 % in geometric average. Therefore, non-cyclical stocks offer stability and are less likely to experience large swings in price during economic downturns. It makes them a favored choice for investors seeking to reduce risk in their portfolios during times of economic uncertainty, or even make a profit.

To sum up, apart from other financial assets, like bonds or real estate, having both cyclical and defensive stocks is crucial for diversification. Not only it helps to take advantage of different cycles of the economy, but it also prevents bigger losses during uncertain market conditions, by hedging against them with stable companies.

1.5 Risks while investing in stocks

Investing in stocks is a popular strategy for financial growth, yet it carries inherent risks that can significantly impact an investor's portfolio. Investment in stocks is not as simple as it could look, as it requires a lot of research and following the trends and situations happening in the world. Thus, this section of the thesis focuses on three key areas: economic risks, industry-specific risks, and the risks associated with specific stock actions that can negatively affect its value. Below, we created a scheme to illustrate how these risks are divided:

Figure 3. *Risk classifications*



1.5.1 Risk in economic factors

Economic risks play a crucial role, since they make up the impact of macroeconomic variables, such as **interest rates**, **inflation**, and **global economic trends**, on the performance of the stock market. These variables emphasize the sensitivity of stock investments to macroeconomic conditions, therefore emphasizing the need for investors to maintain awareness of the dynamic economic environment.

As we go further while exploring various economic risks, it becomes noticeable that these risks are not singular in nature but rather include a variety of connected components. **Inflation** stands as one of the most notable factors in this context. The process of prices rising in an economy is known as inflation. Inflation risk, also known as buying power risk, refers to the risk associated with a general price rise that results in a real decrease in the nominal quantity of money compared to before inflation. According to the European Central Bank (ECB), the ideal annual inflation rate is 2 %, but generally, 1-3 % inflation can also be sustainable for the economy. However, if it becomes higher for a longer period, some consequences can happen globally or in certain countries. There is plenty of research done to examine the effect of inflation on the stock market when it becomes high, unfortunately, many of them contradict each other causing more confusion in this topic. While it's a complicated task to find the correct answer, still most authors, including the paper of Jordà et al. (2019), have discovered that high inflation correlates with lower stock valuations. This is because such environment brings uncertainty and decreases consumer spending which leads to lower economic growth.

Inflation can also have a positive effect on the stock market. In most cases, inflation forces companies to raise prices of products or services. If they can manage to avoid higher input costs, this would lead to higher corporate profits, which would increase the sentiment of investors. However, if a business fails to manage uneven input and output costs, it can have a negative effect on them, primarily due to a decline in demand and growth of costs. (Belanová, 2023). In addition, while prices are increasing at a faster pace, people start looking more actively to hedge their money by investing rather than waiting for it to devalue. Many assets gain increased attention, primarily those including stocks, commodities, or real estate. For example, looking at the latter sector, according to Lee and Lee (2014) research, European real estate equities in developed economies have been identified as successful investment vehicles due to their ability to hedge against inflation over an extended period, while in the short run, they will experience lower returns.

Having a comprehensive understanding of the complex and various economic risks, including those linked to inflation, provides a basis for exploring another crucial element of macroeconomic impact: the risks related to **interest rates**. Just like inflation, variations in interest rates have a substantial influence on the financial markets, also having an influence on investment choices and affecting the broader economic environment. The cost of borrowing and the return on savings are significantly impacted by interest rates, which are mostly regulated by central banks.

During the study (González et al., 2016) it was discovered, after conducting a thorough investigation of how a variety of industry sectors reacted to unexpected shifts in interest rates, that these businesses reacted in a variety of different ways. Notably, sectors like consumer staples and financials often have poor performance during unexpected swings in nominal interest rates, especially during times of recession. However, some industries, such as information technology, as well as some subsectors within the energy, industrials, and materials sectors (such as diversified metals and mining), exhibit a positive reaction, which may indicate resilience or the opportunity for investments that are risk-free. The fact that the majority of sectors do not substantially respond to shifts in real interest rates is one of the study's most interesting findings. This finding highlights the complexity and diversity of the nature of industry reactions to changes in the economy. This complex environment shows that although certain industries may fail as a result of fluctuations in interest rates, other industries may provide possibilities that are either steady or even profitable under such situations.

To summarize, economic risks have a crucial impact on stock market performance, focusing on variables like interest rates, inflation, and global economic trends. We explore the complex nature of these possible risks, particularly inflation, which erodes the real value of money. We also included various industry responses to economic fluctuations, for instance, the real estate sector was mentioned for its inflation-hedging capabilities. Furthermore, it delves into the significant effects of interest rate changes on financial markets and investment decisions, while revealing diverse reactions across different industries to these economic shifts.

1.5.2 Industry effect on stocks

It is necessary to have a solid understanding of the risks that are connected to the industry-specific elements that may influence stock performance. The potential for losses or underperformance in a certain sector because of variables like technological changes,

regulatory shifts, market trends, and economic cycles is referred to as industry-effect risks. These dangers are specific to each sector and have the potential to dramatically impact both the value and the stability of stocks within that industry.

If we look at the automotive industry, as an example, we will find that many known vehicle manufacturers are creating innovations and moving deeply to digital transformation. Therefore, the enterprises that assume a leading position in the development of innovative services and goods connected with the process of digitalization would possess an important benefit in their ability to compete within the automotive sector. The findings indicate a compelling need for putting resources towards implementing appropriate strategies for adapting to the process of digital transformation. Thus, manufacturers hope to gain enhanced profitability, productivity, and competitiveness as a consequence (Llopis-Albert et al., 2021). Moreover, the Chinese electric vehicle (EV) sector, headed by businesses like “Nio”, is well-positioned to threaten Tesla's power. While Tesla has been an innovator in the EV sector under Elon Musk's leadership, its issues in scaling up production and maintaining a fully integrated model have created openings for Chinese rivals. Companies like „Nio” benefit from China's large market size, strong government backing, and growing technical capabilities. They are fast-growing, relying on local supply systems, and looking to enter worldwide markets like Europe (Teece, 2018).

Another crucial industry-effect was clearly visible in the COVID-19 pandemic, when stock prices of pharmacy companies increased due to the high demand for vaccines. During this period, the stock prices of key pharmaceutical companies like Pfizer, Moderna, AstraZeneca, Novavax, and Sanofi, were especially active in vaccine development, showed significant fluctuations influenced by their progress in vaccine research and competitive dynamics within the industry. High Pearson correlation coefficients in stock market analysis revealed a strong relationship between the advancements in vaccine development and stock price movements. While Moderna and AstraZeneca experienced direct positive impacts on their stock prices correlating with their vaccine development achievements. Pfizer was the least influenced by competitors' vaccine progress. In contrast, Novavax's stock showed a way heavier response to the collective development landscape in the vaccine industry. This competitive environment during the pandemic not only brought global recognition to these companies but also significantly influenced their economic returns. Vaccine development played a crucial role in stabilizing and sometimes boosting their share prices (Vera Ramírez & Valencia Serna, 2022).

1.5.3 Risk of stocks in specific

We showed different types of risks which associates with stock investments in previous sections, concentrating on macroeconomic issues such as inflation and interest rates, as well as industry-specific problems such as competitive dynamics. These elements, taken together, offer a picture of the external environment in which stock investments function. However, it is critical to investigate the underlying risks that are directly related to certain stocks.

In this section on stock market risks, we will focus on the unique risks associated with different stock investments. This includes the risk of share dilution, the risk of delisting, the liquidity risk, and the implications of dividend cuts. Examining these risks provides us with a more important knowledge of the complexity and problems related to stock market investing, helping us to make more educated and smart investment decisions.

When a firm issues new shares of stock, the proportion of current shareholders' ownership in the company decreases. It is also known as equity or share dilution. When optionable instruments, such as employee stock options, are exercised, dilution occurs. The simple table below illustrates how the shareholder's A percentage of ownership of the company changes when an additional 1000 shares are issued to shareholder B (Quoc BAO et al., 2020):

Table 2. *Share dilution effect on shareholder's ownership*

Description	Total Outstanding Shares of A (shares)	Ownership Proportion of B (%)	Ownership Proportion of the Existing Shareholders of A (%)
Pre-investment (made by B)	10,000	0%	100%
Post-investment (made by B)	11,000	9.1%	90.9%

Source: Quoc BAO et al., 2020

Diluted earnings per share may also be calculated by public corporations to estimate the possible impact of dilution on stock prices if stock options are exercised. Dilution reduces the book value of the shares as well as the company's profits per share. Moreover, shareholders lose their voting power due to the increased number of stocks.

Thus, equity or share dilution happens when a corporation issues new shares, reducing the ownership percentages of present shareholders. In the example before, shareholder B's post-investment ownership is 9.1%, reducing previous shareholders' holding from 100% to 90.9%. Because of the increasing number of shares, this dilution affects the company's diluted EPS and diminishes shareholders' voting power.

Another specific risk while investing in stocks is delisting. It is a case when a company no longer has active stocks in the exchange market and investors cannot buy them. When a company delists voluntarily, it does so on its own. When a company delists involuntarily, the securities regulator or the stock exchange makes it happen. The reason is usually breaking the rules for showing and/or going out of business. Delisting that isn't the company's choice is usually out of the hands of management and owners. A private delisting, on the other hand, requires a lot of thought and weighing of costs and benefits. People usually think that being listed comes with a lot of benefits, such as more exposure and trustworthiness, easier access to a wider range of funding sources, and quick access to stock through secondary offers. Because the costs of being listed, like listing fees and compliance costs, are higher than the benefits, management can decide to delist the company on their own if they don't think the benefits are strong enough (OECD, 2020).

According to Naik & Reddy (2021), the liquidity of the stock market has a significant influence on how much money consumers might expect to earn from stocks. If a stock's liquidity changes, it influences how much the stock is worth. Liquidity is more essential than other factors in determining stock prices. In simpler markets with less competition, the amount of money needed to own shares has a significant influence. However, not all researches agree. Some argue that liquidity has little impact on stock prices in markets that aren't well-linked to the rest of the globe. Furthermore, the danger of the market being liquid or not (market liquidity risk) influences stock prices. This risk may affect how much money individuals earn from stocks, particularly when the market is volatile. Overall, how simple or difficult it is to buy or sell stocks (liquidity) and the risk associated with it is critical in understanding stock prices.

A dividend reduction occurs when a firm decreases or removes the dividend it pays to its shareholders. A dividend decrease may have an influence on investor sentiment and the stock price of a firm. Dividends are often seen by investors as an indication of a company's financial health and stability; therefore, a reduction may result in a drop in stock price since it might signify possible troubles or a change in the company's capacity to create profits. In

certain situations, however, investors may consider a dividend decrease as a wise option that contributes to the company's long-term financial health. So, to avoid dividend cutting companies usually offer to their shareholders scrip dividends. Scrip dividends are an alternative to cash dividends, where shareholders receive additional shares instead of cash. According to Feito-Ruiz et al. (2020) shareholders, particularly those who rely on dividends for income, are directly impacted by these cuts. The author also suggests that attempts to mask these cuts with scrip dividends fail in deceiving the market or mitigating the negative perception.

To sum up, investing in stocks is a common way to make money, but it comes with risks that depend on the economy, the industry, and the stock itself. The literature that we looked at says that economic risks include interest rates, inflation, and global trends which can affect the stock market. Not only inflation can lower the real value of money, but it can also sometimes boost business profits and investor confidence. Changes in interest rates, which are controlled by central banks, have a big effect on the financial markets and company decisions, and different industries react in different ways. The move toward technology in the car industry and the competition in the electric vehicle market are two examples of industry-specific risks. The pharmaceutical industry's changes during the COVID-19 outbreak are another example. One risk that is unique to a stock is share dilution, which lowers the ownership amounts and vote rights of current shareholders. The danger of being delisted, which means that a company's stock is taken off the market. Moreover, there are risks of liquidity, which can lower stock prices and make the market less efficient. There are also effects of dividend cuts on investor emotions and stock prices. These risks show how hard it is to invest in the stock market and how important it is to make smart choices.

1.6 The role of diversification in portfolio creation

Diversification is a very important part of building an investment portfolio as it mainly lowers the risk. Spreading investments across different industries, geographical areas, and market sectors may help an investor minimize the effects of market instability and the bad effects of a particular stock or sector not performing well. When a company makes a mistake like designing a new aircraft or phone screen that doesn't work as intended or when bad things happen to it like a charismatic corporate leader dying in a ski accident or a technological advancement rendering a particular product suddenly outdated - it can suffer a significant loss of value (Sodini & Viceira, 2020). Most of these peculiar occurrences are unexpected,

particularly to outsiders. Putting all of our money into one business puts us at risk for such disastrous outcomes.

Since different assets often do differently when market conditions change, diversification helps to spread out the profits. For example, when one area is going down, another might be going up, which would keep the total success of the portfolio in check. Diversification also follows the idea of “not putting all your eggs in one basket”, which means you can avoid losing a lot of money. Moreover, it lets buyers benefit from the growth of many different markets and areas, which could lead to more stable and steady long-term profits.

Diversification is critical in risk management for investments, serving as the principal protection against the unpredictability of financial markets. Diversification allows investors to lower their total risk exposure by mixing financial assets that have a weakly positive correlation on average, so that prospective losses in one asset class may be compensated (at least partly) by gains in other asset classes. In times of economic downturn or crisis, an asset that is uncorrelated or negatively correlated with another asset or portfolio becomes a so-called safe haven (Díaz et al., 2022).

However, sometimes over-diversification is also a potential risk because it could minimize investor's returns. Holding too many stocks is expensive, both in terms of the multiple transactions required to establish the original portfolio and the opportunity cost of maintaining a big, diverse portfolio. The more stocks in a portfolio, the more likely it is to underperform the benchmark after fees (Alexeev & Tapon, 2013).

In the diversification process, it is crucial to choose the optimal amount of assets to avoid any previously mentioned problems that diminish the risk-return ratio. This task has been extensively studied and debated over many years. Moreover, authors have utilized various statistical and mathematical methods (e.g., standard deviation, correlation, regression (OLS), Kurtosis, etc.) to arrive at an answer, which leads to different results that might just confuse people who want to generate a portfolio through research recommendations. To simplify the process, the standard deviation was used to present the information, which can be visually accessed by the research conducted by Lucas (2000) in the following table:

Figure 4. *The effect of diversification on portfolio volatility*

<i>No. of Stocks</i>	<i>Standard Deviation (%)</i>	
	<i>Monthly</i>	<i>Annual</i>
1	16.0	55.4
2	11.7	40.4
3	9.8	33.9
4	8.7	30.2
5	8.0	27.7
10	6.3	21.9
20	5.3	18.3
100	4.3	14.9
500	4.1	14.1

Source: Lucas, 2000

This table shows the principle of diminishing returns in risk reduction through diversification. For instance, when the number of stocks in a portfolio goes from 1 to 10, the monthly standard deviation drops from 16,0 % to 6,3 % and the annual standard deviation declines from 55,4 % to 21,9 %. This means that the risk is much lower. However, the further reduction in standard deviation is not as noticeable once the portfolio has more than 10 stocks. For example, when the portfolio has 20 stocks, the monthly standard deviation drops to 5,3 % and the yearly standard deviation drops to 18,3 %. Based on these numbers, adding up to 10 stocks at first can greatly lower volatility and improve the stability of returns. However, adding more stocks after this point seems to have a much smaller effect on the risk profile of the portfolio.

To summarize, until 10 stocks, the change in standard deviation is significant, and it reduced the portfolio volatility by a lot. From 10 stocks, the change in SD is not significant enough, that it would not be necessary to increase because it will limit returns which noticeable change in risk.

Some other authors have come to similar conclusions utilizing the same research method, which is presented in the table below.

Table 3. *Different studies regarding optimal number of stocks in portfolio*

Author(s) and Year	Market(s) and the Observed Period	Method(s)	Number of Stocks or Other Information
Evans and Archer (1968)	U.S. 1958–1967	Equally Weighted Portfolio, Standard Deviation	8–10 stocks
Solnik (1974)	U.S., UK, Germany, France, Switzerland, Italy, Belgium and Netherlands 1966–1971	Standard Deviation	10–15 stocks
Irala and Patil (2007)	India 1999–2005	Standard Deviation	10–15 stocks
Ahuja (2015)	Pakistan 2007–2009	Standard Deviation	10 stocks
Zhou (2014)	U.S. 2008–2013	Standard Deviation, Regression, T-test, F-test	10 stocks
Alexeev and Dungey (2015)	U.S. 2003–2011	Unconditional Correlation, Standard Deviation	7 (10) stocks
Bradfield and Munro (2016)	South Africa 2002–2014	Standard Deviation, 4 Different Weighting Schemes	15–19 for equally-weighted portfolios
Norsiman et al. (2019)	Malaysia 2010–2014	Standard Deviation, Covariance, Correlation	45 stocks (daily basis) 35 stocks (weekly basis)

Source: Evans and Archer, 1968; Solnik, 1974; Irala and Patil, 2007; Ahuja, 2015; Zhou, 2014; Alexeev and Dungey, 2015; Bradfield and Munro, 2016; Norsiman et al., 2019

When we looked at several studies on stock portfolios, we realized that many experts agree on certain things but not on everything. Evans and Archer, for example, believe that holding 10-15 stocks in a portfolio is a decent quantity to limit risk, as do Zhou, Alexeev, and Dungey. However, they do not all perceive things the same way. Evans and Archer question whether more than ten stocks are worth it. Solnik believes that having equities from different countries, particularly Europe, is a good idea, and Irala and Patil agree. Ahuja discovered that the same concept works in Pakistan as well. What's interesting is how Alexeev and Dungey argue that in difficult economic situations, you may not even need that many stocks. According to Bradfield and Munro's research, there should be equality between the weights of stocks in the portfolio and the number of shares should vary from 15-19. While Norsiman et al.'s study in Malaysia shows that it is beneficial to have around 45 daily-basis stocks in a portfolio.

The researchers' findings are also influenced by the period and location of this research. Solnik's study was completed in the late 1960s and early 1970s, and it included multiple countries, including the United States and others in Europe. Irala and Patil concentrated only on India during a period of rapid economic growth, from 1999 to 2005. Ahuja examined Pakistan's stock market from 2007 to 2009, a particularly difficult period for the global economy. Zhou researched the US market from the immediate aftermath of the 2008 financial crisis to 2013, while Alexeev and Dungey's study covered both before and during the crisis, from 2003 to 2011. Bradfield and Munro's research spans over a decade in South Africa, from 2002 to 2014, while Norsiman et al.'s study in Malaysia covers a shorter period, from 2010 to 2014. It is obvious that the location and timing of these experiments had a significant influence on what the researchers discovered regarding stocks and risk.

In conclusion, the fact that diversity allows you to manage financial risks and find a balance between possible losses and gains across a range of asset types shows how important it is when putting together a portfolio. Even though it talks about how diversity can be helpful, especially when the economy is unstable, it also warns about the risks that come with having too much diversity, such as lower returns and higher management costs. The right number of assets for a portfolio is one of the most important things to think about. According to research, the amount of risk is greatly lessened up to a certain number of stocks. After that number, the benefits become less important. We found out that the optimal number of stocks in a portfolio is around 8-15. It's hard to come up with a diverse strategy that works for everyone in portfolio management, because the right number of companies depends on the economy and location.

1.7 Stocks portfolio creation and management

The investor's primary responsibility is to look at needs, create a portfolio in which risk and acceptable yield are balanced, and improve investment conditions by providing the totality of securities with investment characteristics that would be impossible by selecting one or more shares separately.

Portfolio investing enables you to plan, assess, and manage the end outcomes of all investment operations in various risk areas. Typically, the portfolio's composition contains a certain collection of diverse stocks with varying degrees of risk and yield. In this way, a portfolio of shares is an instrument through which the investor may secure the amount of projected yield with little risk.

A thorough evaluation of different types of risks, such as market, credit, and cash risks, is an important part of portfolio management. Investors must understand the risk levels of their investments. Risk management that works is not a one-time thing, but an ongoing process. The buyers must always keep an eye on the portfolio and adjust it as needed to keep the risk level at a level that is reasonable and in line with the investor's financial goals. This flexible method makes sure that the stock stays stable during market changes and in line with the investor's goals.

Another crucial thing while managing a portfolio, is to pay close attention to how investment choices will affect your taxes. To lower your tax bill and get a better return on your investment, you need to use tax-efficient spending techniques. Tax-efficient portfolio management includes making smart choices like whether to invest in tax-free bonds or tax-deferred options, which can have a big effect on results after taxes. Also, if there are way too many stocks collected inside a portfolio it could be hardly manageable and the taxes could be way higher than returns (William Blair, 2022).

Furthermore, advanced technologies are the tools that really help investors to create their desired, most optimal stock portfolio, and portfolio management changed a lot since the invention of new technologies. There are now a lot of tools and platforms available to investors that give them information about market trends, thorough portfolio analysis, and possible investment possibilities. With these technological tools, portfolio management is more accurate and streamlined, and investors can make smart choices based on detailed data analysis and

market predictions. All the newest data is available on the Internet and people can easily get access to this data while doing simulations of their portfolios or returns.

To sum up, when constructing a stock portfolio, it is recommended to consider the following factors:

- risk level (investment safety);
- yield;
- liquidity;
- economic, industry effect.

It is rare to discover shares that are low risk, high yield, and liquid, as well as virtually immune to outside factors. As a result, compromise is unavoidable.

If a stock is dependable, its yield level is generally low, since investors who choose dependable stocks by bidding high prices reduce the yield. The primary purpose of portfolio creation and management is to obtain the best possible mix of investor risk and return. In other words, the optimal collection of investment instruments is intended to reduce the investor's risk while increasing the return on the securities portfolio.

To build a mixed, diversified stock portfolio there are several well-known models which help investors to create and diversify their investment portfolios. In 1952, Harry Markowitz presented the Modern Portfolio Theory (MPT), which changed the way we think about building portfolios (Markowitz, 1952). Markowitz's plan highlights how important it is to spread out investments and look at how different types of assets are related. MPT says that a portfolio's risk and return are not just the weighted average of its assets; they also depend on how these assets interact with each other. It also mentions that an investor can lower portfolio risk for a given amount of expected return by spreading their money across different assets that don't exactly connect with each other. This idea led to the concept which is a set of ideal stocks that offer the best expected return for a certain level of risk or the lowest risk for a certain level of expected return.

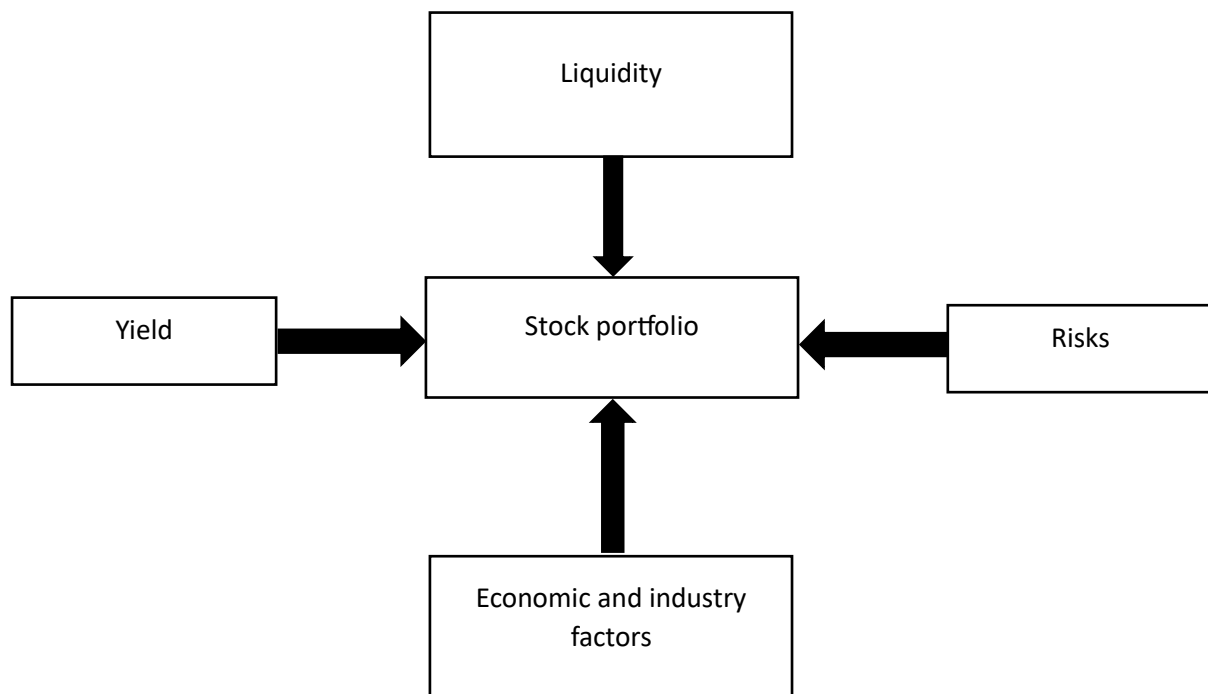
Furthermore, in the 1960s William Sharpe in his book introduced a new model called "The Capital Asset Pricing Model" (CAPM), which is one of the most important ideas in modern portfolio management (Sharpe, 1966). Investors can use CAPM to figure out how projected return and risk in a strategy are related. This model says that an investment's predicted return is directly related to its risk, which is shown by beta. The beta shows how much the

returns on a stock are affected by the returns on the market. According to this model, an investor can only receive greater returns if decides to take more risks. The Sharpe Ratio, which is a measure of risk-adjusted return, can only be found with Sharpe's model. It measures how much extra return is gotten for the extra instability that comes with having a risky asset. In other words, it compares an investment's return to its risk.

While MPT centers on portfolio diversification and the interplay of various assets to minimize risk for a given return, the Sharpe Ratio is a crucial derivative indicator used by CAPM to focus on the link between an individual asset's risk (beta) and its predicted return. Both models have profoundly influenced investment strategies, but they differ in focus: MPT on portfolio composition and CAPM on the risk-return profile of individual assets.

After reviewing the literature, it was discovered that the stock portfolio is influenced by many external and internal environmental elements that have an impact on the construction and maintenance of the stock portfolio. Thus, below we presented a scheme of how external and internal factors appear while constructing a stock portfolio (Figure 4).

Figure 5. *Construction of stock portfolio*



Source: made by author

Based on the scheme that was generated, it is possible that the stock portfolio might be significantly impacted by unforeseen shifts in the economy or a particular sector. When making

a careful selection of stocks, investors are required to do extensive research and decide the appropriate balance between the potential rewards and dangers associated with each company. When considering the liquidity of a stock, this aspect shows whether or not the stock may be purchased or sold on the market with relative ease, as well as whether or not the price of the share will be impacted by this availability.

Thus, investors must find a balance between risk and the amount of money they wish to earn. A solid portfolio has a variety of companies, each with its own risk and potential for profit, that help in achieving desired returns with minimal risk. When choosing stocks, consider how risky they are, how much money they might earn, how simple it is to sell them, and the influence of the economy and industry. Because it is difficult to locate companies that are both low-risk and high-paying. For instance, trustworthy stocks often do not generate as much money since they are in high demand. Some of the already known portfolio creation models invented by William Sharpe or Harry Markowitz are crucial for investors to figure out how projected returns and risks are related or why diversification inside the portfolio is so important. In this case, to handle portfolios effectively investors must also look at the possible market or credit risks and always make changes when conditions of the market change. Buyers also have to consider taxes and use tax-efficiency methods to get the highest returns after applying taxes. Moreover, adding new technologies has made portfolio management even better by giving tools for deep market research and investment models, as well as calculating the different weights of each stock in a portfolio. The key objective is to combine these elements in the best manner possible to decrease risk and enhance profits from the portfolio, while the stock portfolio is impacted by several factors both outside and within the market, which might modify how it is built and managed.

2. RESEARCH METHODOLOGY

Understanding the performance of different stocks can help to decide which of them to focus more on during certain economic conditions. However, the performance of assets varies deeply through various historical times, therefore, it's crucial to have a diversified portfolio to avoid market uncertainties while maximizing the performance. This research aims to analyze and evaluate various stock portfolio diversification strategies to determine their effectiveness in reducing investment risk and improving return on investment for individual investors. In this chapter, the methodological process of the research will be explained to achieve the objectives that are set below.

Objectives of this research:

1. Identify the portfolio with the highest returns
2. Find the least volatile portfolio
3. To find the most optimal asset group

To effectively meet the aims and objectives of this study, firstly it's important to decide for what type of individual the portfolio is being measured. This is because retailers and institutions have distinct conditions in portfolio management. The balance of assets under management in big institutions is incomparably higher, hence the risk of appetite is usually lower than for retailers. Additionally, finance firms have the advantage in trading fees therefore they are not limited to actively traded securities as much as ordinary individuals do. Many more conditions apply for each entity, but for the sake of relevance, this research is going to look for portfolio optimization strategies of retailers.

To achieve the objectives of our research, we will construct seven distinct stock portfolios employing a simulation-based approach. Taking into account the discussed literature in the previous chapter, the portfolio will consist of 10 stocks to have an optimized standard deviation without further affecting the possible return due to over-diversification. More specifically, each stock will have the same weight in the portfolio (10 %). Each portfolio will also be composed of a diversified mix of different types of stocks covered in the previous chapter. This diverse composition will allow us to analyze type-specific performance as well as individual stock behavior within these sectors. Each of the 7 variations will distinguish itself by different risks, growth prospects, sensitivity to economic cycles, and resistance to recession.

According to these conditions, here is the list of 7 portfolio types:

- Growth
- Recession-proof
- Dividend
- Value
- Mix
- Sector mix
- Beta mix

The first 4 asset allocations will be composed of assets that share similar characteristics, for example, only growth stocks, companies that perform the best during economic downturns, dividend-intensive companies, or value stocks. The rest portfolios are made by mixing several types of securities. To avoid discrepancy, most of the assets in portfolios will be made of large capitalization stocks or the biggest stocks by market capitalization that represent specific industries. In addition, companies were also filtered to be publicly listed no later than the earlier year of the periods analyzed in our research. Lastly, only companies that are listed on the New York Stock Exchange (NYSE or XNYS) or NASDAQ (XNAS) will be chosen. According to our literature analysis and information about stocks that were gathered from secondary data, we created seven distinct portfolios each consisting of 10 carefully selected stocks.

The first analysed asset group focuses purely on growth, containing stocks that specify in increasing revenue and earnings over time. Such companies also focus on reinvesting earnings, rather than paying out dividends, hence most of them distribute a low percentage of dividends (<2 % yield) or don't pay any at all. Most of them belong to sectors, such as technology, healthcare, financials, or communication services. Such characteristics should guarantee outperformance among other examples during economic growth while being vulnerable during a recession. Below is the composition of the portfolio:

- 1) Apple Inc. (XNAS:AAPL)
- 2) Microsoft Corporation (XNAS:MSFT)
- 3) The Walt Disney Company (XNYS:DIS)
- 4) Intel Corporation (XNAS:INTC)
- 5) Amgen inc. (XNAS:AMGN)

- 6) International Business Machines Corporation (XNYS:IBM)
- 7) Eli Lilly and Company (XNYS:LLY)
- 8) Novo Nordisk A/S (XNYS:NVO)
- 9) S&P Global Inc. (XNYS:SPGI)
- 10) Comcast corporation (XNAS:CMCSA)

The recession-proof portfolio is strategically designed to withstand economic downturns, featuring a selection of stocks known for their resilience and stability. This portfolio predominantly includes companies with a track record of steady earnings and a strong market presence, often in essential service sectors. These firms typically exhibit less volatility during economic contractions, making them ideal for defensive investing. Most of them are primarily involved in consumer staples, utilities, and healthcare, sectors that tend to be less sensitive to economic cycles. The portfolio composition is as follows:

- 1) Johnson & Johnson (XNYS:JNJ)
- 2) The Procter & Gamble Company (XNYS:PG)
- 3) The Coca-Cola Company (XNYS:KO)
- 4) PepsiCo, Inc. (XNAS:PEP)
- 5) Walmart Inc. (XNYS:WMT)
- 6) McDonald's Corporation (XNYS:MCD)
- 7) NextEra Energy, Inc. (XNYS:NEE)
- 8) The Southern Company (XNYS:SO)
- 9) 3m Company (XNYS:MMM)
- 10) Duke Energy Corporation (XNYS:DUK)

The following asset group is considered as “Dividend” because it is compiled by securities that have a strong history of dividends, as many of them are considered dividend aristocrats – stocks that are part of S&P and have increased dividends for more than 25 years consecutively. As of today, the dividend yield of companies listed below ranges from 2,56 % to 6,66 %, leaning towards the higher dividend yield. In addition, these assets are also stable with predictable cash flows, have diversified and resilient business models, and are responsible for shareholder returns. Below is the list of described securities:

- 1) AT&T Inc. (XNYS:T)
- 2) Exxon Mobil Corporation (XNYS:XOM)
- 3) Chevron Corporation (XNYS:CVX)

- 4) Kimberly-Clark Corporation (XNYS:KMB)
- 5) T. Rowe Price Group, Inc. (XNAS:TROW)
- 6) The Coca-Cola Company (XNYS:KO)
- 7) 3M Company (XNYS:MMM)
- 8) Pfizer Inc. (XNYS:PFE)
- 9) Merck & Co., Inc. (XNYS:MRK)
- 10) JPMorgan Chase & Co. (XNYS:JPM)

The Value portfolio is a carefully curated collection of stocks that are undervalued in the market compared to their intrinsic worth. These companies typically boast robust financials and stable earnings, yet are priced below their potential due to various market factors. The value investing approach aims to identify and capitalize on these market inefficiencies. This portfolio includes companies from diverse industries, offering a balanced mix of risk and potential for long-term capital appreciation. The portfolio composition is as follows:

- 1) Public Service Enterprise Group Incorporated (XNYS:PEG)
- 2) JPMorgan Chase & Co. (XNYS:JPM)
- 3) Wells Fargo & Company (XNYS:WFC)
- 4) Cisco Systems, Inc. (XNAS:CSCO)
- 5) Intel Corporation (XNAS:INTC)
- 6) The Walt Disney Company (XNYS:DIS)
- 7) General Electric Company (XNYS:GE)
- 8) Caterpillar Inc. (XNYS:CAT)
- 9) The Boeing Company (XNYS:BA)
- 10) Ford Motor Company (XNYS:F)

Starting from mixed portfolios we created an asset group that is structured to provide a balance between companies with high-growth potential, mainly from technology or finance sectors, and safe stocks that have a constant demand for their production or services. Through a diversified mix of stocks from various sectors, this example was designed for investors who seek both capital appreciation and stability in their investments.

- 1) Apple Inc. (XNAS:AAPL)
- 2) Microsoft Corporation (XNAS:MSFT)
- 3) Johnson & Johnson (XNYS:JNJ)
- 4) Pfizer Inc. (XNYS:PFE)

- 5) The Coca-Cola Company (XNYS:KO)
- 6) The Procter & Gamble Company (XNYS:PG)
- 7) S&P Global Inc. (XNYS:SPGI)
- 8) Exxon Mobil Corporation (XNYS:XOM)
- 9) Verizon Communications Inc. (XNYS:VZ)
- 10) 3M Company (XNYS:MMM)

The next portfolio has each stock representing one of the leading companies within its sector, excluding real estate. This provides a well-rounded investment approach that covers a wide range of economic activities. Such a strategy aims to capture growth and stability across different economic cycles, making it a robust choice for people who are seeking for diversified exposure. This portfolio includes:

- 1) Apple Inc. (XNAS:AAPL)
- 2) Berkshire Hathaway Inc., (XNYS:BRK.A)
- 3) Electronic Arts Inc. (XNAS:EA)
- 4) UnitedHealth Group Incorporated (XNYS:UNH)
- 5) BHP Group Limited (XNYS:BHP)
- 6) Union Pacific Corporation (XNYS:UNP)
- 7) Walmart Inc. (XNYS:WMT)
- 8) The Home Depot, Inc. (XNYS:HD)
- 9) NextEra Energy, Inc. (XNYS:NEE)
- 10) Exxon Mobil Corporation (XNYS:XOM)

The last combination of different securities is based on their volatility. Half of the portfolio includes high-beta stocks (no less than 1,5 beta), that are known for their greater volatility and potential for higher returns in bullish markets, while the rest contains low-beta stocks (no more than 0,5 beta) to offer stability and resilience in dynamic markets. This balanced design aims to take advantage of favourable economic conditions while creating a hedge against an adverse environment for the stock market. Such composition includes the following equities:

- 1) Advanced Micro Devices, Inc. (XNAS:AMD)
- 2) Valero Energy Corporation (XNYS:VLO)
- 3) Applied Materials, Inc. (XNAS:AMAT)
- 4) Lam Research Corporation (XNAS:LRCX)

- 5) Schlumberger N.V. (XNYS:SLB)
- 6) Eli Lilly And Company (XNYS:LLY)
- 7) Walmart Inc. (XNYS:WMT)
- 8) The Procter & Gamble Company (XNYS:PG)
- 9) Novo Nordisk A/S (XNYS:NVO)
- 10) Merck & Co., Inc. (XNYS:MRK)

After creating the composition of portfolios, the next significant step is to pick different historical periods to simulate each of them. Times chosen will also vary from each other to avoid creating an advantageous environment for a specific portfolio, thus avoiding statistical bias. For this task period of recession, economic recovery and market uncertainty will be included. To fit in these criteria, here is the list of 5 different historical times:

- 1990s economic recovery (1991-1994)
- Dot-com bubble and burst (1998-2002)
- Global financial crisis (2007-2009)
- Post-financial crisis recovery (2010-2015)
- Covid-19 period (2020-2023)

As it is seen the periods chosen for the research represent very distinct market conditions, but in the same way, some of them share similar traits. To test the performance during bad economic moments, we have chosen to include one purely unfavourable environment for the stock market – the global financial crisis. To measure portfolios' performance during the stock-friendly season, 1990s economic recovery and post-financial crisis recovery were included. Lastly, the dot-com bubble and burst and the COVID-19 period were added to check on the endurance of securities during volatile and dynamic markets.

After compiling the list of asset groups and historical market periods, here is the complete table that will be used to measure various financial metrics that will help to discover the effectiveness of diversification.

Table 4. *Stock portfolio types and historical periods for measure*

Stock portfolios Time periods	Growth	Recession-proof	Dividend	Value	Mix
1991-1994					
1998-2002					
2007-2009					
2010-2015					
2020-2023					

Source: made by author

The template of the table will be used to measure numerous financial metrics. Firstly, according to the objectives, monthly and annual returns will be utilized to find the asset group that has the best performance in terms of capital appreciation during set periods. Secondly, to find the stability of portfolios, monthly and annual standard deviations will be required. Lastly, we will use the Sharpe ratio, a well-known statistic devised by Nobel winner William Sharpe, to analyze the efficacy of our portfolio. This method was specifically chosen due to providing accurate results. It includes volatility insights which help to calculate risk-adjusted returns. Moreover, such a ratio provides a simple comparative analysis between portfolios. Below is the formula used for calculations of the Sharpe ratio:

Figure 6. *Sharpe ratio formula*

$$\text{Sharpe ratio} = \frac{(R_x - R_f)}{\text{StdDev } R_x}$$

- R_x – Expected portfolio return
- R_f – Risk-free rate of return
- StdDev R_x – Standard deviation of portfolio return

According to this method, it is crucial to include a risk-free rate, which is considered as a return on an investment that theoretically has zero risk. It shows the excess return earned by additional risk taken with other investment tools. In this research, a United States 10-year

Treasury bond will be used to represent a risk-free rate. By calculating the average of a period of average yield for a specific year, a more accurate representation will be achieved.

Lastly, after calculating the performance of each portfolio, the next step will require optimization of all asset groups that will reveal the final most effective portfolio. For this task, our research will utilize the Excel program, or more precisely, data processing will be done through Solver add-in for optimization and equation solving. To prevent creating too concentrated position on assets or removing them at all, additional conditions were provided, such as the weight of the security should not be less than 4 % while not exceeding 20 % of the whole portfolio.

To ensure coherent research, the process is divided into 5 main steps:

Step 1. Gathering secondary data about the companies' stock prices from financial websites, such as Yahoo! Finance or Google Finance.

Step 2. Selecting research method and according to that preparing a list of financial metrics dedicated to achieving objectives.

Step 3. Processing the data and utilizing a program (Excel Solver) to complete calculations.

Step 4. The analysis compares how portfolios have performed during different historical periods. Looking for trends/patterns that appear in this research.

Step 5. Find the best/most efficient stock portfolio that has shown the best results in terms of risk-reward.

3. RESEARCH DISCUSSION AND FINDINGS

This part of the paper analyses the data gathered on stocks from secondary sources of information and compares the performance of portfolios based on financial metrics discussed in the previous chapter. Based on the results of calculations, tables with data of portfolios will be prepared. The results are presented in the logic and consistency of the calculations, separated into three main parts: portfolio returns, volatility, and overall performance reflected by the Sharpe ratio. After the results are presented, the final part will optimize each variable and present results in the same method.

3.1>Returns of portfolios

Returns of assets are the most crucial thing for an investor as capital appreciation is the primary way they can make money from an investment. It's also the most significant component for calculating Sharpe ratio since having lesser growth than implied risk will lead to negative performance.

Table 5. *Annual returns of portfolios during different historical periods*

Returns	1991-1994	1998-2002	2007-2009	2010-2015	2020-2023
Growth	15,32 %	15,08 %	5,38 %	21,13 %	17,02 %
Recession-proof	15,04 %	9,66 %	5,99 %	12,25 %	5,74 %
Dividend	17,68 %	5,57 %	3,87 %	12,37 %	7,51 %
Value	25,41 %	6,27 %	5,84 %	14,64 %	9,82 %
Mix	14,15 %	11,98 %	5,87 %	15,14 %	10,47 %
Sector mix	24,34 %	17,95 %	5,91 %	16,55 %	15,68 %
Beta mix	22,38 %	17,24 %	1,69 %	14,56 %	27,21 %

Periods for this research were picked by combining rough but also advantageous times for the stock market. Even though it covers various environmental conditions, the primary noticeable thing seen in the table is the positive returns achieved by all portfolios throughout

all periods. However, the amplitude between these groups is visible making it important to analyse more carefully.

In the early '90s, from 1991 to 1994, the market was visibly the most favourable for securities. Every asset group had reached a double-digit annual return, with Value portfolio appreciating 25,41 % yearly. The recovery period after the global financial crisis also provided markets with good conditions, however, this time Growth portfolio took advantage most efficiently by providing annual 21,13 % returns. On the other hand, such recovery was deserved after the horrible period of 2007-2009 for the economy globally. Although portfolios generated positive returns, all of them were in single digits, where the majority of the diversified portfolios had the best resistance to the recessionary environment. The group that was assembled specifically for such conditions had the strongest performance, generating 5,99 % annually. Mix, value, and sector mix portfolios had shown very similar growth, ranging from 5,84 % to 5,91 %. Beta mix portfolio had the worst performance, which was dragged by the “Valero Energy Corporation” (VLO) which was losing more than 2 % of its value every monthly during this interval, as seen in Figure 7. Although this specific stock had an unfortunate period, most of the other companies had positive returns that helped this asset group to have a 1,69 % growth in capital during the global crisis, emphasizing the importance of diversification.

Overall, the highest growth in all periods combined was marked by Beta mix which had an annual growth of 16,62 %. There were 3 main companies that contributed to this result, as shown in Figure 8, including “Lam Research Corporation” (LRCX) with a 2,78 % monthly growth, “Applied Materials” (AMAT) with 2,11 % and “Advanced Micro Devices” (AMD). The Sector mix didn't fall too far behind with an appreciation of 16,09 %.

On the contrary, portfolios with lowest returns, where the ones that specifically were designed to not be likely to have rapid growth. It includes 2 groups, Recession-proof and Dividend, that had similar outcomes, returning 9,74 % and 9,40 % respectively, of value annually throughout all investigated years. Assets in both portfolios were also very stable in terms of their performance, marking growth that ranges between 0,50 % and 1,13 % every year.

3.2. Volatility

The analysis of volatility, as measured by the annual standard deviation in the table below, provides valuable insight into how effectively diversification offsets risk in different portfolios during various historical periods. The following metric is crucial for any person considering an investment, as it can suggest the movement of a stock price. The higher the percentage of standard deviation, the more volatile price fluctuation can be, and failure to notice it beforehand can surprise an investor with unexpected swings in share price, which might create a disbalance in a portfolio.

Table 6. *Standard deviation of portfolios during different historical periods*

Standard deviation	1991-1994	1998-2002	2007-2009	2010-2015	2020-2023
Growth	15,85 %	24,65 %	19,61 %	13,35 %	19,36 %
Recession-proof	11,75 %	15,51 %	13,69 %	9,73 %	15,64 %
Dividend	12,84 %	18,50 %	17,27 %	11,98 %	19,40 %
Value	16,48 %	24,56 %	31,85 %	16,50 %	26,86 %
Mix	13,79 %	16,70 %	17,52 %	11,73 %	16,97 %
Sector mix	15,56 %	17,67 %	19,67 %	11,82 %	18,41 %
Beta mix	15,76 %	28,34 %	22,21 %	16,01 %	21,81 %

In the early 90s, volatility was relatively high across the board, which was especially seen in half of the compiled portfolios: Growth, Value, Sector mix, and Beta mix. While offering substantial returns, they also had a higher standard deviation that ranged between 15,56 % and 16,48 %. This suggests that higher gains were accompanied by higher risk. Unexpectedly, even both asset groups created by a mix of stable and riskier equities presented big swings in price. On the other hand, the Recession-proof portfolio, designed to withstand market fluctuations, showed the lowest volatility of 11,75 %, which only confirmed its effectiveness in providing stability during uncertain times.

The next period of 1998-2002 saw a spike in volatility, with the Beta mix portfolio hitting a peak standard deviation of 28,34 %. While half of the portfolio contains stocks with a beta of less than 0,5 that should promote stability in movement, the other part is exactly the opposite. Constituents like AMD and AMAT were the main reason for the movement, influenced by the tech bubble burst, marking the fluctuation of prices per share between \$6,38 – \$48,50 and \$5,39 – \$57,50 respectively. LRCX was affected the most, recording the growth of its stock price from \$2,79 to \$56,81, which converts to almost 2000 % growth at its peak before coming down almost to its initial price at the start of the period. Value portfolio also exhibited a high standard deviation, mainly due to several technology giants, like “Cisco Systems” (CSCO) or “Intel Corporation” (INTC) being a part of the bubble and inflation financial metrics. This suggests that even a traditionally stable value portfolio can be subject to disturbance because of a few components with unstable price movements.

During the 2007-2009 financial crisis, volatility soared, with the “Value” portfolio again reaching the highest standard deviation of 31,85 %, reflecting the sensitivity of value stocks during the economic downturn. The biggest contributor to such fluctuation appeared to be automaker “Ford Motor Company” (F). Despite its historical stagnation, with price fluctuating in a range of \$5 to \$18, during the recession its share has fallen from \$4,81 to only \$1,01 before recovering its value and climbing back to over \$10 mark. In contrast, the Recession-proof portfolio's standard deviation reached only 13,69 %, demonstrating its relative stability in the face of market distress. “Walmart” (WMT), a consumer goods company, showed the strongest resilience during the recession by having a constant demand due business model. Its share price stayed relatively stable, with a maximum fluctuation from \$42,09 to \$63,85.

Post-crisis, from 2010 to 2015, the standard deviation of returns generally decreased, indicating a calmer market environment. Most of the variables showed low double-digit volatility with the Beta mix and Value portfolios maintaining a higher standard deviation of 16,01 % and 16,50 %, potentially benefiting from the market's recovery volatility, while the Mix portfolio's lower standard deviation of 11,73 % implies a steadier performance. As mentioned earlier, while the Recession-proof group had a lower return, it also was the only one to have a standard deviation in the single-digit range.

The most recent period, 2020-2023, likely influenced by the pandemic and subsequent market volatility, had Dividend and Recession-proof portfolios reach their higher standard deviation increasing to 19,40 % and 15,64 % respectively, indicating about dynamics that the

stock market had experienced. Identically as in the previous period, both Beta mix and Value groups again were leading in volatility, both reaching more than 20 %. “The Boeing Company” (BA) saw the widest fluctuations between the rest of the stocks due to being vulnerable in the lockdown period. Conversely, the Growth portfolio, which is expected to show big volatility had a standard deviation of 19,36 % which suggests that growth stocks, while still rapidly moving in any direction, could be weathering the uncertainty better than expected.

Overall, the data suggest that while diversification can help manage risk, the effectiveness varies across different market conditions. Portfolios designed to be recession-proof tend to show lower volatility, underscoring their stability focus. In contrast, portfolios with a mix of assets tend to show moderate volatility, balancing risk and return. However, periods of high market stress can lead to increased volatility across all portfolio types, highlighting the challenge of maintaining stability during economic upheavals.

3.3. Performance

The Sharpe ratio, a measure that evaluates the performance of an investment by adjusting for its risk, is critical for understanding how different portfolios have performed across various historical periods. This ratio considers volatility, risk-free rate, and returns, offering a comprehensive view of risk-adjusted performance.

Table 7. *Sharpe ratio of portfolios during different historical periods*

Sharpe ratio	1991-1994	1998-2002	2007-2009	2010-2015	2020-2023
Growth	52,75 %	39,63 %	7,79 %	139,69 %	75,99 %
Recession-proof	68,76 %	28,06 %	15,65 %	100,45 %	21,92 %
Dividend	83,53 %	1,40 %	0,11 %	82,55 %	26,83 %
Value	111,96 %	3,90 %	6,23 %	73,73 %	27,97 %
Mix	52,15 %	39,92 %	11,55 %	108,03 %	48,09 %
Sector mix	111,69 %	71,48 %	10,48 %	119,07 %	72,64 %
Beta mix	97,83 %	42,09 %	(9,71 %)	75,50 %	114,20 %

At first glance, it is noticeable that most of the time, portfolios had a positive sharp ratio, in which most of them scored between 0 % and 100 %. This indicates that groups were generating returns that were above the risk-free rate, however, not enough given the risk taken for this performance, including the time with a negative ratio which is even worse than what risk-free rates offer. On the other hand, more examples include the result of over 100 %, which converts into an excellent investment, where it provides a substantial return without much risk of losing the value.

During 1991-1994, Value and Sector mix portfolios not only provided high returns but also achieved this with exceptional risk-adjusted performance, boasting one of the highest Sharpe ratios of 111,96 % and 111,69 % respectively. Primary contributors for the latter asset group involve communication services company “Electronic Arts” (EA) and a representative of healthcare – “UnitedHealth Group Incorporated” (UNH). Both managed to generate a monthly return of almost 5 %, as seen in Figure 9, without incorporating much risk. With other component securities, they managed to promote returns that far outweighed the risk taken. The Dividend portfolio also performed admirably during this period, with its highest Sharpe ratio of 83,53 %, suggesting it’s suited better for moments of economic growth.

The period of 1998-2002 shows a general decline in the Sharpe ratios across all portfolios. This reflects the decreased returns (Table 5) and larger volatility (Table 6). Few asset groups, such as Dividend and Value, came close to zero, where risk-free rates almost outperformed them. Yet, the Sector mix portfolio stands out with a Sharpe ratio of 71,48 %, a more or less stable standard deviation. This indicates that specific sector selections could yield favorable risk-adjusted returns even during tumultuous market conditions.

Analyzing the recessionary time zone, and global financial crisis, the Sharpe ratios plummeted, reflecting the heightened risk and lower returns characteristic of this period. There is no surprise that through economic downturns risk-free rate investments see an increase in popularity, as it becomes a considerate asset for hedging during rough periods. For example, the Beta mix portfolio had a negative ratio of 9,71 %, meaning that it was even worse than investments with zero risk. In stark contrast, the Recession-proof portfolio managed to demonstrate a ratio of 15,65%, living up to its name and affirming its design to navigate through rough economic waters with lower relative risk.

In the next phase of recovery, the trend of portfolios was contrary. While the recessionary environment resulted in dragging the ratio of the asset group to almost 0 %, this

period awarded them with advantageous conditions. The Growth portfolio shines with a Sharpe ratio of 139,69 %, showcasing that the growth stocks' returns significantly outpaced their inherent risks during this period of market rebound. Similarly, Mix and Sector mix portfolios also demonstrated a strong risk-adjusted performance with a Sharpe ratio of 108,03 % and 119,07 % respectively, suggesting that a diversified approach was highly effective post-crisis.

The most recent timeframe of 2020-2023 reflects the economic uncertainty with portfolios providing mixed results. The Beta mix portfolio records a remarkable recovery from the previous crisis with a Sharpe ratio of 114,20 %, contributed by a surprising growth trajectory, whereas the majority of equity in the group provided over 2 % of monthly returns, as shown in Figure 10. Even with a relatively high standard deviation it still outperformed any other portfolio, indicating its robust returns relative to risk in a volatile market. Conversely, the Recession-proof portfolio, while still positive, shows a lower ratio of 21,92 %, which may point to it not capturing as much of the available returns in a recovering market.

Overall, the Sharpe ratio across periods highlights the importance of considering both risk and return in evaluating portfolio performance. This data suggests that the Sector mix stands out in front of others with its performance, signifying the importance of correct diversification. It also shows that securities spread out across different sectors is an effective method for capturing the gains during advantageous cycles while protecting from losing value during uncertain times. On the other side, portfolio concentrated on value equities had the poorest performance, especially due to a lack of resilience during the recession. These varying ratios underscore the importance of diversifying a stock portfolio, but most importantly, they also hint at the potential extra gains that can be acquired by transitioning portfolio style to meet certain market conditions.

3.4. Optimization

The analysis of financial metrics for chosen variables helped to prove the power of diversification in order to protect and steadily grow the capital. However, such analysis is not yet enough to reveal the most effective way to allocate assets, as it only presents various examples of asset groups with stocks across various sectors or containing different characteristics. This part will provide an example to optimize the portfolios even more by changing the weights in a portfolio of each stock that would maximize throughout all periods. Calculations will be done with the help of the Solver add-in on the Excel platform. The analysis

will reveal the most effective optimized portfolio in three categories that were discussed in the previous part: returns, volatility, and risk-adjusted performance. In addition, it will help to understand the more effective allocation of stocks inside the portfolio.

Table 8. *Annual returns of optimized portfolios during different historical periods*

Returns	1991-1994	1998-2002	2007-2009	2010-2015	2020-2023
Growth	21,76 %	19,14 %	14,81 %	23,59 %	26,89 %
Recession-proof	17,74 %	15,19 %	9,09 %	13,83 %	8,33 %
Dividend	22,30 %	7,60 %	7,29 %	13,72 %	14,06 %
Value	32,77 %	10,51 %	12,93 %	16,33 %	14,57 %
Mix	16,95 %	15,40 %	12,68 %	17,38 %	17,67 %
Sector mix	30,90 %	22,61 %	17,29 %	21,64 %	19,57 %
Beta mix	33,11 %	20,15 %	7,38 %	18,88 %	28,00 %

In the early 1990s, the optimization method increased the annual returns of Value and Beta mix portfolios up to 32,77 % and 33,11 % respectively, by concentrating on winning companies, especially on the latter portfolio. Referring to Figure 11, the solver suggested for the Value group allocating 20 % for CSCO and “Wells Fargo” (WFC), more than 10 % for INTC, “Caterpillar Inc.” (CAT), and F, while the rest received minimum allocation. The Beta mix group had a better visual diversification (Figure 12) where sizes were increased for two assets with high beta and two with low beta.

From 1998 to 2002, while being dynamic, all portfolios increased returns slightly after being optimized. The sector mix had shown a 22,61 % return by emphasizing the returns of EA, UNH, and WMT to provide them with maximum allocation, as seen in Figure 13. On the other hand, the performance of the Dividend portfolio barely increased, as most of the included securities had insignificant growth, which wasn’t enough to visibly affect the numbers by increasing a few main stocks, including “ExxonMobil” (XOM), “Chevron Corporation” (CVX), “3M Company” (MMM) and “Pfizer” (PFE), shown in Figure 14.

Comparing the growth of portfolios prior to optimization, during the 2007-2009 period, all of them provided returns in the range of positive single-digit percentages. After restructuring, half of these asset groups have climbed to provide double-digit growth, with Sector mix having the most significant increase, from 5,91 % to showing 17,29 % returns. Most of the difference appeared after the Solver minimized the allocation on poorly performing stocks (Figure 15), such as EA with more than 2 % negative returns, while capitalizing fast-growing companies, like “Apple” (AAPL) or “BHP Group Limited” (BHP) that had provided a monthly appreciation of 2-4 %.

In the years 2010-2015, when the economy gave advantageous conditions for stocks to rise, the growth was very strong, however, it didn't change much before customizing the weights of companies in researched asset groups. This signifies that in a period of market recovery, optimization tool focuses on capturing growing assets rather than diminishing risks. In this period, the Mix portfolio was the most diversified in terms of allocation percentages as seen in Figure 16, where half of the portfolio had seen increased weight, while the rest – vice versa. As a result, it had an average result of 17,38 % compared to the rest.

The latest period, 2020-2023, was the time with dynamic markets that resulted in inconsistent results. Here, the Growth portfolio had improved to reach 26,89 % annual returns, due to the Solver recommending to capitalize on the largest technology giants, AAPL and “Microsoft” MSFT, while also recognizing the power of healthcare companies, “Eli Lilly and Company” (LLY) and “Novo Nordisk A/S” (NVO), visible in Figure 17. All of them generated more than a 2 % monthly return, which can also be identified as the breakpoint for maximizing the Sharpe ratio, as having such a strong growth metric outstands the possible fluctuations that appear. On the other side, the Recession-proof group remained stagnant. Similar to the Dividend portfolio during 1998-2002, none of its assets had remarkable growth, hence changing allocation didn't provide a significant difference.

Throughout these periods, we observe that while optimization generally improves returns, its effectiveness is not uniform across all economic conditions. The high returns in buoyant markets show that optimization can successfully identify growth opportunities, but during times of crisis, even optimized portfolios can struggle, as seen in the case of the Beta mix's strongly varying performance. Lastly, the discrepancies in performance during downturns highlight the importance of dynamic and flexible portfolio management strategies that can adapt to unexpected economic shifts.

Table 9. *Standard deviation of optimized portfolios during different historical periods*

SD	1991-1994	1998-2002	2007-2009	2010-2015	2020-2023
Growth	15,83 %	22,93 %	20,22 %	12,87 %	18,99 %
Recession-proof	11,35 %	15,38 %	13,65 %	10,10 %	15,50 %
Dividend	14,72 %	16,32 %	19,32 %	10,67 %	23,27 %
Value	18,68 %	23,45 %	35,52 %	14,40 %	27,35 %
Mix	12,14 %	18,37 %	19,40 %	12,10 %	18,53 %
Sector mix	15,16 %	18,35 %	23,33 %	11,56 %	18,73 %
Beta mix	17,93 %	27,78 %	19,94 %	13,62 %	17,25 %

The analysis of standard deviation provides distinct results from what's presented in the previous table. In this case, the main tendency to stand out is that the percentages have barely changed comparing portfolios before and after optimization. Therefore, further analysis will ignore trends, but rather focus on the most drastic changes between asset groups across different times.

In the first period, Value and Beta mix portfolios presented the strongest change among other variables. While they have achieved higher returns during this time by optimizing portfolios, this required involving more risk that reflected in an increased annual standard deviation of more than 2 %. While such change seems insensible, the rest of the groups haven't been affected by any shift in volatility. Only Mix portfolio managed to lower its metric by more than 1,50 % which was a consequence of the reduced stake of AAPL from 10 % to only 4 % in weight.

Following the next period, 1998-2002, more fluctuations can be noticed. The Solver method helped to reduce volatility across all portfolios, excluding only Mix and Sector mix. While in previous times Mix was the only portfolio to significantly reduce its standard deviation, this period it surprised by an increased metric of 1,67 %. On the contrary, the group of Growth and Dividend assets stood out with the highest reduction in terms of volatility. Reducing the allocation of INTC (Figure 18) and "JPMorgan" (JPM) (Figure 14) to a minimum

in these portfolios help to soothe the fluctuations by 1,72 % for Growth and 2,18 % for Dividend.

The financial crisis of 2007-2009 marks the highest standard deviations seen in this analysis and also the biggest discrepancy when compared to previous periods. As optimization aims to produce optimal results by maximizing returns and minimizing risk, this period distinguished itself by increased volatility when comparing standard deviation prior to refinement. Value and Sector mix were affected the most with an increased standard deviation of more than 3 %. While metrics of the reset stayed somewhat flat, only the Beta mix was successful in decreasing volatility by 2,27 % which was a consequence of allowing low-beta stocks to have more weight in the portfolio (Figure 19).

Economic recovery from 2010 has been marked by decreased volatility which was at the level of low double-digit percentage. Most of the portfolios had only mildly been affected by optimization. However, as in the first analysed period, both Value and Beta had the most visible change, decreasing to 14,40 % and 13,62 % respectively. Such trend allows us to notice that during markets with certain directions not only does volatility decrease, but there's also some room left to further reduce those fluctuations.

Similar to other disadvantageous markets with recessionary environments, the last period also was notable by significant changes in volatility across asset groups. There was no visible pattern of modifications in standard deviation. However, there were two portfolios that stood out from others. Optimizing the Dividend group required additional risk to present better results overall. Increasing allocation of XOM and CVX, stocks with the biggest variance, were the main motive for an increase in volatility by 3,87 % (Figure 20). On the contrary, to enhance the performance of the Beta mix, the most effective method was to reduce the weight of all high-beta stocks to a minimal percentage (Figure 21).

Overall, the standard deviation data from optimized portfolios reveal that the biggest changes in volatility happened during turbulent markets, suggesting that during uncertain times is recommended to reduce the allocation of assets that have the tendency of big fluctuations. In addition, the overall insignificant changes between standard deviation hints that the most effective way to enhance the performance of portfolios is by concentrating more on securities that generate the best returns as it has the potential

Table 10. *Sharpe ratio of optimized portfolios during different historical periods*

Sharpe ratio	1991-1994	1998-2002	2007-2009	2010-2015	2020-2023
Growth	93,49 %	60,31 %	54,17 %	164,09 %	129,41 %
Recession-proof	94,99 %	64,23 %	38,37 %	112,41 %	38,89 %
Dividend	104,22 %	13,99 %	17,87 %	105,40 %	50,49 %
Value	138,16 %	22,14 %	25,57 %	96,23 %	44,84 %
Mix	77,76 %	54,89 %	45,52 %	123,19 %	82,91 %
Sector mix	157,90 %	94,23 %	57,60 %	165,90 %	92,19 %
Beta mix	145,84 %	53,40 %	17,72 %	120,48 %	148,94 %

The last table, presenting the Sharpe ratio of optimized portfolios, reveals not only the best-performing asset group. It also suggests the recommended construction of it to further enhance the possible diversification for maximizing efficiency.

The first overview presents us positive ratio across all portfolios during all periods. Not only that optimized groups have better performance than risk-free investments, but the increase in percentage was significant compared with previous metrics, including moments where the Sharpe ratio even doubled.

Initially, from 1991-1994, the Sector mix portfolio stood out with a significant increase in the Sharpe ratio post-optimization up to 157,90 %, indicating that this diversification method greatly enhanced risk-adjusted returns, especially by concentrating on leading sectors, such as financial, healthcare and materials as seen in Figure 22. The Beta mix also shows improvement with a ratio of 145,84 %. Going heavy with the allocation on high-beta stocks (Figure 12), which are prompt to big swings in stock price, can heavily inflate results.

The following period of the dot-com bubble also showed a noticeable change in the Sharpe ratio after the transformation. All asset groups reached a double-digit ratio. However, the performance of the Dividend and Value group was still below moderate results with ratios of 13,99 % and 22,14 % respectively. It shows that both portfolios struggle during dynamic markets with investors having a lack of confidence towards these two types of stocks during

market uncertainty. In addition, a conclusion can also be made that none of these assets had a great performance, not being able to improve the overall performance even after heavy allocation on them.

The 2007-2009 financial crisis, compared to the previous period, showed very similar results. Both Dividend and Value portfolios kept the same below moderate performance. In addition, the Beta mix joined these groups with alike ratio of 17,72 %, showing that low-beta and high-beta companies tend to decrease in popularity during economic recessions. Investors might seek assets that have a similar correlation with the main market indices to avoid any unexpected results. While the mentioned portfolios struggled even after the optimization, the Growth and Sector mix had greatly improved, rising from 7,79 % to 54,17 % and 10,48 % to 57,60 %, which was mainly influenced by providing heavier allocation toward technology, healthcare, and communication service stocks, as seen in Figure 23 and Figure 15.

Post-crisis, from 2010-2015, we observe a strong performance in risk-adjusted terms, with the Growth portfolio showing a considerable increase in the Sharpe ratio after optimization, from 136,69 % to 164,09 %. This indicates that growth stocks when optimally selected, can provide exceptional returns for their level of risk in a recovering market. The Sector mix also sees a significant boost, reinforcing the value of sector-specific diversification during the economic recovery.

In the most recent period, 2020-2023, the Beta mix portfolio's Sharpe ratio increases notably to 148,84 %, suggesting that reducing exposure to high-beta stocks and perhaps incorporating more stable, low-beta stocks can enhance performance in volatile markets, refer to Figure 21. Moreover, the performance of the Growth portfolio almost doubled, rising from 75,99 % to 129,41 %, which can add that going heavy on known technology and healthcare giants would be the proper move in this environment (Figure 17).

Overall, the analysis of Sharpe ratios before and after portfolio optimization indicates that the most effective diversification methods vary across different market conditions. Sector and beta-focused strategies seem to provide considerable improvements in risk-adjusted returns, especially during recovery periods. The data also suggests that during stable times, diversification methods that focus on growth and sector specificity tend to perform best. In contrast, in turbulent markets, strategies that minimize volatility by adjusting beta exposure are more effective. The varying effectiveness of optimization on the Sharpe ratios, especially for Dividend and Beta mix groups, highlights the importance of how the concentration into a

specific type of asset can lead to missed gains in recessionary periods, which can be avoided by hedging the portfolio with stable companies that can diminish unexpected fluctuations.

In conclusion, the analysis of the research underscores the effectiveness of strategic diversification. The sector-focused portfolio managed to achieve the highest efficiency compared with the rest, showing that diversification across all sectors can bring the best results as it captures the benefits of different economic cycles. Optimization underscores the importance of tailored asset allocation, highlighting how adjusting the focus towards specific stocks can amplify performance. The findings also reveal valuable insight that during prosperous market conditions, an emphasis on discretionary stocks is beneficial, while the impact of volatile markets can be mitigated by shifting investments towards more stable sectors, such as consumer staples and healthcare.

CONCLUSIONS AND RECOMMENDATIONS

1. To conclude the research work, the problem analysis of stock portfolio diversification revealed the underlying disadvantages that are resulted from incorrect diversification that can be divided into 3 parts. Firstly, the lack of diversification has a high standard deviation that can create irreversible financial damages in case any of the assets is affected by a disappointing company's performance. The portfolio that is constructed by securities that share similar characteristics is vulnerable to strong negative returns that happen due to any of the mentioned risks: economic, industry, or stock-specific. The last drawback arises due to over-diversification, which doesn't reduce the volatility enough to justify the limited returns that are caused as a consequence. The revision of many literature sources also helped to disclose strategies or methods that would remove the mentioned drawbacks, such as the portfolio composition of 8-15 assets being the optimal number for maximizing risk-adjusted returns. Lastly, familiarizing with "Modern Portfolio Theory" highlighted the significance of diversification of assets that are not connected with each other, while "The Capital Asset Pricing Model" suggested the idea of finding the portfolio with the best performance utilizing the Sharpe ratio that was applied later in the research part.

2. For our research, we selected a simulation-based approach as a way to find the most optimal stock portfolio. This type of research allowed us to simulate the performance of selected assets over various historical periods by calculating their outcomes. Each of the seven diversified portfolios that were created had a composition of different securities: combinations of "Growth", "Recession-proof", "Dividend", "Value", "Mix", "Sector mix", and "Beta mix". Each of the giant companies that were carefully chosen for this study was listed in the top US stock exchanges: NYSE and NASDAQ. While using data from Yahoo! Finance we collected monthly stock prices of each company according to selected crucial global periods, which had both negative and positive impacts on the stock market, mentioned in the methodology part: 1991-1994, 1998-2002, 2007-2009, 2010-2015, 2020-2023. After that, we calculated important financial metrics to show how each of these stocks performed individually or in the portfolio and compared it with the average US 10-year Treasury bond yield that represents a risk-free rate. To evaluate the maximized returns of each portfolio we optimized each of them utilizing the Sharpe ratio, in this case, the weight of each stock was modified inside the portfolio that was done using the "Solver" tool in the "MS Excel" program.

3. According to our findings, all seven asset groups provided better results compared to risk-free investments. The study shows that “Growth”, “Sector mix” and “Beta mix” portfolios managed to achieve the highest average annual returns throughout all periods. Although “Recession-proof” had one of the lowest returns, it reflected its name with the lowest volatility compared with other portfolios while presenting the best growth during the financial crisis period. Sharpe ratio also presented the overall best-performing groups, including “Growth”, “Sector mix” and “Beta mix”, of whom sector-focused portfolio had a clear favour in results, underlining that collecting stocks from different sectors is the most effective diversification strategy. Finally, optimizing portfolios revealed gained benefits of reallocating assets by taking advantage of varying economic cycles, such as focusing on discretionary stocks during economic growth while putting more emphasis on consumer staples or healthcare companies during unfavourable stock market periods.

The research findings helped to achieve results that aligned with the literature sources, underlining the importance of theory in investments. However, despite the success of our analysis, the research may have limitations that could have impacted results in one or another way. Firstly, the academic research only utilized ten securities to construct each portfolio, where one excellent or poor performance of a stock could have decided the success of the portfolio. The chosen time periods are yet another significant aspect that has the potential to influence the research. Even though distinct economic conditions were presented in 5 chosen periods, the number of time intervals was too low it might have created better conditions for a certain stock portfolio. Lastly, the choosing criteria of equities were designed to adapt specifically for all periods. Since the earlier analysed period was in 1991, the chosen companies had to be publicly listed no later than this year. Therefore, all stocks included in portfolios were old companies that had successfully operated until this day, hence most of them were the largest companies in a certain sector. While it not may have an obvious influence, growth companies that lasted for such a long time might have a tendency to have a greater performance than stable companies.

For further research on this topic, we would recommend doing research on portfolios that conduct a larger number of securities. For that to be viable, the study could be done from the perspective of investors as an institution, as the current research paper was focused on retailers. Additionally, the time period for the analysis could be customized in many other ways. As an example, the number of periods could be increased. To avoid previously stated limitations, periods only from the current century could be included, which would allow us to

choose for much broader list of companies. The analysis could focus on companies with small or large market capitalization to see if the pattern remains the same. Lastly, to increase the relevancy of the paper, other asset classes could be included, such as bonds, real estate, or cryptocurrencies.

REFERENCES

1. Alexeev, V., & Dungey, M. (2015). Equity portfolio diversification with high-frequency data. *Quantitative Finance*, 15(7), 1205–1215. <https://doi.org/10.1080/14697688.2014.973898>
2. Alexeev, V., & Tapon, F. (2013). *Discussion Paper Series N 2013-16 Equity Portfolio Diversification: How Many Stocks are Enough? Evidence from Five Developed Markets* *Equity portfolio diversification: how many stocks are enough? Evidence from five developed markets.*
3. Atmaz, A., & Basak, S. (2021). Stock Market and No-Dividend Stocks *. In *Risk Management Conference*. <https://ssrn.com/abstract=3116105>
4. Belanová, K. (2023). How Increased Inflation Affects Businesses. *SAR Journal - Science and Research*, 3–8. <https://doi.org/10.18421/sar61-01>
5. Bradfield, David & Munro, Brian. (2016). The number of stocks required for effective portfolio diversification: the South African case. *South African Journal of Accounting Research*. 31. 1-16. 10.1080/10291954.2015.1122284.
6. Buła, R., & Jabłoński, B. (2022). Investing in dividend vs. non-dividend stocks – efficiency assessment using fractal measures. *Scientific Papers of Silesian University of Technology Organization and Management Series*, 2019(139). <https://doi.org/10.29119/1641-3466.2022.160.8>
7. Chatterjee, C., & Tiwari, S. (2022). Dividend reduction and stock price reaction in Indian market: is there a role of share repurchase? *Journal of Indian Business Research*, 14(4), 447–471. <https://doi.org/10.1108/JIBR-11-2020-0348>
8. Cupák, A., Fessler, P., Hsu, J. W., & Paradowski, P. R. (2020). *Confidence, financial literacy and investment in risky assets: Evidence from the Survey of Consumer Finances*. www.nbs.sk/en/publications-issued-by-the-nbs/research-publications
9. Díaz, A., Esparcia, C., & López, R. (2022). The diversifying role of socially responsible investments during the COVID-19 crisis: A risk management and portfolio performance analysis. *Economic Analysis and Policy*, 75, 39–60. <https://doi.org/10.1016/J.EAP.2022.05.001>
10. Diciurcio, K., Lepigina, O., Kresnak, I., & Davis, J. (2021). *Value versus growth stocks: The coming reversal of fortunes.*

- https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_5_factors_2x3.html.
11. Duggan, W. (2023, March 7). How does inflation affect stocks? *Forbes Advisor*.
<https://www.forbes.com/advisor/investing/inflation-and-stock-market/>
 12. Emm, Ekaterina, and Ruben Trevino. (2014). "The Changing Risk-Return Characteristics of Value and Growth Investing." *Journal of Financial Planning* 27: (11) 55–60.
 13. Emsbo-Mattingly, L., Hofschire, D., Weinstein, J., & Dourney, C. (2021). *The Business Cycle Approach to Equity Sector Investing*.
 14. Evans, J. L., & Archer, S. H. (1968). Diversification and the Reduction of Dispersion: An Empirical Analysis. In *Source: The Journal of Finance* (Vol. 23, Issue 5).
 15. Feito-Ruiz, I., Renneboog, L., & Vansteenkiste, C. (2020). Elective stock and scrip dividends. *Journal of Corporate Finance*, 64, 101660.
<https://doi.org/10.1016/J.JCORPFIN.2020.101660>
 16. Fuller, K. P., & Goldstein, M. A. (2011). Do dividends matter more in declining markets? *Journal of Corporate Finance*, 17(3), 457–473.
<https://doi.org/10.1016/j.jcorpfin.2011.01.001>
 17. González, M. de la O., Jareño, F., & Skinner, F. S. (2016). Interest and inflation risk: Investor Behavior. *Frontiers in Psychology*, 7(MAR).
<https://doi.org/10.3389/fpsyg.2016.00390>
 18. Gusti, I., Ajeng, A., Ratih, N., & Candradewi, R. (2020). The Effect of Exchange Rate, Inflation, Gross Domestic Bruto, Return on Assets, and Debt to Equity Ratio on Stock Return in LQ45 Company. In *American Journal of Humanities and Social Sciences Research* (Issue 6). www.ajhssr.com
 19. Hartzmark, S. M., Solomon, (2018). *The Dividend Disconnect* *.
 20. Heaton, J., & Lucas, D. (1999). Stock prices and fundamentals. *NBER Macroeconomics Annual*, 14(1), 202–242. <https://doi.org/10.1162/08893360052471455>
 21. Jordà, Ò., Knoll, K., Kuvshinov, D., Schularick, M., & Taylor, A. M. (2019). The Rate of Return on Everything, 1870–2015*. *The Quarterly Journal of Economics*, 134(3), 1225–1298. <https://doi.org/10.1093/qje/qjz012>
 22. Kang, E., Kim, R., & Oh, S. (2019). Dividend Yields, Stock Returns and Reputation. In *ACRN Journal of Finance and Risk Perspectives* (Vol. 8). <https://doi.org/>
 23. Lee, C. L., & Lee, M. L. (2014). Do European real estate stocks hedge inflation? Evidence from developed and emerging markets. *International Journal of Strategic*

- Property Management*, 18(2), 178–197.
<https://doi.org/10.3846/1648715X.2014.925521>
24. Lisa Emsbo-Mattingly, Dirk Hofschire, Jacob Weinstein, & Cait Dourney. (2021). *The Business Cycle Approach to Equity Sector Investing*.
25. Llopis-Albert, C., Rubio, F., & Valero, F. (2021). Impact of digital transformation on the automotive industry. *Technological Forecasting and Social Change*, 162, 120343. <https://doi.org/10.1016/J.TECHFORE.2020.120343>
26. Maio, P. (2014). Another look at the stock return response to monetary policy actions. *Review of Finance*, 18(1), 321–371. <https://doi.org/10.1093/rof/rfs050>
27. Markowitz, H. (1952). Portfolio Selection Harry Markowitz. *The Journal of Finance*, 7(1).
28. Miller, M. H., & Modigliani, F. (1961). Dividend Policy, Growth, and the Valuation of Shares. *The Journal of Business*, 34(4). <https://doi.org/10.1086/294442>
29. MSCI. (2023). *MSCI World Growth Index (USD)*. <https://www.msci.com/documents/10199/a20000f5-7518-404d-9d37-2fd47939ed28>
30. MSCI. (2023). *MSCI World Value Index (USD)*. <https://www.msci.com/documents/10199/25465a5a-d52c-4bec-b5ed-a7b56eca8e0d>
31. Naik, P., & Reddy, Y. v. (2021). Stock Market Liquidity: A Literature Review. In *SAGE Open* (Vol. 11, Issue 1). SAGE Publications Inc. <https://doi.org/10.1177/2158244020985529>
32. Norsiman, Nadia & Yakob, Noor & McGowan, Carl. (2019). The Effect of Portfolio Diversification for the Bursa Malaysia. *Accounting and Finance Research*. 8. 76. 10.5430/afr.v8n4p76.
33. OECD. (2020). *Understanding Delistings from the Portuguese Stock Market*.
34. Quoc BAO, N., Quoc Bao, N., & Thuc Phap Ly, K. (2020). *Issue 1 / Volume 2 DILUTION AND ANTI-DILUTION CLAUSE: THE BASIC UNDERSTANDINGS “Dilution and Anti-dilution clause: The Basic Understandings” (2020) 2 TND*. www.kienthucphaply.com
35. Rahim Khan, M. S., Rabbani, N., & Kadoya, Y. (2020). Is financial literacy associated with investment in financial markets in the United States? *Sustainability (Switzerland)*, 12(18). <https://doi.org/10.3390/SU12187370>
36. Reddy Irala, L., Patil, P., & Patil, P. (2007). Portfolio Size and Diversification. In *SCMS Journal of Indian Management* (Vol. 4, Issue 1). <http://ssrn.com/abstract=977763>
37. S&P Dow Jones Indices LLC. (2023). *S&P 500 ® VALUE (CNY)*.

38. Sadikin, A., & Dalimunthe, F. R. (2021). The effect of investment risks on stock return in the agricultural sector. *International Journal of Research in Business and Social Science (2147- 4478)*, 10(6), 189–197. <https://doi.org/10.20525/ijrbs.v10i6.1328>
39. Sharpe, W. F. (1966). Mutual Fund Performance. In *Source: The Journal of Business* (Vol. 39, Issue 1). <https://www.jstor.org/stable/2351741>
40. Smith, T. (2023, May 8). *Value Stock: What it is, examples, pros and cons*. Investopedia. <https://www.investopedia.com/terms/v/valuestock.asp>
41. Sodini, P., & Viceira, L. M. (2020). *The Value of Diversification*.
42. Solnik, B. H. (1974). Why Not Diversify Internationally Rather than Domestically? In *Analysts Journal* (Vol. 30, Issue 4).
43. Sunthornwat, R., & Areepong, Y. (2021). Forecasting cyclical and non-cyclical stock prices on the stock exchange of thailand. *Malaysian Journal of Fundamental and Applied Sciences*, 17(5). <https://doi.org/10.11113/MJFAS.V17N5.2175>
44. Taulbee, N. (2001). *Influences on the Stock Market: Examination of the Effect of Economic Variables on S&P 500*. <https://digitalcommons.iwu.edu/parkplace>
45. Team, I. (2022, June 21). *Cyclical vs. Non-Cyclical Stocks: What's the Difference?* Investopedia. <https://www.investopedia.com/articles/00/082800.asp>
46. Teece, D. J. (2018). Tesla and the Reshaping of the Auto Industry. In *Management and Organization Review* (Vol. 14, Issue 3, pp. 501–512). Cambridge University Press. <https://doi.org/10.1017/mor.2018.33>
47. The WFE Research Team. (2022, May). *Number of Listed Companies*. World Federation of Exchanges. <https://focus.world-exchanges.org/articles/number-listed-companies>
48. Umer Ghani, M., Awais, M., & Muzammul, M. (2019). Stock Market Prediction Using Machine Learning(ML)Algorithms. *Advances in Distributed Computing and Artificial Intelligence Journal*, 8(4), 97–116. <https://doi.org/10.14201/ADCAIJ20198497116>
49. Vera Ramírez, H. D., & Valencia Serna, F. A. (2022). Stock price performance of pharmaceutical companies: pre-vaccine COVID-19 - post-vaccine COVID-19. *Revista de Estudios Empresariales. Segunda Época*, 68–93. <https://doi.org/10.17561/ree.n1.2022.6638>
50. William Blair. (2022). *Private Wealth Management Achieving Tax Efficiency in an Investment Portfolio*.
51. Wilmington Trust. (2016). *The importance of a well-diversified portfolio*.

52. Zhu, H. M., Li, R., & Li, S. (2014). Modelling dynamic dependence between crude oil prices and Asia-Pacific stock market returns. *International Review of Economics & Finance*, 29, 208–223. <https://doi.org/10.1016/J.IREF.2013.05.015>

ANEXES

Figure 7. Beta Mix portfolio calculations and results, 2007-2009

2007-2009											
	AMD	VLO	AMAT	LRCX	SLB	LLY	WMT	PG	NVO	MRK	Monthly return
AMD	0.048943	0.009806	0.010428	0.013861	0.007753	0.004397	0.001455	0.002501	-0.00024	0.009771	0.89%
VLO	0.009806	0.014541	0.004045	0.006937	0.006062	0.00401	-0.00128	0.001287	0.001876	0.005188	-2.38%
AMAT	0.010428	0.004045	0.00941	0.007849	0.003495	0.002367	0.000513	0.000983	0.000591	0.002742	-0.09%
LRCX	0.013861	0.006937	0.007849	0.011147	0.007021	0.003581	0.000399	0.001866	0.000408	0.003646	0.11%
SLB	0.007753	0.006062	0.003495	0.007021	0.012762	0.002644	8.15E-06	0.002315	0.002385	0.00213	0.85%
LLY	0.004397	0.00401	0.002367	0.003581	0.002644	0.006124	0.000822	0.001993	0.000995	0.003404	-0.51%
WMT	0.001455	-0.00128	0.000513	0.000399	8.15E-06	0.000822	0.002404	0.000612	-0.00037	0.000298	0.60%
PG	0.002501	0.001287	0.000983	0.001866	0.002315	0.001993	0.000612	0.0033	0.000798	0.001685	0.18%
NVO	-0.00024	0.001876	0.000591	0.000408	0.002385	0.000995	-0.00037	0.000798	0.003103	0.002348	1.58%
MRK	0.009771	0.005188	0.002742	0.003646	0.00213	0.003404	0.000298	0.001685	0.002348	0.008719	0.18%
Portfolio weights											
AMD	10.00%										
VLO	10.00%										
AMAT	10.00%										
LRCX	10.00%										
SLB	10.00%										
LLY	10.00%										
WMT	10.00%										
PG	10.00%										
NVO	10.00%										
MRK	10.00%										
	100%										
	Monthly	Annual									
Return	0.141%	1.69%									
Variance	0.004112										
SD	6.41%	22.21%									
Risk-free rate		3.85%									
Sharp ratio		-9.71%									

Figure 8. *Beta mix portfolio calculations and results, 1991-1994*

1991-1994												
	AMD	VLO	AMAT	LRCX	SLB	LLY	WMT	PG	NVO	MRK		
AMD	0.031304	0.005362	0.004352	0.005774	0.000339	-0.00127	0.001052	0.00091	-0.0012	0.000996	Monthly return	
VLO	0.005362	0.007218	0.002639	0.003319	0.001451	5.09E-05	0.001533	0.001452	2.57E-05	0.001392	4.18%	
AMAT	0.004352	0.002639	0.012027	0.005766	0.001748	0.000801	0.002813	0.002081	6.38E-05	0.001052	0.41%	
LRCX	0.005774	0.003319	0.005766	0.014826	0.001445	0.000769	0.001093	0.000406	-0.00133	0.00061	4.35%	
SLB	0.000339	0.001451	0.001748	0.001445	0.003872	0.000887	0.000372	0.00031	0.000654	0.000935	5.46%	
LLY	-0.00127	5.09E-05	0.000801	0.000769	0.000887	0.004581	0.000773	0.001834	-0.00013	0.00271	0.05%	
WMT	0.001052	0.001533	0.002813	0.001093	0.000372	0.000773	0.004228	0.001305	0.000579	0.001505	0.17%	
PG	0.00091	0.001452	0.002081	0.000406	0.00031	0.001834	0.001305	0.003267	-0.00014	0.001768	0.79%	
NVO	-0.0012	2.57E-05	6.38E-05	-0.00133	0.000654	-0.00013	0.000579	-0.00014	0.00244	0.000662	1.31%	
MRK	0.000996	0.001392	0.001052	0.00061	0.000935	0.00271	0.001505	0.001768	0.000662	0.004218	1.03%	
											0.89%	
Portfolio weights												
AMD	10.00%											
VLO	10.00%											
AMAT	10.00%											
LRCX	10.00%											
SLB	10.00%											
LLY	10.00%											
WMT	10.00%											
PG	10.00%											
NVO	10.00%											
MRK	10.00%											
	100%											
	Monthly	Annual	Average								Monthly growth of assets	
Return	1.865%	22.38%	16.62%								AMD	2.04%
Variance	0.00207										VLO	0.88%
SD	4.55%	15.76%									AMAT	2.11%
											LRCX	2.78%
Risk-free rate		6.96%									SLB	0.78%
											LLY	1.11%
Sharp ratio		97.83%									WMT	0.98%
AVG		63.98%									PG	0.73%
											NVO	1.77%
											MRK	0.67%

Figure 9. Sector mix portfolio calculations and results, 1991-1994

1991-1994											
	AAPL	BRK.A	EA	UNH	BHP	UNP	WMT	HD	NEE	XOM	Monthly return
AAPL	0.018295	0.001911	0.008342	0.003464	0.001425	-0.00012	0.003212	0.002571	-0.00062	0.001042	0.25%
BRK.A	0.001911	0.003126	0.002548	0.000336	0.000484	0.001199	0.001154	0.000841	0.000629	0.000399	2.32%
EA	0.008342	0.002548	0.021863	0.00647	0.001078	0.000929	0.002886	0.00432	0.001457	0.001443	4.92%
UNH	0.003464	0.000336	0.00647	0.012115	-0.00029	0.001371	0.001428	0.002471	6.31E-05	0.000634	4.68%
BHP	0.001425	0.000484	0.001078	-0.00029	0.004767	0.000987	-0.00039	0.000332	0.000127	0.001062	1.89%
UNP	-0.00012	0.001199	0.000929	0.001371	0.000987	0.003543	0.001323	0.000989	0.000705	0.000637	0.80%
WMT	0.003212	0.001154	0.002886	0.001428	-0.00039	0.001323	0.004228	0.002634	0.000149	0.000287	0.79%
HD	0.002571	0.000841	0.00432	0.002471	0.000332	0.000989	0.002634	0.004466	0.000197	0.000299	2.74%
NEE	-0.00062	0.000629	0.001457	6.31E-05	0.000127	0.000705	0.000149	0.000197	0.001905	0.000688	1.09%
XOM	0.001042	0.000399	0.001443	0.000634	0.001062	0.000637	0.000287	0.000299	0.000688	0.001345	0.81%
Portfolio weights											
AAPL	10.00%										
BRK.A	10.00%										
EA	10.00%										
UNH	10.00%										
BHP	10.00%										
UNP	10.00%										
WMT	10.00%										
HD	10.00%										
NEE	10.00%										
XOM	10.00%										
	100%										
	Monthly	Annual	Average								
Return	2.028%	24.34%	16.09%								
Variance	0.002019								AAPL	2.18%	
SD	4.49%	15.56%							BRK.A	1.05%	
									EA	1.77%	
Risk-free rate		6.96%							UNH	2.05%	
									BHP	1.38%	
Sharp ratio		111.69%							UNP	1.04%	
AVG		77.07%							WMT	0.98%	
									HD	1.40%	
									NEE	0.74%	
									XOM	0.83%	

Figure 11. *Optimized Value* portfolio calculations and results, 1991-1994

1991-1994											
	PEG	JPM	WFC	CSCO	INTC	DIS	GE	CAT	BA	F	Monthly return
PEG	0.0014839	0.000709	0.001132	0.001191	0.00077	0.000726	0.000678	0.00078	0.00015	0.000484	0.70%
JPM	0.000709	0.022252	0.002557	0.002617	0.0033	0.003112	0.001161	0.001464	0.000185	0.003383	2.69%
WFC	0.0011322	0.002557	0.004966	0.001535	0.001683	0.001245	0.001983	0.001731	0.000504	0.002714	2.08%
CSCO	0.0011909	0.002617	0.001535	0.015862	0.005253	0.00381	0.001968	0.002157	0.001202	0.000191	5.66%
INTC	0.0007698	0.0033	0.001683	0.005253	0.010429	0.002876	0.001813	0.000647	0.000794	0.001379	2.72%
DIS	0.0007256	0.003112	0.001245	0.00381	0.002876	0.005121	0.001296	0.002298	0.000698	0.002235	1.43%
GE	0.000678	0.001161	0.001983	0.001968	0.001813	0.001296	0.002514	0.001696	0.000905	0.002554	1.35%
CAT	0.0007804	0.001464	0.001731	0.002157	0.000647	0.002298	0.001696	0.005883	0.000848	0.003165	2.11%
BA	0.0001501	0.000185	0.000504	0.001202	0.000794	0.000698	0.000905	0.000848	0.003335	0.000212	0.26%
F	0.0004839	0.003383	0.002714	0.000191	0.001379	0.002235	0.002554	0.003165	0.000212	0.007025	2.17%
Portfolio weights											
PEG	4.00%										
JPM	4.17%										
WFC	19.65%										
CSCO	20.00%										
INTC	11.65%										
DIS	4.00%										
GE	4.00%										
CAT	15.10%										
BA	4.00%										
F	13.42%										
	100%										
	Monthly	Annual	Average								
Return	2.731%	32.77%	17.42%								
Variance	0.0029083										
SD	5.39%	18.68%									
Risk-free rate		6.96%									
Sharp ratio		138.16%									
AVG		65.39%									

Figure 12. *Optimized Beta mix portfolio calculations and results, 1991-1994*

1991-1994											
	AMD	VLO	AMAT	LRCX	SLB	LLY	WMT	PG	NVO	MRK	Monthly return
AMD	0.031304	0.005362	0.004352	0.005774	0.000339	-0.00127	0.001052	0.00091	-0.0012	0.000996	4.18%
VLO	0.005362	0.007218	0.002639	0.003319	0.001451	5.09E-05	0.001533	0.001452	2.57E-05	0.001392	0.41%
AMAT	0.004352	0.002639	0.012027	0.005766	0.001748	0.000801	0.002813	0.002081	6.38E-05	0.001052	4.35%
LRCX	0.005774	0.003319	0.005766	0.014826	0.001445	0.000769	0.001093	0.000406	-0.00133	0.00061	5.46%
SLB	0.000339	0.001451	0.001748	0.001445	0.003872	0.000887	0.000372	0.00031	0.000654	0.000935	0.05%
LLY	-0.00127	5.09E-05	0.000801	0.000769	0.000887	0.004581	0.000773	0.001834	-0.00013	0.00271	0.17%
WMT	0.001052	0.001533	0.002813	0.001093	0.000372	0.000773	0.004228	0.001305	0.000579	0.001505	0.79%
PG	0.00091	0.001452	0.002081	0.000406	0.00031	0.001834	0.001305	0.003267	-0.00014	0.001768	1.31%
NVO	-0.0012	2.57E-05	6.38E-05	-0.00133	0.000654	-0.00013	0.000579	-0.00014	0.00244	0.000662	1.03%
MRK	0.000996	0.001392	0.001052	0.00061	0.000935	0.00271	0.001505	0.001768	0.000662	0.004218	0.89%
Portfolio weights											
AMD	8.21%										
VLO	4.00%										
AMAT	20.00%										
LRCX	20.00%										
SLB	4.00%										
LLY	4.00%										
WMT	4.00%										
PG	11.79%										
NVO	20.00%										
MRK	4.00%										
	100%										
	Monthly	Annual	Average								
Return	2.759%	33.11%	21.51%								
Variance	0.00268								AMD	2.04%	
SD	5.18%	17.93%							VLO	0.88%	
									AMAT	2.11%	
Risk-free rate		6.96%							LRCX	2.78%	
									SLB	0.78%	
Sharp ratio		145.84%							LLY	1.11%	
AVG		97.28%							WMT	0.98%	

Figure 13. *Optimized Sector mix portfolio calculations and results, 1998-2002*

1998-2002											
	AAPL	BRK.A	EA	UNH	BHP	UNP	WMT	HD	NEE	XOM	Monthly return
AAPL	0.032856	1.39E-05	0.010447	0.000955	0.004157	-0.00085	0.002026	0.005964	-0.00271	0.000674	2.54%
BRK.A	1.39E-05	0.006404	-0.00095	0.003736	0.001495	0.001473	0.002684	0.002068	0.002857	0.001245	0.93%
EA	0.010447	-0.00095	0.021094	0.000713	0.000963	-0.00057	-0.00101	0.003599	-0.00075	0.001081	2.81%
UNH	0.000955	0.003736	0.000713	0.00895	0.003244	0.001212	0.002016	0.000535	0.001194	0.001197	2.50%
BHP	0.004157	0.001495	0.000963	0.003244	0.010068	0.00233	0.003496	0.003697	0.000573	0.001741	1.44%
UNP	-0.00085	0.001473	-0.00057	0.001212	0.00233	0.007142	0.001229	0.000282	0.000255	0.000915	0.47%
WMT	0.002026	0.002684	-0.00101	0.002016	0.003496	0.001229	0.008748	0.006488	-0.00086	0.00086	2.06%
HD	0.005964	0.002068	0.003599	0.000535	0.003697	0.000282	0.006488	0.011767	0.000187	0.00096	0.90%
NEE	-0.00271	0.002857	-0.00075	0.001194	0.000573	0.000255	-0.00086	0.000187	0.00581	0.00138	0.69%
XOM	0.000674	0.001245	0.001081	0.001197	0.001741	0.000915	0.00086	0.00096	0.00138	0.002974	0.62%
Portfolio weights											
AAPL	5.34%										
BRK.A	4.00%										
EA	20.00%										
UNH	20.00%										
BHP	4.00%										
UNP	4.00%										
WMT	20.00%										
HD	4.00%										
NEE	14.66%										
XOM	4.00%										
	100%										
	Monthly	Annual									
Return	1.884%	22.61%									
Variance	0.002806										
SD	5.30%	18.35%									
	Risk-free rate	5.31%									
	Sharp ratio	94.23%									

Figure 14. *Optimized Dividend portfolio calculations and results, 1998-2002*

1998-2002												
	T	XOM	CVX	KMB	TROW	KO	MMM	PFE	MRK	JPM		Monthly return
T	0.010573	0.002231	0.002231	0.002941	0.002934	0.001276	0.001409	0.002063	0.004129	0.002029		0.17%
XOM	0.002231	0.002974	0.002974	0.001478	0.002327	0.001678	0.001708	0.001028	0.000634	0.001677		0.62%
CVX	0.002231	0.002974	0.002974	0.001478	0.002327	0.001678	0.001708	0.001028	0.000634	0.001677		0.62%
KMB	0.002941	0.001478	0.001478	0.007183	0.003268	0.003385	0.002034	0.000263	0.002141	0.001833		0.33%
TROW	0.002934	0.002327	0.002327	0.003268	0.011515	0.004002	0.002957	0.002917	0.003392	0.007558		0.39%
KO	0.001276	0.001678	0.001678	0.003385	0.004002	0.007669	0.001475	0.001271	0.002873	0.003626		-0.17%
MMM	0.001409	0.001708	0.001708	0.002034	0.002957	0.001475	0.005519	0.000305	0.00076	0.002697		1.12%
PFE	0.002063	0.001028	0.001028	0.000263	0.002917	0.001271	0.000305	0.006322	0.004254	0.003246		0.59%
MRK	0.004129	0.000634	0.000634	0.002141	0.003392	0.002873	0.00076	0.004254	0.008595	0.002573		0.50%
JPM	0.002029	0.001677	0.001677	0.001833	0.007558	0.003626	0.002697	0.003246	0.002573	0.017704		0.47%
Portfolio weights												
T	4.00%											
XOM	20.00%											
CVX	20.00%											
KMB	4.00%											
TROW	4.00%											
KO	4.00%											
MMM	20.00%											
PFE	16.00%											
MRK	4.00%											
JPM	4.00%											
	100%											
	Monthly	Annual										
Return	0.633%	7.60%										
Variance	0.002219											
SD	4.71%	16.32%										
	Risk-free rate	5.31%										
	Sharp ratio	13.99%										

Figure 15. *Optimized Sector portfolio mix calculations and results, 2007-2009*

2007-2009												
	AAPL	BRK.A	EA	UNH	BHP	UNP	WMT	HD	NEE	XOM		Monthly return
AAPL	0.01659	0.0024641	0.009928	0.00489	0.008625	0.007859	-2.2E-05	0.00194	0.00494	0.002264		3.48%
BRK.A	0.002464	0.0039309	0.00245	0.002518	0.001934	0.002868	0.000628	0.001433	0.000946	0.000618		-0.10%
EA	0.009928	0.0024497	0.012632	0.002479	0.007297	0.004396	0.000346	0.001564	0.002963	0.000883		-2.21%
UNH	0.00489	0.0025176	0.002479	0.014291	0.003694	0.005074	-0.00053	0.002033	0.003256	0.001028		-0.78%
BHP	0.008625	0.0019344	0.007297	0.003694	0.014887	0.00527	0.00158	0.000909	0.004142	0.003312		2.75%
UNP	0.007859	0.0028676	0.004396	0.005074	0.00527	0.009089	0.001512	0.003213	0.003318	0.000624		1.27%
WMT	-2.2E-05	0.0006284	0.000346	-0.00053	0.00158	0.001512	0.002404	0.001532	0.000303	0.000189		0.60%
HD	0.00194	0.0014327	0.001564	0.002033	0.000909	0.003213	0.001532	0.006446	0.000871	-0.00071		-0.40%
NEE	0.00494	0.0009459	0.002963	0.003256	0.004142	0.003318	0.000303	0.000871	0.004167	0.000916		0.27%
XOM	0.002264	0.0006176	0.000883	0.001028	0.003312	0.000624	0.000189	-0.00071	0.000916	0.002552		0.06%
Portfolio weights												
AAPL	20.00%											
BRK.A	4.00%											
EA	4.00%											
UNH	4.00%											
BHP	20.00%											
UNP	16.00%											
WMT	20.00%											
HD	4.00%											
NEE	4.00%											
XOM	4.00%											
	100%											
	Monthly	Annual										
Return	1.441%	17.29%										
Variance	0.004537											
SD	6.74%	23.33%										
	Risk-free rate	3.85%										
	Sharpe ratio	57.60%										

Figure 16. *Optimized Mix portfolio calculations and results, 2010-2015*

2010-2015											
	AAPL	MSFT	JNJ	PFE	KO	PG	SPGI	XOM	VZ	MMM	Monthly return
AAPL	0.005004	0.001467	0.000434	0.000295	0.0008	0.00048	0.001602	0.001052	0.000291	0.001276	2.26%
MSFT	0.001467	0.004559	0.000926	0.000883	0.001022	0.000649	0.001725	0.001323	0.000816	0.001241	1.41%
JNJ	0.000434	0.000926	0.001592	0.001099	0.000857	0.00075	0.001478	0.000898	0.000658	0.001047	1.05%
PFE	0.000295	0.000883	0.001099	0.002281	0.000997	0.000738	0.001743	0.001051	0.001017	0.001274	1.20%
KO	0.0008	0.001022	0.000857	0.000997	0.001628	0.000619	0.000885	0.00074	0.001077	0.000762	0.98%
PG	0.00048	0.000649	0.00075	0.000738	0.000619	0.001472	0.000788	0.00064	0.000367	0.000649	0.70%
SPGI	0.001602	0.001725	0.001478	0.001743	0.000885	0.000788	0.00499	0.001474	0.000992	0.001779	1.94%
XOM	0.001052	0.001323	0.000898	0.001051	0.00074	0.00064	0.001474	0.002205	0.000563	0.001461	0.61%
VZ	0.000291	0.000816	0.000658	0.001017	0.001077	0.000367	0.000992	0.000563	0.002118	0.000463	1.26%
MMM	0.001276	0.001241	0.001047	0.001274	0.000762	0.000649	0.001779	0.001461	0.000463	0.002442	1.22%
Portfolio weights											
AAPL	20.00%										
MSFT	5.08%										
JNJ	15.40%										
PFE	11.33%										
KO	4.00%										
PG	4.00%										
SPGI	12.19%										
XOM	4.00%										
VZ	20.00%										
MMM	4.00%										
	100%										
	Monthly	Annual									
Return	1.448%	17.38%									
Variance	0.00122										
SD	3.49%	12.10%									
	Risk-free rate	2.47%									
	Sharp ratio	123.19%									

Figure 17. *Optimized Growth portfolio calculations and results, 2020-2023*

2020-2023											
	AAPL	MSFT	DIS	INTC	AMGN	IBM	LLY	NVO	SPGI	CMCSA	Monthly return
AAPL	0.008197	0.004553	0.005799	0.003443	0.002329	0.001976	0.001726	0.001135	0.004979	0.003316	2.37%
MSFT	0.004553	0.004653	0.00312	0.003544	0.001242	0.000946	0.002431	0.002091	0.004095	0.00213	2.02%
DIS	0.005799	0.00312	0.011163	0.004707	0.002179	0.002335	0.000846	0.001139	0.004718	0.005459	-0.31%
INTC	0.003443	0.003544	0.004707	0.010007	0.003511	0.003094	0.003342	0.001768	0.003672	0.003777	-0.03%
AMGN	0.002329	0.001242	0.002179	0.003511	0.004892	0.003081	0.002874	0.001036	0.002133	0.002509	0.94%
IBM	0.001976	0.000946	0.002335	0.003094	0.003081	0.004526	0.001237	0.000743	0.002489	0.003051	0.92%
LLY	0.001726	0.002431	0.000846	0.003342	0.002874	0.001237	0.007992	0.002928	0.001883	0.000814	3.63%
NVO	0.001135	0.002091	0.001139	0.001768	0.001036	0.000743	0.002928	0.00381	0.002456	0.001405	3.03%
SPGI	0.004979	0.004095	0.004718	0.003672	0.002133	0.002489	0.001883	0.002456	0.006662	0.003803	1.13%
CMCSA	0.003316	0.00213	0.005459	0.003777	0.002509	0.003051	0.000814	0.001405	0.003803	0.006594	0.49%
Portfolio weights											
AAPL	16.24%										
MSFT	19.76%										
DIS	4.00%										
INTC	4.00%										
AMGN	4.00%										
IBM	4.00%										
LLY	20.00%										
NVO	20.00%										
SPGI	4.00%										
CMCSA	4.00%										
	100%										
	Monthly	Annual									
Return	2.241%	26.89%									
Variance	0.003006										
SD	5.48%	18.99%									
	Risk-free rate	2.31%									
	Sharp ratio	129.41%									

Figure 18. *Optimized Growth portfolio calculations and results, 1998-2002*

1998-2002											
	AAPL	MSFT	DIS	INTC	AMGN	IBM	LLY	NVO	SPGI	CMCSA	Monthly return
AAPL	0.032856	0.012585	0.003219	0.018779	0.006935	0.011122	-0.00291	0.000719	0.003761	0.005371	2.54%
MSFT	0.012585	0.021638	0.003118	0.012867	0.00668	0.009795	0.001195	0.002195	0.002166	0.005466	1.59%
DIS	0.003219	0.003118	0.01044	0.008486	0.000637	0.004831	0.00261	0.000377	0.001154	0.001148	-0.74%
INTC	0.018779	0.012867	0.008486	0.025822	0.00736	0.011898	0.002685	-0.00037	0.001909	0.003008	0.94%
AMGN	0.006935	0.00668	0.000637	0.00736	0.0151	0.004493	-1.4E-05	0.000811	0.001413	0.005074	3.02%
IBM	0.011122	0.009795	0.004831	0.011898	0.004493	0.014292	-0.0002	0.002789	0.001331	0.00477	1.50%
LLY	-0.00291	0.001195	0.00261	0.002685	-1.4E-05	-0.0002	0.01117	-0.00018	0.001239	0.000645	0.56%
NVO	0.000719	0.002195	0.000377	-0.00037	0.000811	0.002789	-0.00018	0.008792	0.000451	0.001612	0.60%
SPGI	0.003761	0.002166	0.001154	0.001909	0.001413	0.001331	0.001239	0.000451	0.00537	0.002366	1.35%
CMCSA	0.005371	0.005466	0.001148	0.003008	0.005074	0.00477	0.000645	0.001612	0.002366	0.010115	1.21%
Portfolio weights											
AAPL	14.67%										
MSFT	4.00%										
DIS	4.00%										
INTC	4.00%										
AMGN	20.00%										
IBM	4.00%										
LLY	11.55%										
NVO	10.31%										
SPGI	20.00%										
CMCSA	7.47%										
	100%										
	Monthly	Annual									
Return	1.595%	19.14%									
Variance	0.004381										
SD	6.62%	22.93%									
	Risk-free rate	5.31%									
	Sharp ratio	60.31%									

Figure 20. Optimized *Dividend* portfolio calculations and results, 2020-2023

2020-2023											
	T	XOM	CVX	KMB	TROW	KO	MMM	PFE	MRK	JPM	Monthly return
T	0.004903	0.003908	0.003908	0.00206	0.001875	0.002025	0.002125	0.001318	0.001842	0.002991	-0.26%
XOM	0.003908	0.011399	0.011399	0.001798	0.003382	0.002729	0.003273	0.000825	0.003098	0.005335	2.07%
CVX	0.003908	0.011399	0.011399	0.001798	0.003382	0.002729	0.003273	0.000825	0.003098	0.005335	2.07%
KMB	0.00206	0.001798	0.001798	0.003423	0.001626	0.002105	0.001842	0.00218	0.002161	0.001073	0.09%
TROW	0.001875	0.003382	0.003382	0.001626	0.009074	0.00265	0.004266	0.00348	0.001338	0.005663	0.13%
KO	0.002025	0.002729	0.002729	0.002105	0.00265	0.003567	0.002427	0.001721	0.002064	0.002492	0.42%
MMM	0.002125	0.003273	0.003273	0.001842	0.004266	0.002427	0.004818	0.002189	0.001738	0.003659	-0.42%
PFE	0.001318	0.000825	0.000825	0.00218	0.00348	0.001721	0.002189	0.006839	0.001166	0.00169	0.31%
MRK	0.001842	0.003098	0.003098	0.002161	0.001338	0.002064	0.001738	0.001166	0.004182	0.001538	0.91%
JPM	0.002991	0.005335	0.005335	0.001073	0.005663	0.002492	0.003659	0.00169	0.001538	0.007219	0.94%
Portfolio weights											
T	4.00%										
XOM	20.00%										
CVX	20.00%										
KMB	4.00%										
TROW	4.00%										
KO	4.00%										
MMM	4.00%										
PFE	4.00%										
MRK	20.00%										
JPM	16.00%										
	100%										
	Monthly	Annual									
Return	1.171%	14.06%									
Variance	0.004513										
SD	6.72%	23.27%									
	Risk-free rate	2.31%									
	Sharp ratio	50.49%									

Figure 21. *Optimized Beta mix portfolio calculations and results, 2020-2023*

2020-2023											
	AMD	VLO	AMAT	LRCX	SLB	LLY	WMT	PG	NVO	MRK	Monthly return
AMD	0.026457	0.002562	0.011538	0.013293	0.000606	0.000252	0.001737	0.001622	0.001997	-0.00019	3.25%
VLO	0.002562	0.021362	0.008634	0.006484	0.018695	0.002065	0.001637	0.001078	0.001281	0.002916	2.27%
AMAT	0.011538	0.008634	0.01379	0.012709	0.008571	0.001493	0.001293	0.000987	0.001111	0.000338	2.80%
LRCX	0.013293	0.006484	0.012709	0.014426	0.006784	0.001059	0.00076	0.001198	0.000947	-0.00068	2.69%
SLB	0.000606	0.018695	0.008571	0.006784	0.024721	0.00108	0.001383	0.001562	0.000215	0.004108	2.39%
LLY	0.000252	0.002065	0.001493	0.001059	0.00108	0.007992	0.000983	0.000387	0.002928	0.002083	3.63%
WMT	0.001737	0.001637	0.001293	0.00076	0.001383	0.000983	0.003006	0.001548	0.001447	0.001876	0.94%
PG	0.001622	0.001078	0.000987	0.001198	0.001562	0.000387	0.001548	0.002831	0.001241	0.001554	0.76%
NVO	0.001997	0.001281	0.001111	0.000947	0.000215	0.002928	0.001447	0.001241	0.00381	0.001702	3.03%
MRK	-0.00019	0.002916	0.000338	-0.00068	0.004108	0.002083	0.001876	0.001554	0.001702	0.004182	0.91%
Portfolio weights											
AMD	6.86%										
VLO	4.00%										
AMAT	4.00%										
LRCX	6.94%										
SLB	4.00%										
LLY	20.00%										
WMT	15.16%										
PG	15.04%										
NVO	20.00%										
MRK	4.00%										
	100%										
	Monthly	Annual									
Return	2.333%	28.00%									
Variance	0.002479										
SD	4.98%	17.25%									
	Risk-free rate	2.31%									
	Sharp ratio	148.94%									

Figure 22. *Optimized Sector mix portfolio calculations and results, 1991-1994*

1991-1994												
	AAPL	BRK.A	EA	UNH	BHP	UNP	WMT	HD	NEE	XOM	Monthly return	
AAPL	0.018295	0.001911	0.008342	0.003464	0.001425	-0.00012	0.003212	0.002571	-0.00062	0.001042	0.25%	
BRK.A	0.001911	0.003126	0.002548	0.000336	0.000484	0.001199	0.001154	0.000841	0.000629	0.000399	2.32%	
EA	0.008342	0.002548	0.021863	0.00647	0.001078	0.000929	0.002886	0.00432	0.001457	0.001443	4.92%	
UNH	0.003464	0.000336	0.00647	0.012115	-0.00029	0.001371	0.001428	0.002471	6.31E-05	0.000634	4.68%	
BHP	0.001425	0.000484	0.001078	-0.00029	0.004767	0.000987	-0.00039	0.000332	0.000127	0.001062	1.89%	
UNP	-0.00012	0.001199	0.000929	0.001371	0.000987	0.003543	0.001323	0.000989	0.000705	0.000637	0.80%	
WMT	0.003212	0.001154	0.002886	0.001428	-0.00039	0.001323	0.004228	0.002634	0.000149	0.000287	0.79%	
HD	0.002571	0.000841	0.00432	0.002471	0.000332	0.000989	0.002634	0.004466	0.000197	0.000299	2.74%	
NEE	-0.00062	0.000629	0.001457	6.31E-05	0.000127	0.000705	0.000149	0.000197	0.001905	0.000688	1.09%	
XOM	0.001042	0.000399	0.001443	0.000634	0.001062	0.000637	0.000287	0.000299	0.000688	0.001345	0.81%	
Portfolio weights												
AAPL	4.00%											
BRK.A	20.00%											
EA	4.00%											
UNH	20.00%											
BHP	18.23%											
UNP	4.00%											
WMT	4.00%											
HD	17.63%											
NEE	4.14%											
XOM	4.00%											
	100%											
	Monthly	Annual	Average									
Return	2.575%	30.90%	22.40%									
Variance	0.001915											
SD	4.38%	15.16%										
Risk-free rate	6.96%											
Sharp ratio	157.90%											
AVG	113.56%											
					AAPL	2.18%						
					BRK.A	1.05%						
					EA	1.77%						
					UNH	2.05%						
					BHP	1.38%						
					UNP	1.04%						
					WMT	0.98%						
					HD	1.40%						
					NEE	0.74%						
					XOM	0.83%						

Figure 23. *Optimized Growth portfolio calculations and results, 2007-2009*

2007-2009											
	AAPL	MSFT	DIS	INTC	AMGN	IBM	LLY	NVO	SPGI	CMCSA	Monthly return
AAPL	0.01659	0.006575	0.004945	0.008048	4.26E-05	0.003717	0.001626	0.002633	0.006576	0.002042	3.48%
MSFT	0.006575	0.007627	0.00318	0.004452	0.000506	0.001589	0.002732	0.000433	0.003898	0.001088	0.49%
DIS	0.004945	0.00318	0.006011	0.003642	0.001532	0.002915	0.00317	0.001493	0.005023	0.003565	0.16%
INTC	0.008048	0.004452	0.003642	0.007887	0.002417	0.003324	0.003547	0.001261	0.004623	0.003026	0.55%
AMGN	4.26E-05	0.000506	0.001532	0.002417	0.009159	0.00171	0.001536	0.000765	0.001852	0.002042	-0.20%
IBM	0.003717	0.001589	0.002915	0.003324	0.00171	0.004376	0.002324	0.000934	0.002406	0.002371	1.17%
LLY	0.001626	0.002732	0.00317	0.003547	0.001536	0.002324	0.006124	0.000995	0.002106	0.002405	-0.51%
NVO	0.002633	0.000433	0.001493	0.001261	0.000765	0.000934	0.000995	0.003103	0.00066	-0.00019	1.58%
SPGI	0.006576	0.003898	0.005023	0.004623	0.001852	0.002406	0.002106	0.00066	0.012702	0.003737	-1.13%
CMCSA	0.002042	0.001088	0.003565	0.003026	0.002042	0.002371	0.002405	-0.00019	0.003737	0.00822	-1.10%
Portfolio weights											
AAPL	20.00%										
MSFT	16.00%										
DIS	4.00%										
INTC	4.00%										
AMGN	4.00%										
IBM	20.00%										
LLY	4.00%										
NVO	20.00%										
SPGI	4.00%										
CMCSA	4.00%										
	100%										
	Monthly	Annual									
Return	1.234%	14.81%									
Variance	0.003409										
SD	5.84%	20.22%									
	Risk-free rate	3.85%									
	Sharp ratio	54.18%									