VILNIUS UNIVERSITY
BUSINESS SCHOOL

SUSTAINABLE CORPORATE FINANCE AND INVESTMENTS PROGRAMME

RYTIS DRAGŪNAS

THE FINAL MASTER'S THESIS

Akcijų kainų nustatymo metodų patikimumo vertinimas	***Evaluation of Stock Price Determination Methods Reliability***

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Name, surname, academic title, scientific degree of the supervisor

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SUMMARY

VILNIUS UNIVERSITY BUSINESS SCHOOL
SUSTAINABLE CORPORATE FINANCE AND INVESTMENTS STUDY PROGRAMME
RYTIS DRAGŪNAS

EVALUATION OF STOCK PRICE DETERMINATION METHODS RELIABILITY

Supervisor – lecturer Dr. J. Kartašova
Master's thesis was prepared in Vilnius, 2024
Scope of Master's thesis – 41 pages.
Number of tables used in the FMT - pcs. -3
Number of figures used in the FMT - 16
Number of bibliography and references - 53

Analysis of current economic situation in US, study of independent variables money supply and interest rate impact on S&P500 stock returns and valuation.

Problem. Valuation of the stock market varies, and comparative model depends on assumptions of valuations.

Objective. Monetary policy impact on S&P500 stock prices and valuations.

Analyze literature, analyze the relationship between monetary policy and stock returns, interpretate the results.

Research methods. Comparative analysis, analysis of scientific literature, statistical analysis and interpretation, graphical modeling.

Finally, in the results section it was revealed that effective federal funds rate is important and significant factor for S&P500 index price changes, but dependency varies on historical period. It was also found out that money supply is an important variable which affects the S&P500 index. In conclusion, in any case fundamental analysis is helpful to analyze which determinants could influence stock prices and what we could expect in the future based on the past data.

Conclusions of the FMT: Fundamental analysis is affected by monetary policy. The effect varies throughout the period analyzed, based on economic situation and expectations of the market participants.

SANTRAUKA

VILNIAUS UNIVERSITETO VERSLO MOKYKLA
TVARŪS VERSLO FINANSAI IR INVESTICIJOS STUDIJŲ PROGRAMA
RYTIS DRAGŪNAS

AKCIJŲ KAINOS NUSTATYMO METODŲ PATIKIMUMO VERTINIMAS

Vadovė – lektorė Dr. J. Kartašova
Magistro darbas parengtas Vilniuje, 2024 m.
Magistro darbo apimtis – 41 puslapiai.
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Naudotų literatūros ir šaltinių skaičius – 53.

Darbo metu analizuota dabartinė ekonominė situacija JAV, nagrinėtas nepriklausomų kintamųjų pinigų pasiūlos ir palūkanų normos – poveikis S&P500 akcijų grąžai ir vertinimui.

Problema. Modeliai nustatantys akcijų vertę, priklauso nuo įkainojimo prielaidų, tačiau akcijų įkainojimo įverčiai rinkoje skiriasi.

Tikslas. Išnagrinėti monetarinės politikos įtaką S&P500 akcijų kainoms ir vertinimams.

Uždaviniai:

- Išnagrinėti literatūrą,
- Išanalizuoti ryšį tarp monetarinės politikos ir akcijų grąžos,
- Interpretuoti rezultatus.

Tyrimo metodai. Lyginamoji analizė, mokslinės literatūros analizė, statistinė analizė ir interpretavimas, grafinis modeliavimas.

Rezultatai. Rezultatų skyriuje atskleista, kad efektyvi palūkanų norma yra svarbus ir reikšmingas veiksnys, lemiantis S&P500 indekso kainų pokyčius, tačiau priklausomybė kinta pagal nagrinėjamą istorinį laikotarpį. Taip pat nustatyta, kad pinigų pasiūla yra svarbus kintamasis, veikiantis S&P500 indeksą.

Išvados. Fundamentalioji analizė yra naudinga siekiant nustatyti, kokie veiksniai gali daryti įtaką akcijų kainoms ir ko galima tikėtis ateityje, remiantis praeities duomenimis.

Magistro darbo išvados:

Fundamentalioji analizė yra veikiama monetarinės politikos. Šio poveikio stiprumas ir kryptis priklauso nuo nagrinėjamo laikotarpio, ekonominės situacijos ir rinkos dalyvių lūkesčių.

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INTRODUCTION

Relevance of the Topic. Each workday stock exchange markets operate around the world, in each of them there are investors, speculators and institutional players that want to make a return on their money. Those market players want to optimize their strategies, and they use different valuation methods to examine the intrinsic value of the company. These methods help determine the true value of stock prices and interpret whether the shares are overvalued, undervalued, or whether their true value aligns with the market price. Additionally, using various stock valuation methods, investors can easily compare different stocks within the same industry. In a dynamic business investors and financial analysts often face challenges in predicting future developments. Therefore, it is essential to analyze how stock valuation methods can help investors understand market changes and assess investment opportunities. While valuation analysis methods are widely used by investors, it is vital to examine how different approaches can support decision making. It is also important to note that stock valuation methods allow investors to evaluate market sentiments and trends while identifying potential investment risks. By applying these methods, investors can make investment decisions, compare opportunities, manage risks, and plan strategic actions. This research is relevant because it explores what most common valuation methods are analyzing and checks if those gaps can be filled by certain parameters.

Problem. S&P500 profit per earning valuations vary throughout history, due to it price prediction models are inaccurate.

Object of Research. The reliability of stock valuation models and comparison methods in US stock market.

Aim of Research. To analyze various stock valuation methods and determine their reliability and suitability.

Objectives of the Research:

1. To reveal the theoretical aspects of regular valuation methods and check their suitability.
2. To develop a methodology for researching the reliability of stock valuation methods in the context of constantly changing valuation metrics.
3. To conduct a study on stock valuation methods using the proposed research methodology and present its results.

Calculations are performed using formulas provided in academic sources, with the help of Microsoft Excel and Eviews statistical program.

Structure of the Work. The Master thesis consists of three parts:

- **Theoretical.** Overview of most common variables used in price prediction and valuation models. Explore what results were achieved by other authors in their works while using price prediction model and valuation models and formulate a problem based on those results.
- **Empirical Research Methodology.** Describes the methodology of empirical study, including the research sample, analysis period and research methods.
- **Results and Interpretation.** presents the results of calculations based on the applied methods and interprets these findings.

Research methods used in this study: comparison, regression analysis.

Limitations of the work. Thesis does not take into account the flows of capital from foreign countries, changes in tax code, analysis of individual companies, impact of technical analysis on valuation.

1. STOCK PRICE VALUATION AND MONETARY POLICY

1.1 Fundamentals of stock price

If an analyst wants to understand how to properly analyze a stock and what fair value should be set for the stock, he needs to understand fundamentals about the company. Each company operates in a different environment. Work should begin with understanding the business model, in what area the company operates and if there are any cyclical parts for the observable company. Those environments are usually classified into two different categories:

- **Macroeconomics.** Macroeconomics variables involve growth of GDP, unemployment rate inflation rate. The tool that is used by the government is fiscal policy by the government and monetary policy by the central bank.
- **Microeconomics.** Microeconomics variables describe the conditions of the company itself. Part of microeconomic parameters could be described as the industry in which company operates. Also, when describing the company or creating models' variables such as debt levels, sales, profitability, costs, growth of sales or profit are used.

When analyzing small businesses that are not so well-known, without any major leaders, using these parameters is usually enough. But when we analyze major companies with known executives within the industry, popularity and reputation of the executives start to matter. Adams and Veprauskaite (2013) analyzed what impact powerful Chief executive officers might have on stock's performance within the market and concluded that the more person is authoritarian, more likely that he will pressure staff to not disclose certain information to the public, which leads to more sudden price crashes when that information gets public in the end.

Intrinsic value and **market value** are two fundamental concepts in the world of investing and finance. One of the most famous investor Warren buffet is well known for his advocation for intrinsic value investing. In one of his wisdom pearls he says:

" Price *is what you pay, value is what you get*"

They provide distinct perspectives on the worth of a stock or asset and play a crucial role in shaping investment decisions. Understanding the difference between these two values can help investors make more informed choices.

Figure 1 represents a graph, that illustrates how market value and intrinsic value deviate over the time.

Figure 1

Intrinsic value and price deviation

Source: Intrinsic value vs market value (2019)

Intrinsic Value refers to the perceived or calculated true worth of an asset based on its fundamental characteristics, such as financial performance, growth potential, and cash flow generation. It represents the value an investor believes a stock or company should be worth, independent of market sentiment or price fluctuations. The intrinsic value is inherently subjective, as different investors may use varying assumptions, methodologies, and projections. For example, one investor might assume higher future growth rates, resulting in a higher intrinsic value estimate.

Market value, on the other hand, is the current price at which an asset trades on an exchange. It reflects the collective sentiment, supply, and demand in the market at any given time. Unlike intrinsic value, market value is observable and determined by factors that may not always relate to the company's fundamentals.

Market value can deviate significantly from intrinsic value due to these factors. For instance, during periods of market euphoria, stocks may trade at prices well above their intrinsic value, while fear or pessimism may cause prices to fall below their fundamental worth.

The relationship between intrinsic value and market value often creates investment opportunities:

Undervalued Stocks: When the market value is lower than the intrinsic value, the stock is considered undervalued. This is an attractive opportunity for value investors who seek to buy assets at a discount. Overvalued Stocks: When the market value exceeds intrinsic value, the stock is deemed overvalued, potentially signaling caution for investors.

For example, during the dot-com bubble of the late 1990s, many technology stocks had market values that far exceeded their intrinsic values. When the bubble burst, prices corrected sharply, highlighting the importance of aligning investments with intrinsic value.

Intrinsic value and market value are two sides of the same coin, offering different lenses through which to view an asset's worth. While market value is driven by external factors and fluctuates in real time, intrinsic value provides a more stable and rational measure based on underlying fundamentals. Successful investors often seek to identify disparities between these values to capitalize on mispriced opportunities. By combining intrinsic valuation methods with an understanding of market dynamics, investors can navigate the complexities of the financial markets more effectively.

Market sentiment arises from a mixture of factors such as: news, media, economic indicators, technical signals. The effect of **news** was analyzed by L.Vaidziulyte. In her master thesis „*Investigation of Influence of Media Announced Non-Financial Information on Stock Price Fluctuations*“ impact of media announcments about the companies non-financial information. In her work she took baltic NASDAQ companies, separating the ones that have announcements about them. Then she took information from top lithuanian websites: delfi.lt, 15min.lt, lrytas.lt, skelbiu.lt and autoplius.lt, evaluated articles based on positivity and negativity about the companies. Her results summarizes her findings Research results also concluded, that non-financial information, provided by the media have only a temporary effect on stock prices. Tendency was observed that the prices changes on the day of released article or 1, 2, 5 days after." She has not made any comments if there were any news about executive replacements in the news. Another work analyzing sentiment was performed by Sabaliauskaite (2022), she concluded that sentiment on twitter can be used to determine short term price action of the stocks.

Social Media. Online platforms amplify opinions and emotions, often creating feedback loops. Markus et al. (2024) made an analysis of reddit platform and what impact it had on stocks. They have concluded that it momentarily increased shareholders amount for those particular stocks

that were mentioned. If stock was mentioned in initial post with positive analysis, additional buying interest was noticed.

Technical signals and analysis. There are many different methodologies and indicators that are used in technical analysis. Park et.al (2007) made an analysis of studies that were performed on technical analysis. Their findings are that out of 95 modern studies, 56 studies found positive results in investments when using technical analysis, 20 studies showed negative results and 19 mixed results. As long as people believe in technical analysis, it will show some beneficial results as a risk's management and trend prediction tool.

Economic indicators. Countries are monitoring not only past data like inflation, GDP growth, but also conducts surveys with purchases managers, CEOs, CFO. Better or worse data reported compared to expectations of the market tend to move markets around and set a sentiment for some period of time.

To conclude this subsection, there are many different angles investor can look into it when determining appropriate price for the stock. It could be fundamentals of company itself or a trend that began in social media or technical analysis. In most cases market's value will be different compared to intrinsic, due to varying approaches, different opinion about future's performance and sentiment of the market.

1.2 Valuation models

Valuation models could be classified into 3 different areas: fundamental, comparative and statistical.

Fundamental Analysis. This approach examines a company's financial strengths based on historical data, industry and sector conditions, management, history, capitalization, and future growth potential. A combination of historical and fiscal information reflects all data not directly related to stock prices, which is used to define investment value and compare stocks with one another. (Thomsett, M. C., 2006).

Comparative Analysis. This method compares and evaluates companies and their stock prices based on industry sector, geographical location, company size, and growth level. Comparative analysis helps determine whether stocks are fairly valued in comparison with other companies in the same market.

Discounted Cash Flow (DCF) Method evaluates stocks by projecting future cash flows and discounting them to their present value, determining whether a stock investment will pay off in the long term. This method is popular among experienced investors due to its detailed approach. However, it is rarely used by beginners due to its complex calculations, time-consuming nature, and the high level of attention required.

Price-to-Net Asset Value This ratio measures how expensive a stock is compared to its net asset value. It is often used to evaluate asset-heavy companies as it focuses on tangible assets, making it unsuitable for companies dependent on intangible assets. This method is especially relevant for businesses whose main operations rely on physical assets, such as infrastructure, manufacturing, and real estate industries. However, it does not account for the company's income generation or financial condition.

Price-to-Book Value This ratio is calculated by dividing the stock price by the book value per share and compares the market value with the company's book value. A low ratio may indicate that a company is undervalued and could provide future returns for investors. Similar to the price-to-sales ratio used in this study, the P/BV ratio is suitable for analyzing companies with negative or volatile revenues.

Price-to-Cash Flow. This ratio is similar to the price-to-earnings ratio used in this study but is calculated based on the cash flows generated by a company in a year. The ratio analyzes the stock price relative to the cash flows produced. The advantage of this ratio over others that use earnings, sales, or book value for calculations is that cash flows are harder to manipulate since they are not influenced by a company's accounting policies. The P/CF ratio is particularly effective when used in combination with the discounted cash flow method.

Price-to-Earnings (P/E) ratio is one of the most commonly used financial metrics for valuing a company's stock. It measures the relationship between a company's stock price and its earnings per share (EPS), providing investors with a simple tool to evaluate whether a stock is overvalued, undervalued, or fairly priced compared to it's peers. Standard P/E ratio takes net profit of previous 12 month, but forward looking P/E ratio is also used and calculated:

$$Foward\,\frac{P}{E} = \frac{Market\ cap}{Expected\ net\ profit\ for\ following\ 12\ months} \qquad (1)$$

Forward P/E is more commonly used when talking about growth stocks, these days it usually refers to technology sector and new startups.

Imam et.al (2008) reviewed what investments analysts that were working in UK used as main tool of valuations. Majority of the analysts were using DCF as primary tool when analyzing prospects of companies. P/E was used as a secondary tool to compare it with similar companies.
Another augmented P/E ratio that is used when talking about growth stock is **PEG ratio**. This ratio takes into account expected growth of profits for the following year and is calculated as:

$$PEG = \frac{P/E}{Annual\ growth\ ratio} \qquad (2)$$

Rate below indicates 1.00 indicates undervalue and rate above 1.00 overvalue.
E.g. Market cap 100 MUSD, earnings 10 MUSD and expected growth rate of 20%,
PEG = $\frac{100/10}{20}$= 0.5, which indicates undervaluation.

Another approach is to use **statistical** valuation methods. Statistical methods are more commonly used nowadays, when computing power is increasing. According to Groette (2023) around 70-80% of all trade volume in US comes from algorithms. Part of that is due to overall decision making of algorithms, but there is another reason, to obtain better buying or selling price. Large order is split in smaller parts that is executed over longer period of time, thus not affecting price movement in larger scale.

Regression analysis is a statistical technique used to model the relationship between a dependent variable (stock price) and one or more independent variables (e.g., earnings, revenue, interest rates). Determines how changes in a specific factor (e.g., earnings per share) affect stock prices. Considers multiple factors simultaneously (e.g., earnings, dividends, and macroeconomic variables). Provides a holistic view of factors influencing stock prices. Liaudanskaite (2021) performed auto regression analysis to check how money supply and changes in interest rates affect stock prices. In her conclusion, different sectors reacted differently to changes and for some there was basically no correlation between prices movements and changes in interest rates or money supply.

Autoregressive Integrated Moving Average (ARIMA) Models and forecasts stock prices based on historical price patterns. Autoregression (AR): Relates current values to past values. Integration (I): Accounts for trends. Moving Average (MA): Captures relationships between a stock's price and residual errors. Assigns exponentially decreasing weights to older data,

emphasizing recent data for predictions. Predicting stock prices for short-term trading strategies or portfolio adjustments. Paplauskaite (2009) in her research used ARIMA model to determine if Siemens AG price is properly valued. She has concluded that price is fully valued at the stock market and that ARIMA model predicts well only in the following period, results for future periods were not consistent with market's price.

Monte Carlo Simulation. Monte Carlo simulation generates a range of possible outcomes for stock prices based on statistical probability distributions. Simulates thousands of possible future stock prices based on inputs like volatility, average returns, and time horizon. Incorporates randomness to reflect market uncertainties. Modern statistical valuation incorporates machine learning algorithms to enhance accuracy and adaptability. Xiang et. al (2021) performed analysis using Monte Carlo simulation on Malaysia and US stocks. Results of the simulation were not significantly better than regular return of the stocks.

Machine Learning-Based Statistical Methods. Modern statistical valuation incorporates machine learning algorithms to enhance accuracy and adaptability. Predicts stock price movements by classifying data into categories (e.g., bullish vs. bearish trends). Uses ensemble learning to predict stock prices based on multiple decision trees. Research performed by Chen et.al (2023) into machine learning shows promising results. In their research they have set up candlestick pattern recognition algorithms, which learn from the past data and forecast movements into the future. Authors concluded that in short term trading it can be used to get yield results.

There are other valuation metrics as well that were not described here, like Sales to Market cap, Sales to EV and many others that could be derived from combining several different valuation metrics and come up with a new one. Table 1 below illustrates most common ones and what effort it takes to prepare it, weaknesses and strengths. There is no single correct model, as each business operates in different circumstances and those differences must be accounted for when forecasting growth of those companies and comparing with counterparts.

Table 1

Summary of valuation models

Method	Efforts level	Weaknesses	Strength
DCF	High	Depends on predictions	Estimates real worth
P/E	Low	Cannot be used for many companies due to different business approaches/lower profit scenarios	Easy to calculate
P/E forward	Medium	Cannot be used for new business without profit	Shows market's expectations
PEG ratio	Medium	Depends on predictions	Shows valuation
AR	Medium	Works best only in long term predictions	weak results in short term
ARIMA	Medium	Adaptable, considers recent movements	Adaptable and "fixes" itself in time
MACHINE learning	High	Costly, hard to setup and maintain.	Adaptable
MCS	Medium	Hard to use, does not guarantee better results	Estimates uncertainty

Source: Prepared by author

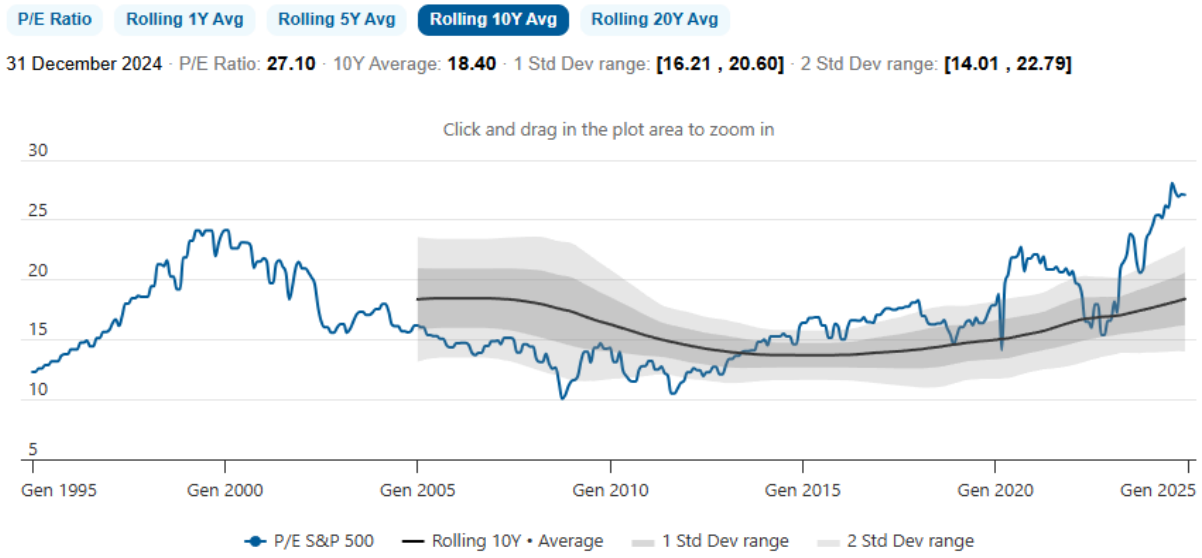
Long term sentiment indicators. There are few indicators developed over the years, that can be used to determine market's sentiment towards the stock market. One of the most well known in US is American association of individual investors (AAII) survey. The survey measures number of investors that are bullish or bearish in the next six month. Survey is used as a contrarian tool, when bullishness or bearishness levels reach extremes, that is a sign that a market's bottom or top is reached. Another sentiment indicator that is used in predicting "calm" and "uncertain" times is Volatility index (VIX). It measures the market's expectation of volatility over the next 30 days, derived from S&P 500 options prices. A higher VIX indicates increased uncertainty or fear in the market, often linked to potential declines, while a lower VIX reflects calmer, more stable conditions. It serves as a key barometer for market sentiment and is widely used by investors for

risk assessment and hedging strategies. Rosillo et. al (2013) conducted research into VIX as additional input into support vector machines (SWM). Research's authors concluded that using VIX as additional indicator helped to predict movement of S&P500 better.

Majority of the models are relating to the same idea, what should we pay for certain stock. As figure 2 illustrates, historically S&P average P/E ratio of the last 10 years (2014-2024 period) is 18.4. The current ratio of S&P500 is 27.1. Compared with historical averages, current ratio is 47% higher than it was of average last 10 years.

Figure 2

S&P500 P/E ratio with trailing 10 years average



Source: worldoperatio.com

Major investors and investments banks are warning of ever-increasing valuations and concentration of stock within the index. David Kostin, Chief US Equity Strategist at Goldman Sachs market outlook newsletter mentions that "The top ten stocks in the S&P 500 by market capitalization today, which are mainly but not exclusively tech companies, account for around 36% of the total market cap of the index. That compares to an average of around 20% over the 45 years for which we have daily data for this metric, and a prior peak of around 25% at the height of the Dot Com boom in 2000".

Valuations are high in the market, and opinions like Kostin are quite frequent. Gürkaynak (2008) analyzed if bubbles can be determined by econometric measures. He used assumptions that discounted future dividends or net profit ratio should form a linear regression with stock's price.

He came to a conclusion that; bubbles cannot be clearly distinguished or part of those inconsistencies can be explained by some other fundamental expectation.

Nenkov (2017) claims that, during bull runs investors tend to use relative valuation metrics. Those are P/E, P/S and other comparative methods that can compared between companies within the same industry. As such, ignoring underlying fact, that fundamentals of the company do not justify current valuation. Ben-David and Chinco (2024) claim that DCF method is not used for majority of the sectors analysis. Only for several sectors like materials or real estate is using DCF as primary tool to set a price of stock. For majority of other sectors, analysts are using P/E as a main tool, expecting to maintain the same ratio of profit versus market cap for future repricing.

In Conclusion diverse range of stock valuation models caters to varying investor needs, from classical methods focused on fundamentals to advanced statistical and machine learning techniques. A nuanced understanding of these models, alongside an appreciation for their strengths and limitations, enables analysts and investors to make informed decisions tailored to specific investment contexts.

1.3 Monetary policy measures impacting stock prices

Monetary Policy During the Global Financial Crisis (GFC), triggered by the collapse of the U.S. housing market and the ensuing banking sector instability, led to a global economic downturn. Central banks, particularly the U.S. Federal Reserve, the European Central Bank (ECB), and the Bank of England, implemented unprecedented measures to stabilize the financial system and stimulate economic recovery. Central banks rapidly lowered interest rates to near-zero levels. The Federal Reserve cut the federal funds rate from 5.25% in 2007 to a range of 0-0.25% by December 2008. Similarly, the ECB reduced its main refinancing rate from 4.25% in October 2008 to 1% by May 2009.

Traditional monetary policy tools proved insufficient, leading to the adoption of QE. The Federal Reserve initiated QE1 in late 2008, purchasing $1.25 trillion in mortgage-backed securities and $300 billion in Treasury securities (Fawley & Neely, 2013). These purchases aimed to inject liquidity into the financial system and lower long-term interest rates. While QE and other measures helped stabilize financial markets and restore confidence, the recovery was uneven. Emerging

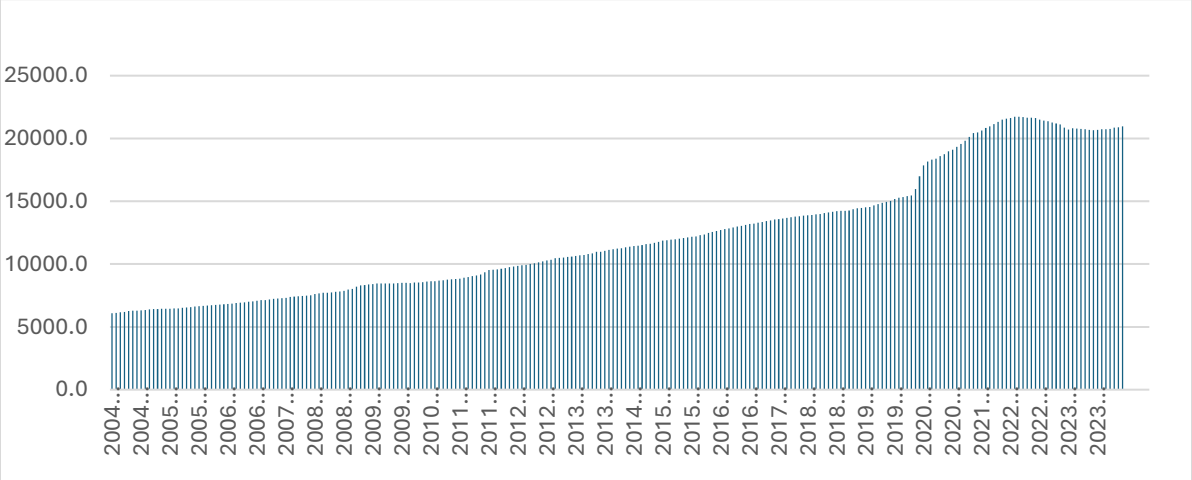
markets experienced capital inflows, raising concerns about currency appreciation and asset bubbles (Rey, 2013).

Monetary Policy During the COVID-19 Pandemic. The COVID-19 pandemic presented unique challenges, with simultaneous demand and supply shocks disrupting global economies. Central banks responded with a combination of traditional and innovative measures. The Federal Reserve, ECB, and other central banks swiftly reduced policy rates. The Fed cut rates to 0.00-0.25% range in March 2020, while the ECB maintained its deposit rate at -0.5%. Central banks expanded QE programs to unprecedented levels. The Federal Reserve's balance sheet grew from $4 trillion in early 2020 to over $7 trillion by the end of the year (Board of Governors, 2021). The ECB launched the Pandemic Emergency Purchase Program (PEPP), committing €1.85 trillion to stabilize financial markets (ECB, 2021).

M2 encompasses M1 (currency in circulation and demand deposits) along with savings deposits, small-denomination time deposits (certificates of deposit under $100,000), and retail money market mutual fund balances.M2 is often used as an indicator of monetary policy's impact on economic activity and inflation, as changes in M2 can signal shifts in liquidity and potential spending power within the economy. The Federal Reserve monitors M2 to assess the effectiveness of its policies and the overall health of the financial system. (Federal Reserve, 2021). Figure 3 illustrates how M2 money supply has increased during last 20 years.

Figure 3

US M2 supply



Source: FRED

Prolonged accommodative policies raise concerns about moral hazard and financial stability. Persistently low interest rates can encourage excessive risk-taking and asset price inflation, as observed in the aftermath of the GFC (Rajan, 2010).

Monetary policy has played a pivotal role in mitigating the effects of financial crises. The experiences of the GFC, and COVID-19 pandemic highlight the evolution of central banking, from traditional interest rate adjustments to advanced and innovative approaches.

Alden (2022) claims that lower central interest rate corresponds to expected lower discount norm, thus increasing valuation of stocks. It also changes yield expectations, central bank policy shifts risk free rate, though affecting all bonds and risk premium. Though other author, Rabener (2022) highlighted, that interest rates and P/E multiples do not always correspond directly. That is especially true during high inflation periods, when market's sentiment and expectations of economic growth go down. Rabener highlighted Shiller's provided graph, which can is seen Figure 3. In author's opinion, Shiller's Cape index represent laggard movement and it cannot be used in comparison to current interest rates.

Figure 4

Interest Rates and P/E Ratios in the US Stock Market

Source: Robert J. Shiller Library

Results of theory. Investors are using different valuation methods, depending on a sector, business model and availability for comparison. United states most known index S&P500 valuation is increasing throughout the years and compared to historical level was only seen higher in 2021 and during 2001 bubble. Experts are contributing increasing valuations partially to federal reserve (FED) policy. Part of that policy is money supply, which is controlled by two tools: purchases of debt securities and setting interest rates. As inflation is falling, expectations of further rate cuts by the market is expected. Current valuations of P/E levels are in question by the experts.

2. ESTABLISHMENT OF RESEARCH METHODOLOGY PARAMETERS AND METHOD

The empirical study examines how discussed monetary policy factors influence valuation of indexes. SP500 is selected, so it would represent the most accurate picture of what happens in stock exchange for whole market.

Research Hypotheses. As discussed in the literature review, some authors have argued that changes in money supply and interest rates (monetary policy) have a direct impact on stock valuations. However, others have claimed the opposite, stating that investment decisions are not influenced by changes in interest rates or money supply. Based on the theories of various authors, the following hypotheses are proposed:

- **Hypothesis 1:** Interest rates affect the S&P500 price.
- **Hypothesis 2**: Increase in M2 money supply increases S&P500 price.

Standard measurements of the money supply include the monetary base M0, M1, and M2. Authors of the reviewed sources analyzed different monetary aggregates. Rjoub et al. (2017), in their empirical study, relied on the M2 aggregate to determine whether it affects shares in Turkey's banking sector. Finally, Friedman (1988), while researching the Dow Jones stock market index, utilized both M1 and M2 measurements. Liaudanskaite (2021) chose to use M1, as it represents higher transition between money supply and movements in the market. Thus, the authors of the reviewed sources most opted to use the M1 and M2 monetary aggregates. This study specifically uses the ratio of **M2** money supply as an indicator, as it is more used in long term trends.

Interest Rate Data. There are several types of interest rates that could be used in analyses, such as federal funds rate, effective federal funds rate, discount rate, and various maturity treasury bonds. Bjørnland and Leitemo (2009) used the federal funds rate in their study of the U.S. market. Ferrer et al. (2016) selected the 10-year government bond yield as a proxy for long-term interest rates in their research.

In this empirical study, effective federal funds rate is chosen, as it represents not only what current central bank set interest rate range is, but also demand and supply of interbank borrowing.

Data and Sources. The study uses monthly data for the period from January 2004 to November 2024 to analyze how selected variables influence valuation of the indexes. This period was chosen to allow for a comparison of the impact of monetary policy factors on the selected stock indices

during various economic conditions, including the global financial crisis, the post-crisis period of economic stability, COVID-19 and artificial intelligence expansion.

Econometric Methods Used in the Study. The empirical study employs econometric analysis, specifically regression analysis, conducted using Excel. Regression analysis enables the quantification of the impact of specific factors on a given phenomenon and expresses this influence through a mathematical equation.

To determine the relationship between the dependent variable (Y) and the independent variable (X), a model known as a simple regression model is constructed, expressed as (Balabonienė et al., 2013):

$Y_i = \beta_1 + \beta_2 X_i + U_i$ (3)

Where Y is the dependent variable, X is the independent variable, U_i is residual and $\beta_1$and β_2 are population parameters.

When regression is linear, formula becomes:

$Y = B_1 + B_2 X$ (4)

Here β_1 and β_2 represents B_1 and B_2.

B_1sets value of Y_i when X_i is 0, β_2 shows how much Y would change if X changes.

Least Squares Method. To ensure that B_1 and B_2 values closely approximate β_1 and β_2, the least squares method (LSM) is used. This method calculates residual errors:

$e_i = y_i - \hat{y}_i (i = 1, n)$ (5)

Residual error describes deviation of of y_i from calculated in regression model $\hat{y}_i$. It is U_i valuation.

Assumptions of Classical Regression Analysis

The regression function is linear with respect to the errors and coefficients.

The average of errors is zero.

The errors are not autocorrelated (i.e., they are not mutually related).

The variance of errors is homoscedastic (constant).

Errors follow a normal distribution.

Independent variables are not linearly correlated with each other (no multicollinearity).

According to the Gauss–Markov theorem, if the classical assumptions of a regression model are satisfied, the estimates obtained using the least squares method are efficient—they have the smallest variance among all unbiased linear estimators (Balabonienė et al., 2013).

White's test is used to determine homoscedastic. This test involves creating a regression for the phenomenon being studied and obtaining residual estimates.

Hypothesis $H_0: \beta_1 = 0$ means that residuals are homoscedastic and $H_1: \beta_1 \neq 0$ that residuals are heteroscedastic. If $\beta_1$is statistically significant then H_0 hypothesis is dismissed indicating heteroskedasticity.

Breusch-Godfrey Test for Autocorrelation. Residual estimates are first obtained, and then an auxiliary regression is evaluated. The hypotheses are:

$H_0: \beta_1 = 0$ there is no autocorrelation

$H_1: \beta_1 \neq 0$ autocorrelation is present

If $\beta_1$is statistically significant, H_0 hypothesis is dismissed.

Student's Test for Significance. Test is used to check if independent variable affects dependent variable.

$H_0: \beta_1 = 0$ independent variable does not affect dependent variable.

$H_1: \beta_1 \neq 0$ Independent variable affects dependent variable.

Pearson Correlation Coefficient for Multicollinearity. This coefficient measures the relationship between variables, indicating whether it is direct or inverse and the strength of the relationship. The coefficient ranges from -1 to 1. A positive coefficient indicates a direct relationship, while a negative one indicates an inverse relationship. The closer the coefficient is to -1 or 1, the stronger the relationship and the higher the likelihood of multicollinearity among independent variables. A value near zero suggests a weak relationship and an absence of multicollinearity.

Interpretation of Test Results

The interpretation of these tests is based on the significance level, indicated by the p-value:

If p>0,05, the null hypothesis H_0 is accepted.

If p<0,05, the null hypothesis H_0 is rejected.

3. ANALYSIS OF S&P500

3.1 Overview of economic situation in US

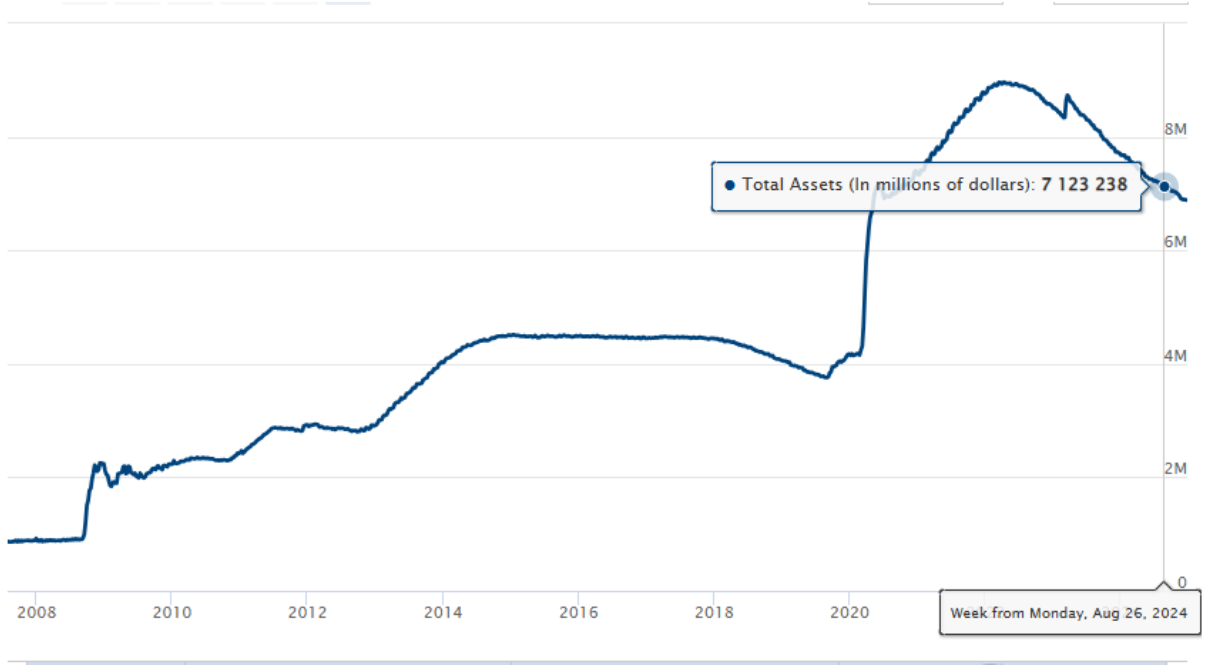
In December 2024, the Federal Reserve reduced the federal funds rate by 0.25 percentage points, bringing it to a target range of 4.25% to 4.5%. This move aligns with the Fed's strategy to support economic growth amid moderating inflation. (FOMC,2024)

Projections indicate a gradual approach to further rate adjustments in 2025, with the Federal Open Market Committee (FOMC) scheduled to meet multiple times throughout the year to assess economic conditions and adjust policy as needed. Expectations of the market for end of 2025 is between 3.75% and 4.00% according to benchmark which is calculated by Chicago stock exchange. Balance sheet of federal reserve is shrinking at steady pace. The Fed is currently allowing up to $25 billion in Treasuries and up to $35 billion in mortgage-backed securities to mature monthly without reinvesting the proceeds. (Jasinski, 2024)

Figure 5 illustrates current holdings that FED has in debt securities market. Expectation of the market is that FED will allow it to shrink, till $4 trillion in next several years.

Figure 5

Recent FED balance sheet trends



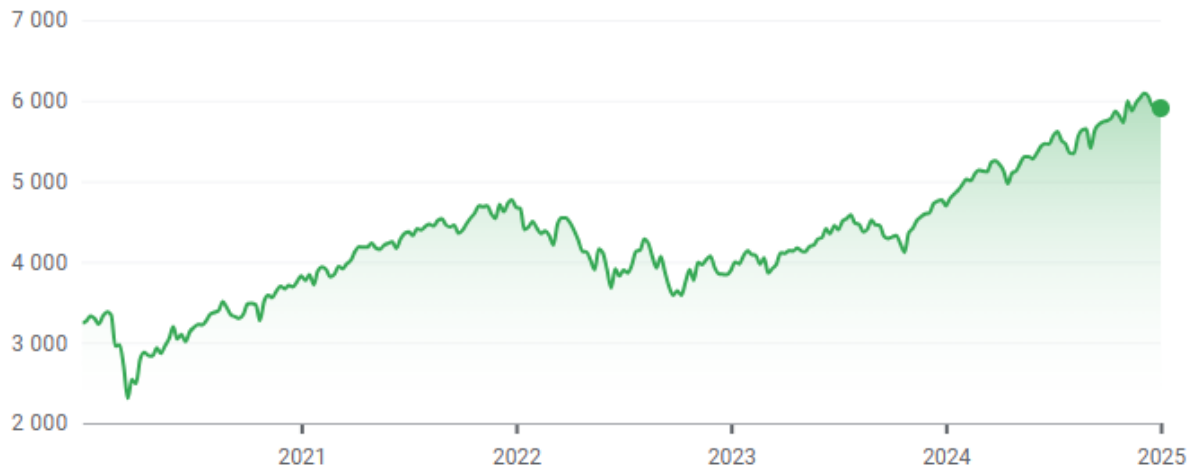
Source: federalreserve.com

The Fiscal Year 2025 budget, released in March 2024, outlines the administration's priorities, including significant investments in infrastructure, education, and healthcare. The budget proposes $3.3 trillion in net deficit reduction over the next decade, aiming to stabilize the debt-to-GDP ratio around 106% by 2030. Key initiatives include increased funding for the Child Care and Development Block Grant and substantial investments in affordable housing to address rising living costs. Analysts project a GDP growth rate of approximately 2.5% for 2025, supported by fiscal stimulus measures and a resilient labor market. (Tax policy center, 2024)

S&P500 had a stellar year in 2024, index reached new highs, and stellar performance is expected to continue fueled by expectations in revenue growth. Figure 6. Illustrates how one-sided market was in year 2023 and 2024.

Figure 6

S&P500 index



Source: Google Finance (2024)

Lolade (2024) raises concern about what is counted in valuations for the market and warns about potential stock market crash if those expectations are not fulfilled. Not all valuation increases are linked directly to technology sector or monetary policy. Part of most recent gains in the market can be attributed to new elected government. Trump’s policies are expected to bring more lax regulations and additional tax benefits, which should bring growth. One of the example is Tesla. Tesla’s stock price has soared over 60%, from $250 to $400 after election. Expectations are that the government’s policy will heavily benefit Tesla in years to come. Lesser regulation on

autonomous vehicles exploitation, higher tariffs on imported electrical vehicles from China will help Tesla to get higher earnings in the future.

Table 2

S&P 500 revenues from foreign sources (2023)

Sector	Total Revenues ($bn)	Foreign Revenues ($bn)	Foreign Sales Exposure (%)	Explicit Emerging Market (EM) Sales Exposure (%)
Information Technology	$1,601	$942	59%	17%
Materials	$469	$221	47%	12%
Energy	$1,301	$469	36%	3%
Industrials	$1,666	$531	32%	5%
Communication Services	$1,236	$369	30%	2%
Consumer Discretionary	$2,011	$546	27%	3%
Consumer Staples	$2,211	$576	26%	3%
Real Estate	$154	$36	23%	3%
Financials	$1,973	$437	22%	1%
Health Care	$3,039	$419	14%	1%
Utilities	$420	$10	2%	2%
S&P 500	**$16,082**	**$4,556**	**28%**	**4%**

Source: Zhu (2024)

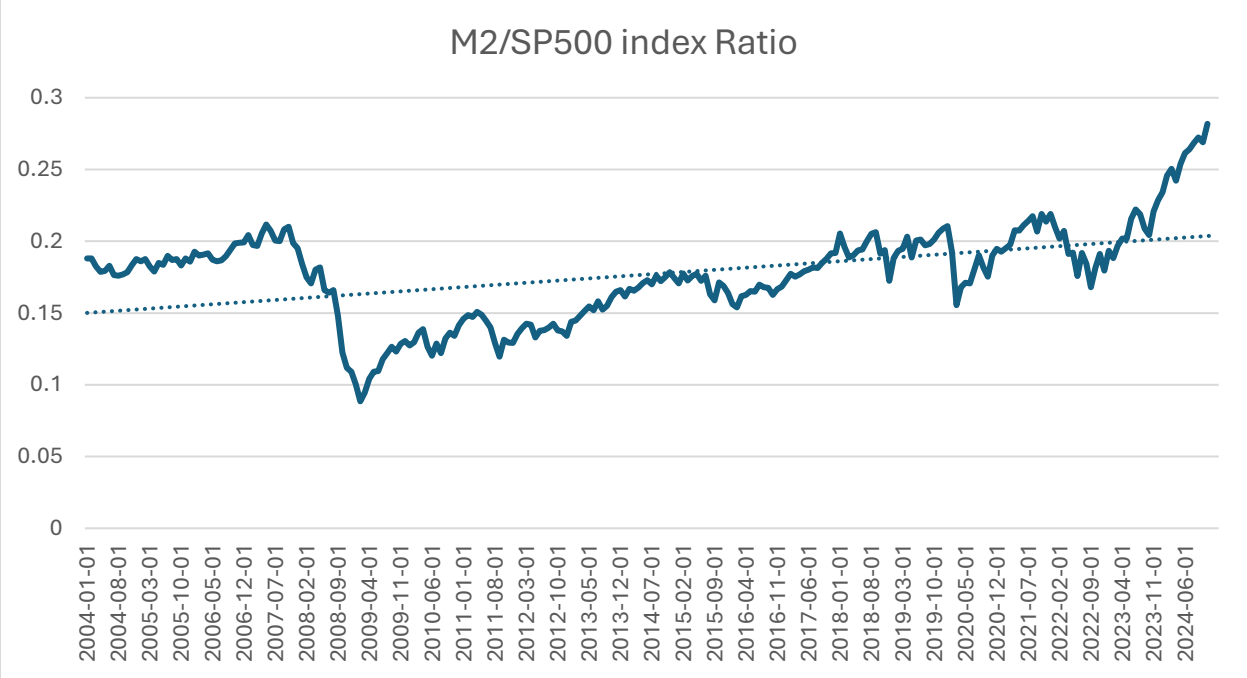
Table 2 shows revenue of different S&P500 sectors split into foreign and domestic. In author's opinion it highlights how global US stock's exchange has become. Even though technology sector by revenue is only 10% of total SP500 revenue, from capitalization standpoint it reached over 30% (Fernandez, 2024). It bears risks, as the government is threatening additional tariffs on imports. If that comes to fruition, foreign entities might retaliate with higher taxes, additional administrative burden, barriers to entry or directly banning some operations.

3.2 Empirical study

In this section relation between monetary policy tools: interest rates, money supply and stock returns will be analyzed. Data set was for M2 supply and fed effectives funds were obtained from federal reserve statistics website fred.stlouisfed.org, monthly closing data for S&P500 obtained from investing.com. Initial combined data set can be seen at annex 1.

Figure 7

Ratio of M2 divided by S&P500 index price

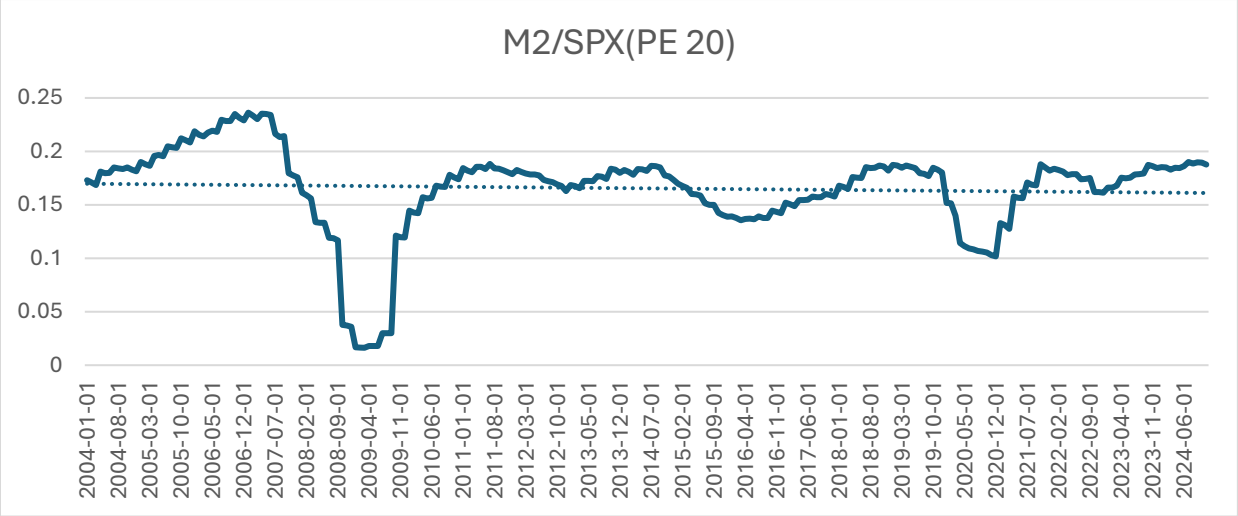


Source: prepared by author

Figure 7 illustrates how ratio between M2 and S&P500 index changed throughout last 20 years. It can be noted that during financial crisis of 2008, M2 amount hasn't decreased, but it was index's price and valuations that went down. Between 2010 and 2023, ratio of M2/S&P500 was on average 0.18. Shift in ratio started in year 2023, some would argue it's due to artificial intelligence bubble, S&P500 has grown exponentially, but money supply, which indicates real activity has not caught up, valuations are on the rise as well. Following figure 8 will demonstrate what would happen, if S&P500 index valuation would be fixed at P/E 20 ratio.

Figure 8

Ratio between M2 and adjusted S&P500 to 20 P/E



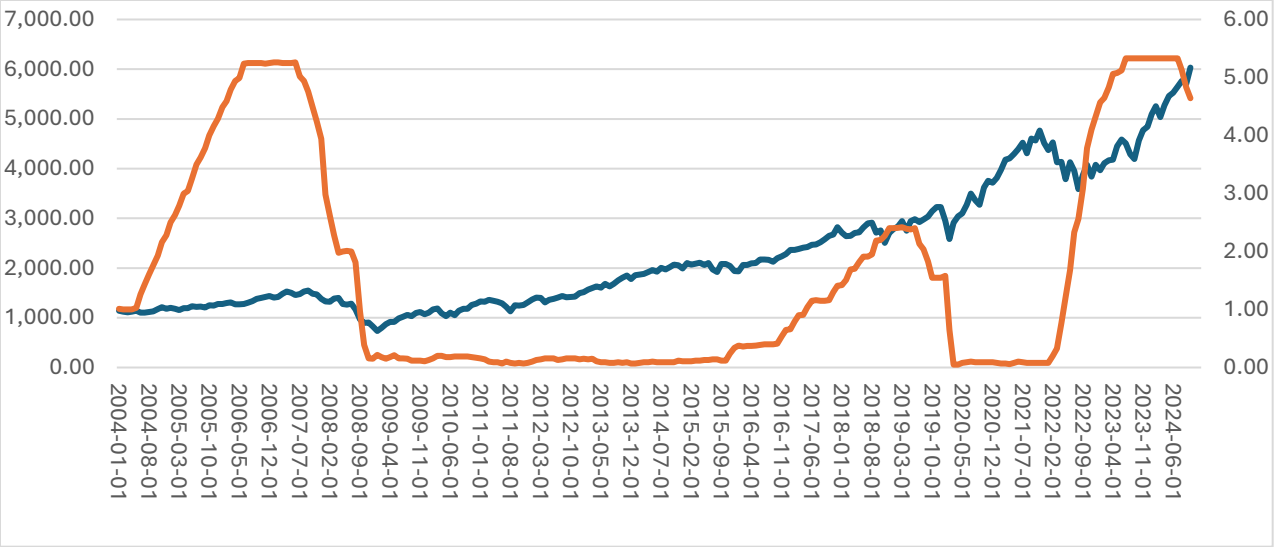
Prepared by author.

Figure 8 illustrates what happens with relation between M2 and S&P500, if P/E would be fixed at 20, for all historical periods.

E.g. if P/E after financial crisis was 15, S&P500 price was at $1000, S&P500 would be adjusted to $1333. Same procedure was done for all historical periods. Outcome is quite clearly illustrated, besides crisis of 2008 and COVID-19, relationship between M2 and S&P500 is stable.

Figure 9

S&P500 and effective FED interest rate



Prepared by author.

Figure 9 in above page illustrates how interest rate changed compared to S&P500 stock index. FED's policy is to lower interest rate when there is a recession or a crisis, to achieve maximum employment and 2% inflation rate, interest rates are kept at 0% till there is clear indication of inflation is returning to 2%. The opposite is done when inflation over shots, interest rates are kept at higher level than inflation to curtail inflation, interest rates are lowered again when there is indication of inflation returning to 2%. Looking at figure 9 of historical S&P500 and effective FED interest rate, it is quite clear that during each crisis interests are lowered and when economy is back on track, interest rate is increased again.

Initial linear regression shows correct probabilities of independent variables FED_FUNDS and M2. Variables are significant in explaining price of S&P500, R-squared statistic is close to 1, which means model explains majority of the relation between independent and dependent variables. **Durbin Watson** stat shows 0,181, which indicates strong positive autocorrelation with first lagged residual.

Figure 10

Initial linear regression

Dependent Variable: S_P500_PRICE
Method: Least Squares
Date: 01/03/25 Time: 00:32
Sample: 2004M01 2024M11
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-867.4916	46.53420	-18.64202	0.0000
FED_FUNDS	135.9442	8.962177	15.16865	0.0000
M2	0.235705	0.003378	69.77532	0.0000

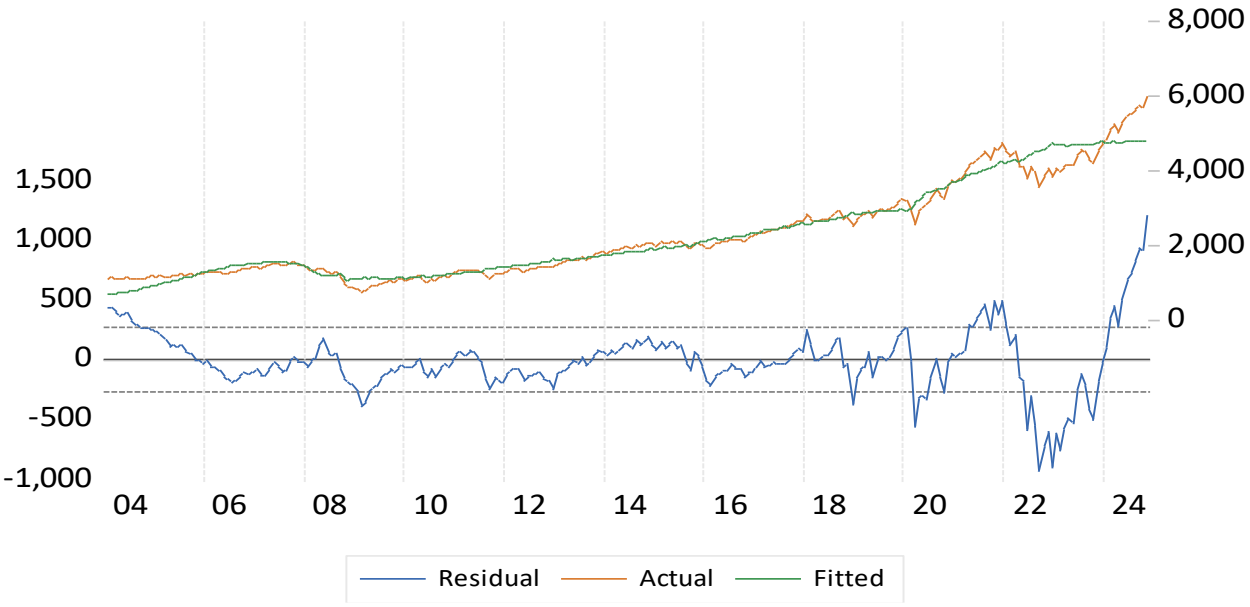
R-squared	0.955408	Mean dependent var	2288.219
Adjusted R-squared	0.955048	S.D. dependent var	1262.704
S.E. of regression	267.7158	Akaike info criterion	14.02961
Sum squared resid	17774588	Schwarz criterion	14.07175
Log likelihood	-1757.716	Hannan-Quinn criter.	14.04657
F-statistic	2656.771	Durbin-Watson stat	0.181660
Prob(F-statistic)	0.000000		

Source: prepared by author

To confirm autocorrelation **Breusch-Godfrey** test is conducted with default 2 lags, probability return was 0. **Autocorrelation** is confirmed.

Figure 11

Graph of residual fitted on actual



Source: prepared by author

In figure 11 instability of residuals can be seen, values of the residuals deviate from the mean.

White's test results returns value of observations*R^2 of 117,39, value is greater than value from Chi table, so **heteroskedacity** is confirmed.

Multicollinearity test value is 0.083, which is close to 0, no correlation between variables detected. In author's opinion initial results show inadequate regression. As Rigobon (2003) claims Autocorrelation and heteroskedasticity is often seen in financial time series, as variables are trending in time, so residuals in later periods will increase compared to early periods.

Liaudanskaite (2021) during her research of M1 and FED interest rate analysis on impact of Dow Jones index, came to a similar situation of heteroskedasticity. To get a workaround this problem she has used Newey - West standard deviation method. New regression complied with assumptions of good fit for linear regression.

First Ramsey – reset test is used to test an assumption that, variables are affecting price of index S&P500, that regression is not linear and parameters are incorrectly set. This method works by adding higher order terms of the fitted values into an auxiliary regression. Results of f and t statistics shown in Figure 13 indicate that parameters are set correctly.

Figure 12

Results of Ramsey reset test

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: S_P500_PRICE C M2 FED_FUNDS

	Value	df	Probability
t-statistic	1.962528	247	0.0508
F-statistic	3.851516	(1, 247)	0.0508
Likelihood ratio	3.883687	1	0.0488

Source: prepared by author

Reconstruction of data set was performed, values of S&P500 index and M2 supply were recalculated to percentage change between periods, so heteroskedasticity and autocorrelation would be removed. Figure 13 shows new details extracted with adjusted AR model, which indicates how percentage returns of S&P500 index change, when M2 money supply changes by a percentage. But model itself does not explain movements of SPX, 0.782% of change in SPX price is directly assigned to intercept variable. Fed interest rate has a positive correlation, majority of interest rate increases happen during expansionary periods of economy, M0 variable shows

unexpected relation, it shows negative relationship with S&P500 index, partially that could be explained due to shocks in the market, but further testing is needed.

Figure 13

Reconstructed model with changes in percentage for SPX and M2

Dependent Variable: SPX0
Method: Least Squares
Date: 01/03/25 Time: 22:26
Sample (adjusted): 2004M02 2024M11
Included observations: 250 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.782428	0.403538	1.938922	0.0536
M0	-0.053655	0.277750	-0.193177	0.8470
FED	0.005131	0.144743	0.035447	0.9718

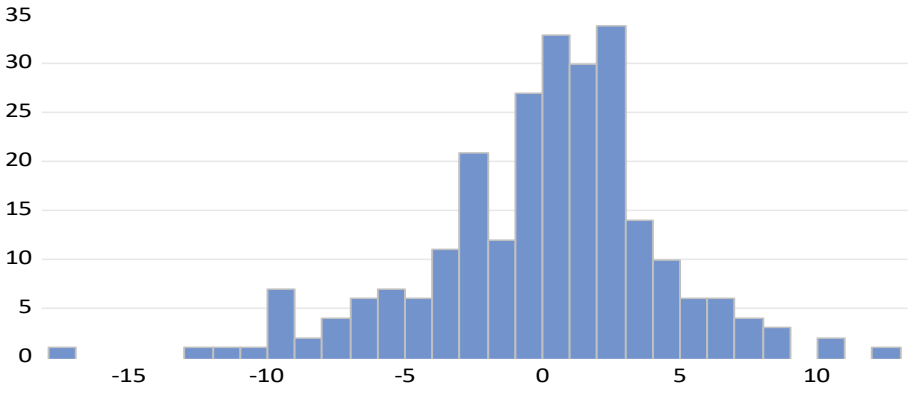
R-squared	0.000170	Mean dependent var	0.763385
Adjusted R-squared	-0.007926	S.D. dependent var	4.260184
S.E. of regression	4.277033	Akaike info criterion	5.756324
Sum squared resid	4518.374	Schwarz criterion	5.798581
Log likelihood	-716.5404	Hannan-Quinn criter.	5.773331
F-statistic	0.021017	Durbin-Watson stat	1.978468
Prob(F-statistic)	0.979204		

Source: prepared by author

Newly constructed model's residuals are not normally distributed. It is shown in figure 14a and figure 14b, that can be attributed to shocks of the market, for periods of great financial crisis, COVID19, war in Ukraine. In those months of greater volatility, price of index changes drastically, but decision of interest rate decrease is with a lag. Open market operations of FED are also done on monthly basis, expanding months or even years in advance.

Figure 14a

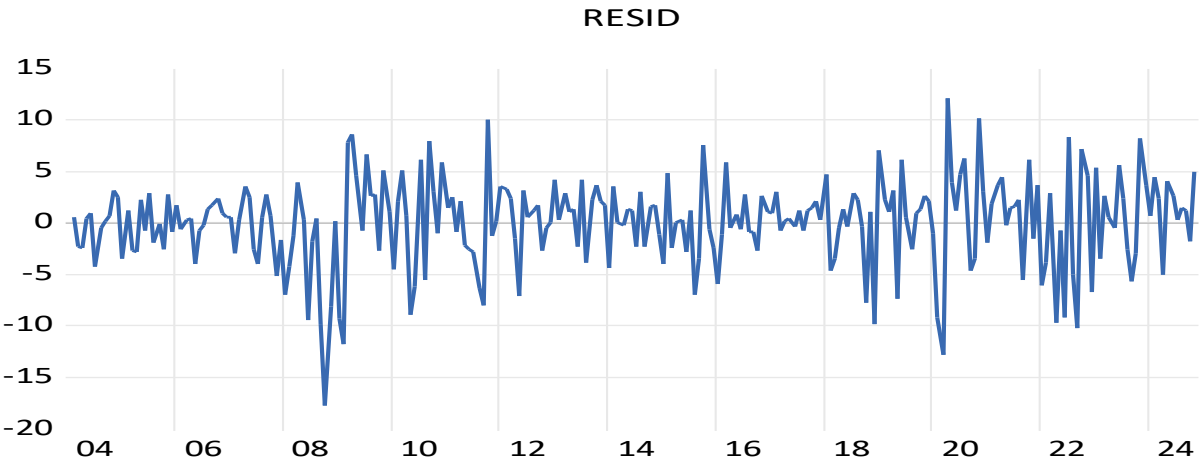
Residuals distribution of S&P returns



Source: prepared by author

Figure 14b

Residuals distribution in time line



Source: prepared by author

Restricted regression will be constructed for a period of January 2010 – December 2019, in author's opinion based on figure 14b and historical knowledge of the events, this period should produce a regression that is most fit.

Figure 15

Returns of S&P500 Jan 2010 - Dec 2019

Dependent Variable: SPX0
Method: Least Squares
Date: 01/04/25 Time: 15:35
Sample: 2010M01 2019M12
Included observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.117107	0.480459	2.325085	0.0218
M0	-0.320189	0.426726	-0.750338	0.4546
FED	-0.004388	0.436175	-0.010061	0.9920

R-squared	0.004793	Mean dependent var	0.954615
Adjusted R-squared	-0.012219	S.D. dependent var	3.596742
S.E. of regression	3.618650	Akaike info criterion	5.434761
Sum squared resid	1532.071	Schwarz criterion	5.504448
Log likelihood	-323.0857	Hannan-Quinn criter.	5.463062
F-statistic	0.281738	Durbin-Watson stat	2.310508
Prob(F-statistic)	0.754982		

Source: prepared by author

Newly constructed regression for periods January 2010 – December 2019 explains returns of S&P500 even worse than previous, but it fits rules of homoscedasticity and residuals

distributions. From previous data analysis, it should be understandable that model should show positive correlation between M2 returns and S&P500 index. Model is rejected for coefficients being incorrect.

Synek and Vesela (2024) analyzed M2 supply effect on S&P500, they were using VEC model in their study. Data that was used in their study was from year 1959 to 2023, but found no cointegration between S&P500 and M2. In their study, their conclusion was that money supply and index values might deviate for decades, due to increases or decreases in valuations of the index, that can last for decades.

Vector error correction model is choosen as a tool for trend analysis. Model is chosen due to stochasticity of returns. There are several assumptions that have to be met for this model to

Initial testing of causality shows that federal reserve rate does not trend with S&P500 returns. Due to that different testing will be performed for interest rates after.

Actions taken in building VECM model for Money supply changes and S&P500 monthly returns.

1) Stationarity of both series tested.
2) Lags test statistics confirms that 4 lags are recommended for cointegration.
3) Johansen cointegration test is performed, a confirmation for cointegration is confirmed.
4) Granger causality test is performed. Data confirms that M2 affects S&P500 and S&P500 does not affect M2.
5) VECM model is created with 4 lags.

Final model is built that explains relationship between M2 changes and S&P500 returns.

Final equation can be expresssed as :

D(RSPX) = C(1)*(RSPX(-1) - 1.9722905884*RM2(-1) + 0.319257560218) + C(2)*D(RSPX(-1)) + C(3)*D(RSPX(-2)) + C(4)*D(RSPX(-3)) + C(5)*D(RSPX(-4)) + C(6)*D(RM2(-1)) + C(7)*D(RM2(-2)) + C(8)*D(RM2(-3)) + C(9)*D(RM2(-4)) + C(10)

Constants explained:

C1- return rate of the equation to equilibrium

C2,C3,C4,C5 – lags of difference of S&P500 return;

C6,C7,C8,C9 – lags of difference of Money supply changes;

C10 – intercept constant

Which can be interpreted as a difference of S&P500 return, depends on previous 4 months of differences of return and previous 4 months difference of money supply returns with a constant.

Figure 16

VECM with constants

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.751325	0.121552	-6.181115	0.0000
C(2)	-0.226300	0.112659	-2.008711	0.0457
C(3)	-0.271147	0.102330	-2.649745	0.0086
C(4)	-0.148729	0.086875	-1.711986	0.0882
C(5)	-0.030659	0.064944	-0.472080	0.6373
C(6)	-1.040930	0.362681	-2.870096	0.0045
C(7)	-0.692959	0.409486	-1.692266	0.0919
C(8)	-0.669023	0.378637	-1.766925	0.0785
C(9)	-0.203782	0.289895	-0.702953	0.4828
C(10)	0.014760	0.276281	0.053426	0.9574

R-squared	0.508957	Mean dependent var	0.015487
Adjusted R-squared	0.490152	S.D. dependent var	6.055841
S.E. of regression	4.324093	Akaike info criterion	5.806242
Sum squared resid	4393.978	Schwarz criterion	5.949150
Log likelihood	-701.2646	Hannan-Quinn criter.	5.863791
F-statistic	27.06373	Durbin-Watson stat	1.973050
Prob(F-statistic)	0.000000		

Source: prepared by author

Model estimated for whole period shows ambiguous results, only lag of -1 for difference of money supply can be interpreted as significant with 0.05 degree of freedom. Variables with -2 and -3 lags are close to significance level, variable with -4 lag is not significant in deciding returns of S&P500.

S&P500 and Fed interest rate analysis. VAR model is tested, initial lag structure recommendations suggest to use 2 different lags. Initial Equation with 2 lags was created, granger causality test shows t statistics shows a value of 0.2, which indicates that fed increases does cause change in S&P500 returns. VAR model can be written as :

RSPX = C(1)*RSPX(-1) + C(2)*RSPX(-2) + C(3)*DFED(-1) + C(4)*DFED(-2) + C(5)

Formula can be interpreted as, current month's S&P500 price return can is caused by two previous month's S&P500 return and difference of interest rate of two previous months and a constant. Initial model has low R squared and t statistics of interest rate difference is insignificant. Residuals are homoTherefore to test a theory that significance might vary through periods, analyzed period was split into 3 additional parts:

- January 2004 – January 2010 period represents a housing bubble and financial crisis.
- January 2010- January 2020 stability period.

- January 2019 - November 2024 COVID19 and inflationary pressure period.

Table 3

t statistics of interest rate

Period, year	2004-2024	2004-2010	2010-2019	2019 - 2024
t FED rates -1 lag	0.142	0.3789	0.768	0.0082
t FED rates -2 lag	0.0918	0.5138	0.2992	0.1679

Source: prepared by author

Results of different periods, are ambiguos. During 2004-2010 period, decreases in interest rates were already after market has reacted to the financial crisis, due to that, no significance can be attributed. During period of January 2010 – January 2019, growth was stable and interest rate adjustments were not significant. For the period 2019 – 2024, even though rates cut and then increases were significant, t statistics is only significant for one -1 lag.

Based on t statistics, **hypothesis 1** that interest rate is significant variable is rejected and **hypothesis 2** that money supply affect S&P500 is accepted.

M2 and S&P500 regression interpretation. There is a direct link between M2 and S&P500 stock index. For one, M2 is cash, cash equivalents and short-term deposits, it is used in daily activities of Americans life. It has direct link to economy of US, earnings of the companies. Sudden increase in money supply should support higher economic activity and potentially cause inflation. This was seen during post COVID-19, but on the other hand, after great financial crisis, exact same actions by the FED, did not cause disturbance in inflation numbers. Ratio between M2 and S&P500 index varies, it can be seen trending from 0.105 in 2009, to 0.29 at the end of 2024. That does not indicate an underlying change of relationship, as valuations of P/E are increasing steadily as well. The question remains if excessive quantity easing increases P/E valuations as well, or if all of it should transition through regular economic activity.

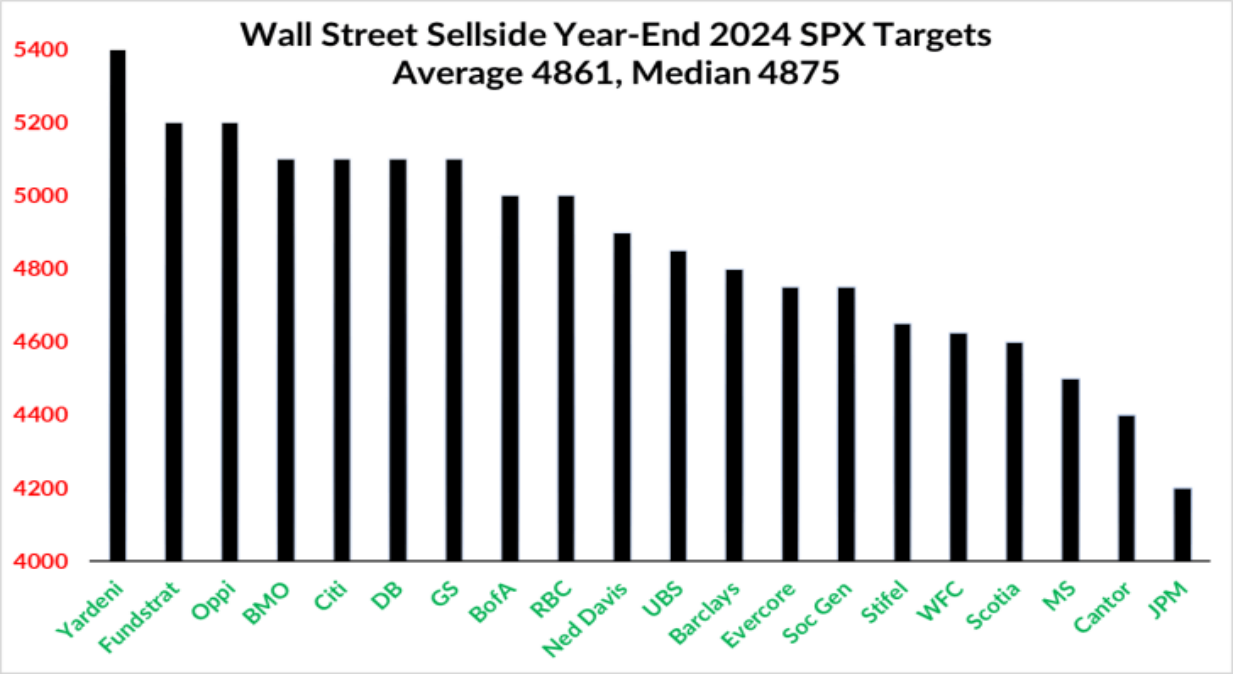
Interest rate and S&P500 regression interpretation. Regression shows ambiguous results, as in different cycles results are completely different, with a different coefficient. That might be explained due to nature of the increase or decreases of interest rates, if the economy is performing well, inflation is increasing, and just to normalize monetary policy, FED signals incoming rate increases beforehand, then there are no major changes in market dynamic and

trend of expansionary economic policy and S&P500 gains are continuing. In the 2022–2023-year setup, opposite can be seen, inflation has been spiking for some time, and to curtail it, interest rates were increased to 5.5%. Market participants were afraid that such high interest rates might cause a financial crisis. In expectations of that, S&P500 price and valuation have plummeted, so in this period analysis, regression increases as a negative signal.

Main question of valuation is not answered, as there is no clear signal what might be causing valuation increase in S&P500. There might be some underlying trend that is influencing valuations, but to clearly acknowledge that, additional studies need to be done. The author's opinion is that it is hardly quantifiable. Figure 16 represents a graph, which shows what major banks predicted S&P500 to end at 2024 December, predictions were made in November and December of 2023. As of December 2024, the price of S&P500 is $5906. The largest investments' banks forecasts were missed. Majority of targets were performed with initial idea, that valuation of P/E will remain same for the year. Comparing P/E of 2023 December and 2024 December, it went up from 24.5 to 29.5. This P/E change explains such a large deviation between forecast and real price of S&P500.

Figure 17

S&P500 target by investments banks



Source: financialsamurai.com, 2023

Monetary policy significantly impacts stock markets through its influence on interest rates, liquidity, and investor behavior. Lower interest rates reduce borrowing costs and encourage investment. Investor expectations play a critical role, as markets often react not only to current policy changes but also to anticipated future actions. Over the long term, fundamentals such as corporate earnings and economic growth also influence stock performance, often tempering the effects of monetary policy. Thus, while monetary policy is a vital driver of stock market dynamics, fundamentals and sentiment of investors are also playing a crucial role in determining stock prices and return on investments.

CONCLUSIONS AND RECOMMENDATIONS

1. Analysts are analyzing stock markets using both fundamental and technical analysis. Combination of both is most effective in reaching the highest returns.
2. Changes in stock market prices can be influenced by various macroeconomic factors, such as sentiment, exchange rates, bond yields, unemployment levels, consumer spending, GDP growth, prospects of future growth. Among these, money supply and interest rates are identified as monetary policy tools. Through monetary policy, the central bank controls the amount of money in the market and interest rates. Depending on the economic cycle, officials implement expansionary or restrictive monetary policy. Main tools of the central are interest rates and open market operations.
3. Most of the reviewed sources that examined how the money supply affects stock prices found a strong and direct relationship between stock prices and the money supply. Authors who analyzed the impact of interest rates on stock markets found a strong and negative relationship between these variables.
4. Regression analysis conducted between the money supply and S&P500 index revealed a significant relationship. The ratio of this regression has been increasing in recent years. Analysis of longer periods is needed, to determine if this is a new trend or such behavior can be explained by other variables.
5. Interest rate regression analysis shows a strong historical link to the S&P500 stock index. Each cycle must be analyzed separately, depending on what is the reasoning behind interest rate changes. Market anticipates future, due to that majority of the interest rate increases or decreases are already priced into the S&P500 index. To solve this a new study must be conducted, which should monitor the effect on S&P500 price, based on changes in market participants' expectations.
6. The combination of the data must be taken into the account, since during FED meetings, both money supply and interest rate decisions are made and announced together. During a longer period FED uses active market operations to increase money supply, but knowledge of that, might cause investors to front-load their investments based on knowledge of future operations.

7. Recommendation would be to include additional economic indicators into analysis, such as GDP, expected GDP, inflation rate, consumer and investor sentiment indicator, inflation, revenue growth from other countries.
8. Valuations of indexes measured in P/E are increasing. Ratio between money supply and S&P500 is shifting as well, additional studies are needed to determine what is causing such sentiment shift.

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ANNEXES

Annex 1

observation_date	S&P500 price	M2, Billion USD	FED FUNDS
2004-01-01	1,131.10	6015.6	1.00
2004-02-01	1,144.90	6089.4	1.01
2004-03-01	1,126.20	6175.1	1.00
2004-04-01	1,107.30	6199.2	1.00
2004-05-01	1,120.70	6249.9	1.00
2004-06-01	1,140.80	6237.7	1.03
2004-07-01	1,101.70	6247.5	1.26
2004-08-01	1,104.20	6275.7	1.43
2004-09-01	1,114.60	6300.0	1.61
2004-10-01	1,130.20	6332.3	1.76
2004-11-01	1,173.80	6404.3	1.93
2004-12-01	1,211.90	6457.6	2.16
2005-01-01	1,181.30	6351.1	2.28
2005-02-01	1,203.60	6413.5	2.50
2005-03-01	1,180.60	6470.1	2.63
2005-04-01	1,156.80	6467.8	2.79
2005-05-01	1,191.50	6444.7	3.00
2005-06-01	1,191.30	6487.1	3.04
2005-07-01	1,234.20	6503.3	3.26
2005-08-01	1,220.30	6527.2	3.50
2005-09-01	1,228.80	6550.2	3.62
2005-10-01	1,207.00	6593.2	3.78
2005-11-01	1,249.50	6648.1	4.00
2005-12-01	1,248.30	6716.4	4.16
2006-01-01	1,280.10	6645.5	4.29
2006-02-01	1,280.70	6741.7	4.49
2006-03-01	1,294.80	6787.3	4.59
2006-04-01	1,310.60	6844.2	4.79
2006-05-01	1,270.10	6787.2	4.94
2006-06-01	1,270.20	6829.8	4.99
2006-07-01	1,276.70	6840.3	5.24
2006-08-01	1,303.80	6876.4	5.25
2006-09-01	1,335.80	6882.7	5.25
2006-10-01	1,377.90	6941.3	5.25
2006-11-01	1,400.60	7041.6	5.25

2006-12-01	1,418.30	7119.7	5.24
2007-01-01	1,438.20	7039.0	5.25
2007-02-01	1,406.80	7124.7	5.26
2007-03-01	1,420.90	7220.1	5.26
2007-04-01	1,482.40	7216.5	5.25
2007-05-01	1,530.60	7227.5	5.25
2007-06-01	1,503.30	7253.1	5.25
2007-07-01	1,455.30	7261.1	5.26
2007-08-01	1,474.00	7367.2	5.02
2007-09-01	1,526.80	7331.6	4.94
2007-10-01	1,549.40	7371.1	4.76
2007-11-01	1,481.10	7456.5	4.49
2007-12-01	1,468.40	7526.6	4.24
2008-01-01	1,378.50	7483.7	3.94
2008-02-01	1,330.60	7604.6	2.98
2008-03-01	1,322.70	7747.4	2.61
2008-04-01	1,385.60	7684.6	2.28
2008-05-01	1,400.40	7708.0	1.98
2008-06-01	1,280.00	7713.5	2.00
2008-07-01	1,267.40	7722.1	2.01
2008-08-01	1,282.80	7725.3	2.00
2008-09-01	1,166.40	7871.1	1.81
2008-10-01	968.8	7902.6	0.97
2008-11-01	896.2	8015.9	0.39
2008-12-01	903.2	8277.7	0.16
2009-01-01	825.9	8249.9	0.15
2009-02-01	735.1	8309.1	0.22
2009-03-01	797.9	8427.7	0.18
2009-04-01	872.8	8379.0	0.15
2009-05-01	919.1	8424.6	0.18
2009-06-01	919.3	8386.6	0.21
2009-07-01	987.5	8384.6	0.16
2009-08-01	1,020.60	8370.0	0.16
2009-09-01	1,057.10	8361.5	0.15
2009-10-01	1,036.20	8408.8	0.12
2009-11-01	1,095.60	8523.4	0.12
2009-12-01	1,115.10	8544.3	0.12
2010-01-01	1,073.90	8432.4	0.11
2010-02-01	1,104.50	8528.3	0.13
2010-03-01	1,169.40	8576.6	0.16
2010-04-01	1,186.70	8546.2	0.20

2010-05-01	1,089.40	8608.6	0.20
2010-06-01	1,030.70	8576.1	0.18
2010-07-01	1,101.60	8555.1	0.18
2010-08-01	1,049.30	8604.8	0.19
2010-09-01	1,141.20	8622.3	0.19
2010-10-01	1,183.30	8687.4	0.19
2010-11-01	1,180.50	8804.3	0.19
2010-12-01	1,257.60	8896.1	0.18
2011-01-01	1,286.10	8812.2	0.17
2011-02-01	1,327.20	8931.7	0.16
2011-03-01	1,325.80	9008.6	0.14
2011-04-01	1,363.60	9042.8	0.10
2011-05-01	1,345.20	9044.0	0.09
2011-06-01	1,320.60	9141.6	0.09
2011-07-01	1,292.30	9231.7	0.07
2011-08-01	1,218.90	9454.3	0.10
2011-09-01	1,131.40	9465.0	0.08
2011-10-01	1,253.30	9544.9	0.07
2011-11-01	1,247.00	9633.9	0.08
2011-12-01	1,257.60	9731.5	0.07
2012-01-01	1,312.40	9695.3	0.08
2012-02-01	1,365.70	9793.3	0.10
2012-03-01	1,408.50	9882.3	0.13
2012-04-01	1,397.90	9852.4	0.14
2012-05-01	1,310.30	9859.2	0.16
2012-06-01	1,362.20	9903.1	0.16
2012-07-01	1,379.30	9988.4	0.16
2012-08-01	1,406.60	10048.6	0.13
2012-09-01	1,440.70	10111.1	0.14
2012-10-01	1,412.20	10235.5	0.16
2012-11-01	1,416.20	10325.7	0.16
2012-12-01	1,426.20	10630.8	0.16
2013-01-01	1,498.10	10413.2	0.14
2013-02-01	1,514.70	10463.2	0.15
2013-03-01	1,569.20	10596.4	0.14
2013-04-01	1,597.60	10545.8	0.15
2013-05-01	1,630.70	10552.3	0.11
2013-06-01	1,606.30	10573.3	0.09
2013-07-01	1,685.70	10660.6	0.09
2013-08-01	1,633.00	10710.5	0.08
2013-09-01	1,681.50	10840.3	0.08

2013-10-01	1,756.50	10909.5	0.09
2013-11-01	1,805.80	10954.6	0.08
2013-12-01	1,848.40	11140.6	0.09
2014-01-01	1,782.60	11044.8	0.07
2014-02-01	1,859.45	11148.1	0.07
2014-03-01	1,872.34	11315.4	0.08
2014-04-01	1,883.95	11231.2	0.09
2014-05-01	1,923.57	11251.3	0.09
2014-06-01	1,960.23	11343.1	0.10
2014-07-01	1,930.67	11364.3	0.09
2014-08-01	2,003.37	11383.5	0.09
2014-09-01	1,972.29	11451.4	0.09
2014-10-01	2,018.05	11525.4	0.09
2014-11-01	2,067.56	11580.5	0.09
2014-12-01	2,058.90	11799.9	0.12
2015-01-01	1,994.99	11687.2	0.11
2015-02-01	2,104.50	11850.4	0.11
2015-03-01	2,067.89	11970.5	0.11
2015-04-01	2,085.51	11862.5	0.12
2015-05-01	2,107.39	11882.7	0.12
2015-06-01	2,063.11	11958.2	0.13
2015-07-01	2,103.84	11960.7	0.13
2015-08-01	1,972.18	12087.0	0.14
2015-09-01	1,920.03	12084.0	0.14
2015-10-01	2,079.36	12143.2	0.12
2015-11-01	2,080.41	12316.0	0.12
2015-12-01	2,043.94	12464.1	0.24
2016-01-01	1,940.24	12423.3	0.34
2016-02-01	1,932.23	12559.9	0.38
2016-03-01	2,059.74	12735.0	0.36
2016-04-01	2,065.30	12693.8	0.37
2016-05-01	2,096.96	12689.6	0.37
2016-06-01	2,098.86	12738.8	0.38
2016-07-01	2,173.60	12805.9	0.39
2016-08-01	2,170.95	12928.7	0.40
2016-09-01	2,168.27	12939.2	0.40
2016-10-01	2,126.15	13078.8	0.40
2016-11-01	2,198.81	13187.7	0.41
2016-12-01	2,238.83	13298.9	0.54
2017-01-01	2,278.87	13183.7	0.65
2017-02-01	2,363.64	13325.8	0.66

2017-03-01	2,362.72	13473.6	0.79
2017-04-01	2,384.20	13472.2	0.90
2017-05-01	2,411.80	13457.3	0.91
2017-06-01	2,423.41	13454.3	1.04
2017-07-01	2,470.30	13585.7	1.15
2017-08-01	2,471.65	13631.6	1.16
2017-09-01	2,519.36	13620.1	1.15
2017-10-01	2,575.26	13718.2	1.15
2017-11-01	2,647.58	13810.8	1.16
2017-12-01	2,673.61	13941.9	1.30
2018-01-01	2,823.81	13752.9	1.41
2018-02-01	2,713.83	13849.2	1.42
2018-03-01	2,640.87	14002.9	1.51
2018-04-01	2,648.05	13924.3	1.69
2018-05-01	2,705.27	13968.9	1.70
2018-06-01	2,718.37	13997.9	1.82
2018-07-01	2,816.29	14081.8	1.91
2018-08-01	2,901.52	14143.4	1.91
2018-09-01	2,913.98	14126.5	1.95
2018-10-01	2,711.74	14165.6	2.19
2018-11-01	2,760.17	14235.4	2.20
2018-12-01	2,506.85	14544.7	2.27
2019-01-01	2,704.10	14340.5	2.40
2019-02-01	2,784.49	14390.6	2.40
2019-03-01	2,834.40	14550.3	2.41
2019-04-01	2,945.83	14492.3	2.42
2019-05-01	2,752.06	14582.6	2.39
2019-06-01	2,941.76	14676.2	2.38
2019-07-01	2,980.38	14807.7	2.40
2019-08-01	2,926.46	14850.0	2.13
2019-09-01	2,976.74	15032.8	2.04
2019-10-01	3,037.56	15097.6	1.83
2019-11-01	3,140.98	15252.2	1.55
2019-12-01	3,230.78	15473.1	1.55
2020-01-01	3,225.52	15315.7	1.55
2020-02-01	2,954.22	15350.4	1.58
2020-03-01	2,584.59	16629.2	0.65
2020-04-01	2,912.43	17334.5	0.05
2020-05-01	3,044.31	17797.8	0.05
2020-06-01	3,100.29	18174.2	0.08
2020-07-01	3,271.12	18125.7	0.09

2020-08-01	3,500.31	18392.9	0.10
2020-09-01	3,363.00	18501.7	0.09
2020-10-01	3,269.96	18650.9	0.09
2020-11-01	3,621.63	19055.3	0.09
2020-12-01	3,756.07	19294.3	0.09
2021-01-01	3,714.24	19277.8	0.09
2021-02-01	3,811.15	19533.9	0.08
2021-03-01	3,972.89	20100.9	0.07
2021-04-01	4,181.17	20137.0	0.07
2021-05-01	4,204.11	20266.3	0.06
2021-06-01	4,297.50	20336.6	0.08
2021-07-01	4,395.26	20530.1	0.10
2021-08-01	4,522.68	20791.7	0.09
2021-09-01	4,307.54	20843.5	0.08
2021-10-01	4,605.38	21037.1	0.08
2021-11-01	4,567.00	21384.1	0.08
2021-12-01	4,766.18	21751.7	0.08
2022-01-01	4,515.55	21522.9	0.08
2022-02-01	4,373.94	21658.7	0.08
2022-03-01	4,530.41	21852.6	0.20
2022-04-01	4,131.93	21607.1	0.33
2022-05-01	4,132.15	21523.5	0.77
2022-06-01	3,785.38	21528.3	1.21
2022-07-01	4,130.29	21520.4	1.68
2022-08-01	3,955.00	21469.5	2.33
2022-09-01	3,585.62	21356.0	2.56
2022-10-01	3,871.98	21341.6	3.08
2022-11-01	4,080.11	21340.4	3.78
2022-12-01	3,839.50	21393.7	4.10
2023-01-01	4,076.60	21089.9	4.33
2023-02-01	3,970.15	21083.2	4.57
2023-03-01	4,109.31	20861.6	4.65
2023-04-01	4,169.48	20653.8	4.83
2023-05-01	4,179.83	20713.2	5.06
2023-06-01	4,450.38	20636.6	5.08
2023-07-01	4,588.96	20665.4	5.12
2023-08-01	4,507.66	20606.4	5.33
2023-09-01	4,288.05	20548.4	5.33
2023-10-01	4,193.80	20523.4	5.33
2023-11-01	4,567.80	20679.2	5.33
2023-12-01	4,769.83	20873.4	5.33

2024-01-01	4,845.65	20685.9	5.33
2024-02-01	5,096.27	20730.8	5.33
2024-03-01	5,254.35	20978.5	5.33
2024-04-01	5,035.69	20783.1	5.33
2024-05-01	5,277.51	20797.0	5.33
2024-06-01	5,460.48	20898.7	5.33
2024-07-01	5,522.30	20914.6	5.33
2024-08-01	5,648.40	21030.9	5.33
2024-09-01	5,762.48	21159.2	5.13
2024-10-01	5,705.45	21206.7	4.83
2024-11-01	6,032.38	21406.4	4.64

Annex 2

	Average P/E for last 20 years	Current P/E	Difference
2023-01-01	24.8	23.266	-1.556748606
2023-02-01	24.8	22.6585	-2.164248606
2023-03-01	24.8	23.4527	-1.370048606
2023-04-01	24.8	23.0345	-1.788248606
2023-05-01	24.8	23.0917	-1.731048606
2023-06-01	24.8	24.5864	-0.236348606
2023-07-01	24.8	24.9062	0.083451394
2023-08-01	24.8	24.4649	-0.357848606
2023-09-01	24.8	23.273	-1.549748606
2023-10-01	24.8	21.7939	-3.028848606
2023-11-01	24.8	23.7375	-1.085248606
2023-12-01	24.8	24.7874	-0.035348606
2024-01-01	24.8	25.2654	0.442651394
2024-02-01	24.8	26.5721	1.749351394
2024-03-01	24.8	27.3964	2.573651394
2024-04-01	24.8	26.2563	1.433551394
2024-05-01	24.8	27.5171	2.694351394
2024-06-01	24.8	28.07	3.247251394
2024-07-01	24.8	27.8	2.977251394
2024-08-01	24.8	28.5	3.677251394
2024-09-01	24.8	28.7	3.877251394
2024-10-01	24.8	28.4	3.577251394
2024-11-01	24.8	30.05	5.227251394