Correlation of European and U.S. Technology and Financial Stocks during COVID-19 Pandemic

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ARTICLE INFO	ABSTRACT
Keywords: *Stock correlation,* *COVID-19,* *Stock indices,* *Central banks,* *Stock valuation*	In 2022 stock markets around the world lost some of their value, led by high-growth sectors, sectors that tend to show a significantly higher growth rate than the average market. At the same time the financial sector shows a potentially higher interest rate sensitivity. The prevailing academic opinion is that central bank monetary policy during the COVID-19 pandemic is one key factor for the stock market development globally. This paper discusses the assumption of a significant technology and financial sector correlation for Europe and the United States from 2020 to 2022 based on market capitalization. The objective is fulfilled with a Pearson correlation for representative parts of STOXX Europe 600 and S&P 500. The results confirm significant correlation for the selected sectors and stocks for both regions, indicating potentially general sensitivity for the entire investigation period. Based on this, further research on sectors and potential alternative independent variables is recommended.

1. Introduction

The ECB and the Fed have taken far-reaching monetary policy measures in response to the COVID-19 pandemic to prevent risk to price stability which provides the basis for an examination of the stock markets in both regions. Apart from the central bank policy, Europe, and the United States (U.S.) offer good fundamental data for the stock markets based on the sector breakdown and development of the market capitalization of the S&P 500 and STOXX 600 Europe. Market capitalizations were at roughly the same level at the beginning of 2010 and have drifted apart significantly since then. The technology sector in the S&P 500 already had the highest share within the index at the beginning of 2010 with 15.7 percent, while this sector accounted for just 1.7 percent of the STOXX Europe 600 at the same time. In absolute terms, the technology sector was already more than ten times as large as the European counterpart. Only the real estate sector, with a weighting of 1.0 percent, was less important in the STOXX Europe 600. By contrast, financials were heavily weighted in the European index. Significant differences can also be seen in the basic materials, telecommunications, and utilities sectors. Comparing the values from 2010 with 2022 weightings, a clear shift for the relative weighting can be observed in both indices. The largest difference for the technology sector

with 20 percent higher weighting in the S&P 500 as end of December 2020 (Flossbach von Storch 2021). The reasons for this divergence are diverse, the main factors defined in the literature are macroeconomic development and interest rate levels. This provides a good basis for a comparable analysis of the potential correlation of the highly capitalised technology sector and the financial sector with a potentially higher interest rate sensitivity of the sector. This is a well-known aspect, but one that has not yet been considered in academic literature for an in-depth analysis on both markets and is the focus of this paper.

The objective of this paper is to analyze the correlation of the European and U.S. technology and financial sectors performance during the COVID-19 pandemic regime of the ECB and Fed from 2020 to 2022. This is based on the hypothesis that there is a significant correlation between selected technology and financial stocks in Europe and the U.S. from for the investigation period. By focusing on selected stocks of the STOXX Europe 600 and S&P 500 indices, which represent broad market performance in Europe and the United States respectively, the analysis can indicate potential overall correlations for both regions.

In a first step, the current research status is analyzed in the form of a literature review. In the second step, the performance correlation of selected sectors and stocks for both indices are observed to account for a potential similar interest rate sensitivity in Europe and the U.S. The paper concludes with the results compared with the sources used to substantiate the literature review.

2. Literature Review

There are several studies on stocks in general and interest rates in relation to the COVID-19 pandemic and interest rates in relation to the COVID-19 pandemic. Selected important studies are reviewed in more detail below. For a better overview, the literature review is segmented in two parts in the academic literature. The first part focusses on dynamic conditional correlation methods on the link between financial assets. The second part focusses on indices. The literature is listed by the year of publication in ascending order for Europe first and then for the U.S.

The pandemic affected the cointegration and causality relationships between asset classes, especially in the context of oil prices this phenomenon is examined by an analysis from Kyriazis (2021) on the relationships between European stock indices (total and sectoral), gold and oil during the COVID-19 pandemic. Econometric estimations were conducted to investigate whether COVID-19 deaths, gold or oil determine the market values of the EURO STOXX 50 and EURO STOXX 600 indices and sectoral sub-indices. Table 1 illustrates the Econometric estimations on COVID-19 deaths, gold, or oil as determinants of the EURO STOXX 50 and the EURO STOXX 600 indices and sectoral sub-indices.

Table 1.
Econometric estimations on COVID-19 deaths, gold, or oil for EURO STOXX 50 & 600 indices and sectoral sub-indices

	COVID-19 deaths	Gold	WTI_Oil	Arch constant
Eurostoxx 50	− 0.01154	0.56037***	0.0826***	0.00062***
Eurostoxx600	− 0.01155	0.45314***	0.08111***	0.00048***
Health care	− 0.0022	0.32609**	0.03932*	0.0003***
Industrial goods & services	− 0.01669	0.51403***	0.08672***	0.00071***
Banks	− 0.02272	0.43921*	0.119***	0.00107***
Personal & household goods	− 0.01113	0.36786***	0.05594**	0.00037***
Food & beverage	− 0.00733	0.22617*	0.06084***	0.00033***
Technology	− 0.00689	0.60516***	0.08602***	0.00053***
Insurance	− 0.01841	0.59706***	0.09163**	0.00097***
Oil & gas	− 0.01527	0.73314***	0.17891***	0.00119***
Utilities	− 0.0061	0.49734***	0.07944***	0.00052***
Chemicals	− 0.00376	0.4021**	0.08084***	0.00049***
Retail	− 0.00962	0.39469***	0.04234*	0.00038***
Telecommunications	− 0.00892	0.492***	0.0848***	0.00045***
Construction & materials	− 0.0151	0.60044***	0.09665***	0.00082***
Financial services	− 0.0128	0.62769***	0.10267***	0.00066***
Real estate	− 0.01958	0.55335***	0.07914***	0.00054***
Automobiles & parts	− 0.02164	0.60383**	0.11536***	0.00124***
Basic resources	− 0.02051	0.5769**	0.12714***	0.001***
Media	− 0.01128	0.37131*	0.08074***	0.00052***
Travel & leisure	− 0.02911	0.46461*	0.07253	0.00137***

Source: Kyriazis, 2021

Table 1 shows the empirical results based on the Dynamic Conditional Correlations (DCC) method. This methodology examines the links between financial assets dynamically rather than statistically, allowing the relationships to be analyzed over time. The results demonstrate that more deaths caused by COVID-19 result in lower market values for all the indices studied. This is consistent with rationality, as negative externalities lead to negative effects on financial markets. Moreover, it is evident that these negative effects are very weak. Moreover, these estimates are not statistically significant.

In addition, the authors highlight that the first part of the relevant academic literature focusses on studying linkages between financial assets (Ciner et al., 2013). Cepoi (2020) applies panel quantile regression methods and examines the relationships between COVID-19-related news and stock market returns in the United States, the United Kingdom, Germany, France, Spain, and Italy. It is confirmed that stock markets exhibit asymmetric dependencies with information about the disease, such as fake news, media coverage, or contagion. Similarly, Erdem (2020) uses panel data regressions covering 75 countries to analyze whether freedom in countries is associated with stock market volatility when news about COVID-19 is announced. The author argues that COVID-19 leads to a decrease in stock market returns but an increase in their volatility. Salisu and Vo (2020) use data for the 20 countries most affected by COVID-19 to determine the importance of health news on stock returns. Moreover, financial news is found to be important for the efficiency of the health news model. To summarize, the study from Cepoi (2020) confirms that health news was a good predictor of stock returns during the COVID-19 period.

Assel et al. (2022) poses the research question whether sustainable stock indices performed more stably and better than conventional indices during the COVID-19 pandemic. The focus

is on the European region. The results show that all selected indices, whether sustainable or conventional, react with abnormal returns in the light of selected events. Significant market movements were found up to ten days after the event.

The authors of a paper by Oxford Analytica (2023) refer to considerations from some Central and Eastern European countries to raise interest rates due to high inflation and possible implications for indices such as the STOXX Europe 600, arguing that raising interest rates could slow economic growth and increase pressure on governments blamed for rising prices. Instead, lowering interest rates in some countries in the region could be an option to support growth and mitigate the impact of inflation.

In addition, with the ECB's changing interest rate environment in 2022 due to increased inflation, the prevailing academic view in the academic literature for Europe is that this environment will weigh on high-growth equities such as the technology sector and that this sector will be particularly affected by interest rate hikes (Lange, 2022). This supports the assumption of this this paper that there is a significant correlation between selected technology and financial stocks in Europe and the U.S. from 2020 to 2022. For the U.S., there are also several studies on technology stocks and interest rates in relation to the COVID-19 pandemic, some are examined in more detail in the following section, assuming the same two literature parts as for Europe.

Alfaro et al. (2020) examine the pandemic impact on stock returns at company and aggregate level. It analyzes the stock markets and individual firms during the COVID-19 pandemic in comparison to previous pandemics. Figures 1 show the U.S. firm COVID-19 sensitivity by NAICS sector.
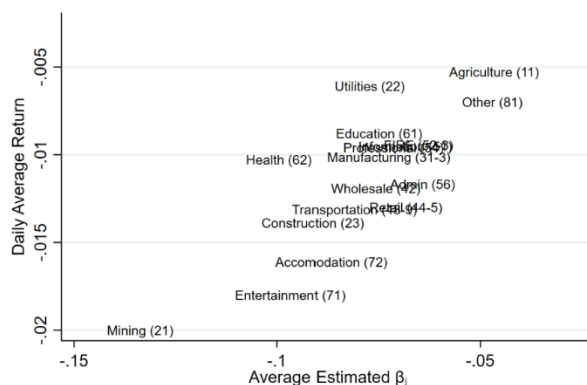

Figure 1. U.S. firms COVID-19 sensitivity by NAICS sector
Source: Alfaro et al., 2020

Figures 1 demonstrates that sectors clearly differ in their mean of exposure, there are significant differences within sectors. Alfaro et al. (2020) conclude that stock return impact is similar compared to previous pandemics, but the firm shows significant differences. Industries that are particularly affected by the pandemic experience bigger losses, while industries that benefit from the pandemic, such as technology firms, show higher returns. The authors note that this can vary during pandemics and the impact can change over different time periods. This supports the assumption of this this paper that there is a significant correlation between selected technology and financial stocks in Europe and the U.S.

Verma et al. (2021) analyzed 60 countries and examined that COVID-19 had a significant negative impact on stock markets. Figure 2 shows the last maximum increase of the stock index in the month of February. The analysis show that the S&P 500 stock index is strongly influenced during the COVID-19 period. Moreover, the results of the study show that the

impact of COVID-19 on stock markets was asymmetric, with negative effects lasting longer than positive effects.
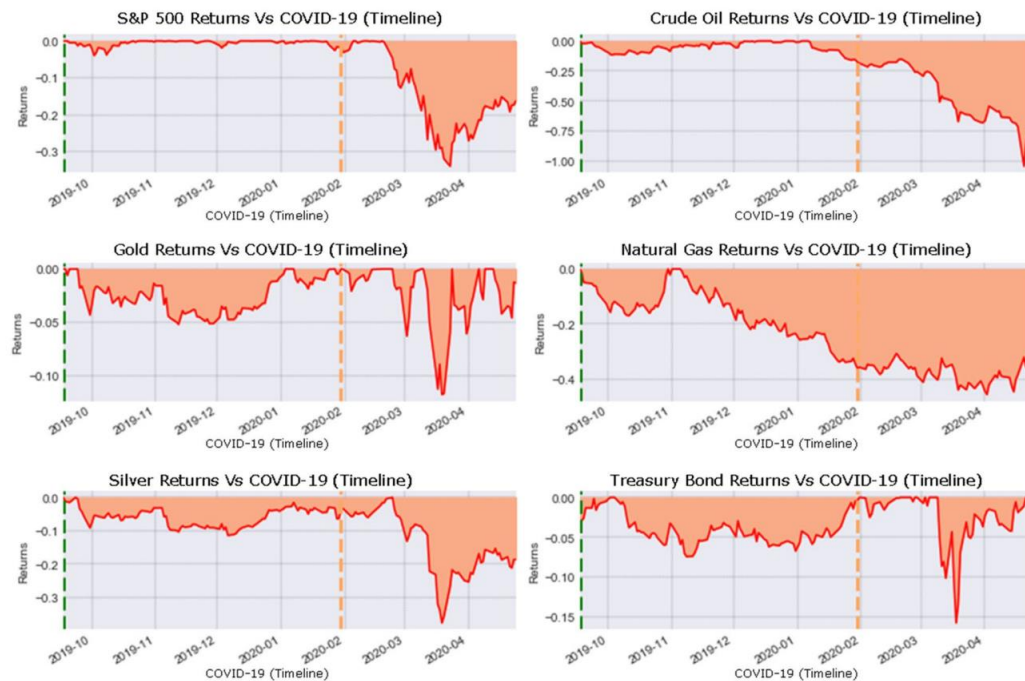

Figure 2. Stock index highlighting of maximum return during COVID-19 timeline
Source: Verma et al., 2021

Baker et al. (2021) uses a newly developed weekly index to measure economic uncertainty, which rose sharply during the pandemic. Uncertainty and stock market responses to the pandemic vary widely across industries and countries. Figure 3 highlights the newspaper-based Stock Market Stock Market Volatility (EMV) alongside the VIX, with an inset of the most recent data in weekly frequency.
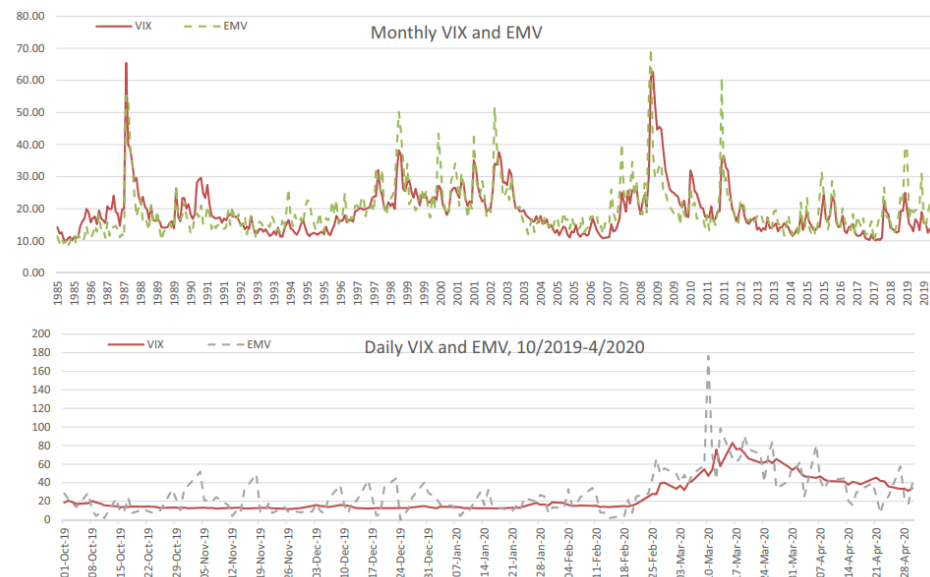

Figure 3. Newspaper-based equity market volatility tracker and the 30-day VIX from January 1985 to April 2020
Source: Baker et al., 2021

Figure 3 shows that the EMV tracker reflects the time series behavior of implied stock market volatility. The results also show that government policy responses had a significant impact on stock markets. The authors emphasize that the collapse in stock prices and increased volatility were due to unprecedented uncertainty about the economic impact of the pandemic, as well as policy responses to it. The study also shows that the stock market's response to the pandemic was influenced by industries and factors such as company size and reliance on international supply chains. The results suggest that the COVID-19 pandemic and its economic impact emphasize the need to be better prepared for unexpected crises and uncertainties at both the macroeconomic and individual firm levels.

Mazur et al. (2020) examine the connection between the COVID-19 pandemic and the stock market crash in March 2020 based on the S&P 1500. Figure 4 illustrates the S&P 1500 performance and volatility in March 2020. The authors document extreme asymmetric volatility for S&P1500 companies and find that volatility is negatively correlated with realized stock returns.
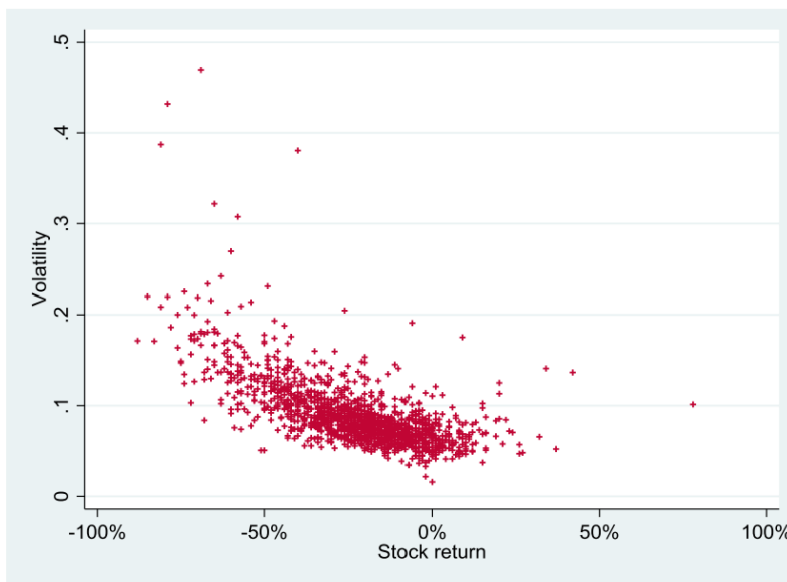

Figure 4. Stock volatility March 2020
Source: Mazur et al., 2020

A different perspective is the basis of a paper by Mazur et al. (2020) to analyze the reason why U.S. stock market values fell abruptly in March 2020. They argue that stocks in health care, food, natural gas, and software performed very well during this period. However, other sectors such as oil, real estate, entertainment, and hospitality saw dramatic declines in value. It is also noted that loser stocks exhibited asymmetric fluctuations that were negatively related to stock returns.

Yilmazkuday (2021) also examines the impact of the COVID-19 pandemic on the S&P 500 index. Both direct and indirect effects are considered, including impacts on economic activity, public health, and policy actions. Figure 5 indicates the cumulative impulse response of the S&P 500, the Baltic Exchange Dry Index, and the Effects on the Spread to COVID-19 Cases.

	After 1 Day	After 1 Week	After 1 Month
COVID-19 Effects on the S&P 500 Index (%)	−0.010* [−0.014, −0.007]	−0.028* [−0.036, −0.020]	−0.024* [−0.031, −0.017]
COVID-19 Effects on the Baltic Exchange Dry Index (%)	−0.002 [−0.008, 0.004]	−0.008 [−0.035, 0.019]	−0.013 [−0.052, 0.029]
COVID-19 Effects on the Spread (%)	0.000* [0.000, 0.000]	0.001* [0.000, 0.001]	0.001* [0.000, 0.001]

*represents significance based on these intervals

Figure 5. Cumulative impulse responses to COVID-19 cases
Source: Yilmazkuday, 2021

Figure 5 highlights that a 1 percent increase in cumulative daily COVID-19 cases in the U.S. leads to a cumulative decline in the S&P 500 Index of about 0.01 percent after one day and about 0.03 percent of a decline after one week. These statistically significant results (68 percent confidence intervals) are consistent with the results of studies such as those by Cao et al (2020) which showed that the elasticity of stock market indexes with respect to cumulative confirmed COVID-19 cases is about 0:028. The authors find that the pandemic had a significant and persistent impact on the S&P 500, especially in 2020, while also examining different scenarios to quantify the impact of the pandemic on the index.

To summarize, it can be said that with the changed interest rate environment in 2022 the literature shows the prevailing academic opinion that this environment weighs technology stocks and that this sector is particularly affected by interest rate hikes (Ghosh et al., 2022). In addition, a potentially higher interest rate sensitivity of the final sector is discussed in the literature. This leads to the hypothesis that there is a significant correlation between selected technology and financial stocks in Europe and the U.S. from 2020 to 2022. This paper therefore analyzes the performance correlation of selected STOXX Europe 600 and S&P 500 stocks during the 2020-2021 pandemic and in 20202 with the 2022 central bank regime change. The regression analyzes indicates the broad sector performance in Europe and the United States and is conducted and evaluated in relation to the literature review.

3. Relationship between Interest Rates and Stock Prices

The scientific relationship between interest rates and stocks is multi-layered and complex. There are several aspects to which interest rates and equity markets are related. It is important to note that the relationship between interest rates and stocks depends on many factors, including the economic situation, central bank monetary policy, investor sentiment and geopolitical events (Schürmann 2023). This paper is focused on time series analysis. Time series analysis such as cointegration-based analysis can be used to identify long-term relationships between interest rates and stock prices. These techniques help uncover long-term trends, structures, and equilibria between the two variables (Eldomiaty et al. 2020).

The extent to which the turnaround in interest rates at the end of the Covid 19 pandemic resulted in strains on balance sheets and income statements that had a detrimental effect on stock prices is examined in more detail in the following section. For this paper, debt and discounting of future cash flow relationships are considered in more detail. Rising interest rates increase the

cost of borrowing, which can have a negative impact on companies' profits. This in turn can affect share prices, as higher costs reduce the profitability and value of companies (Schürmann 2023). Further analysis is based on the selected indices for Europe and the USA, the STOXX Europe 600 and the S&P 500. The observation period is from 2020 to 2023. Figure 4 shows bonds yields with ratings within the BBB category, in both euro and dollar terms, from 2012 to 2023.

Figure 6 illustrates that the debt service of all companies at the beginning of the Covid 19 pandemic in 2020 has decreased significantly. By contrast, as interest rates rose toward the end of the pandemic, financing requirements also became more expensive. At the same time, bond yields have become much more attractive to investors. Yields on bonds with ratings within the BBB category in both euros and dollars have risen significantly, in some cases to just under four to five percent toward the end of 2022.
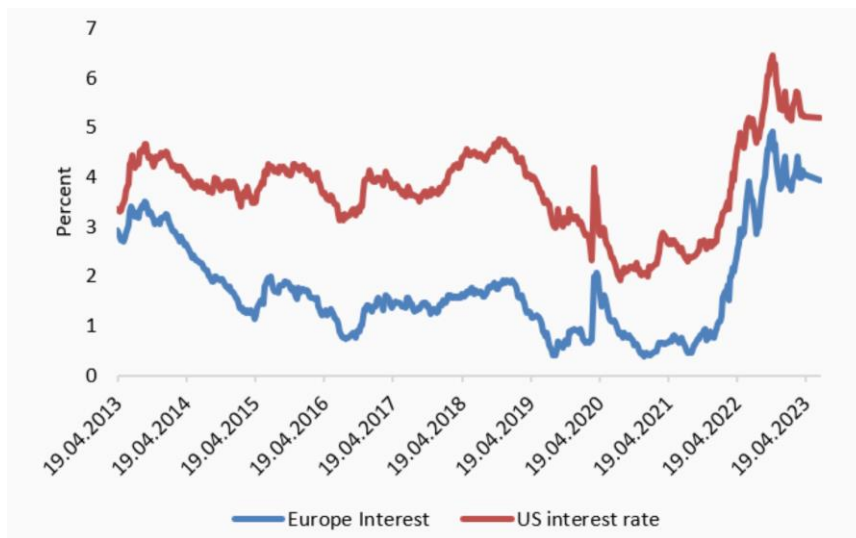
Figure 6. Selected Corporate Bond Yields for Europe and the U.S.
Source: Flossbach von Storch Research Institute & Bloomberg, 2023

In the next step the debt situation of companies for the period under review from 2020 to 2022 is analyzed.

Figure 7 shows the decreased interest rate on debt for Europe and the U.S. with beginning of the COVID-19 pandemic and the turnaround in 2022. The effective interest rate for US companies on debt capital decreased minimally in 2022. In contrast, the interest rate for the selected Stoxx 600 companies has already risen. The difference between Europe and the USA is due to different refinancing dates for companies, the average-based calculation method and currency effects.
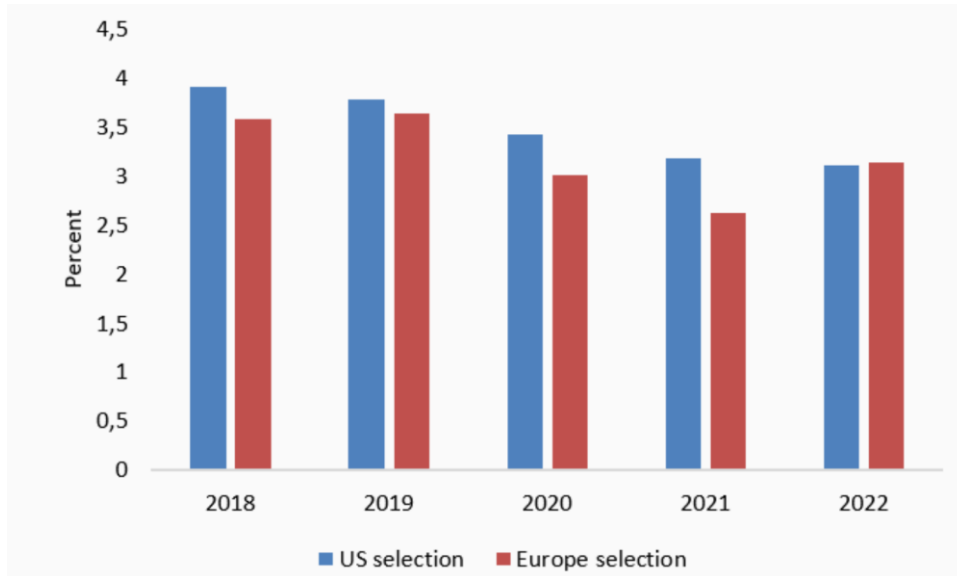
Figure 7. Effective interest rate on selected European and U.S. corporate debt
Source: Flossbach von Storch Research Institute & Bloomberg, 2023

Discounting of Future Cash Flows: Future cash flows are discounted to determine the present value of stocks. Rising interest rates lead to higher discount rates, making future cash flows worth less. This may cause current stock prices to fall to reflect these reduced future cash flows. In addition, rising interest rates may cause a shift of investments away from equity to bond markets. The reason for this is the improved risk-return profile of bonds compared to equities due to higher interest rates. The reason for the rise in interest rates is crucial, as the interest rate level correlates with economic growth expectations. Changes in the interest rate environment also affect recognized and unrecognized assets like goodwill or pension obligations which may have to be revalued and may result in impairment losses (Immenkötter, 2023).

In the following section, the differences in the market price reaction to changes in the interest rate environment are considered for period under review from 2020 to 2023 exemplary for the U.S. The periods cover different changes in the interest rate environment.

Figure 8 shows the US inflation, Fed interest and US treasury yields.
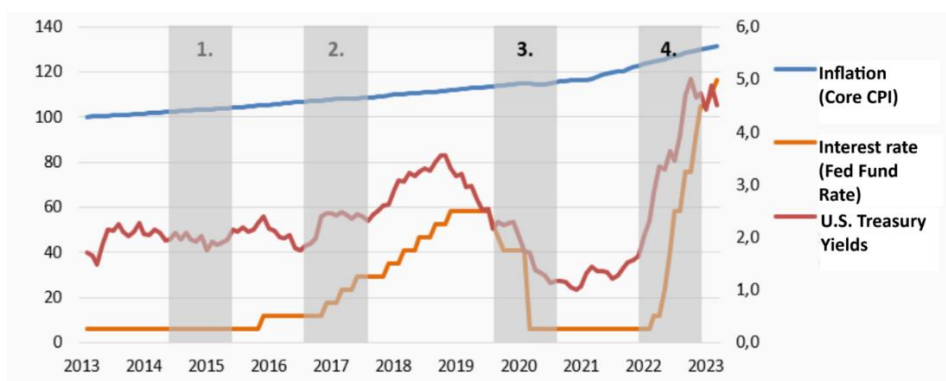
Figure 8. U.S. Inflation, Fed interest rate and U.S. treasury yields
Source: Flossbach von Storch Research Institute & Bloomberg, 2023

Figure 8 illustrates the decreased interest rate environment from 2020 to 2021 with low U.S. treasury yields. In 2023, interest rates rose sharply, and so does the yield on U.S. government bonds. The data shows that with changes in the interest rate environment, the expected time structure of cash flows is related to returns. For the period under review, stocks for which a

larger share of the present value is accounted for by cash flows in the distant future perform worse when interest rates rise. On the other hand, these stocks benefit from lower interest rates which supports the hypothesis that there is a significant correlation between selected technology and financial stocks in Europe and the U.S. from 2020 to 2022. In addition, the literature research shows that the broad S&P 500 index provides a good data basis for the United States and the STOXX Europe 600 for Europe. In this context, Pearson analyzes for performance of both indices are conducted and evaluated in relation to the literature review.

4. Methods and Data

The objective of this paper is fulfilled using Pearson correlation. The usage of correlation for the analysis is relevant as it allows for the examination of the relationship between the performance of technology and financial sector and selected stocks and therefore an indication for the contribution to entire sectors and markets. By calculating the correlation coefficient, one can assess the extent to which performance for both regions is related. If there is a strong correlation, it would support the prevailing academic opinion that rising interest rates negatively impact high-growth sectors and that there is a sensitivity for financial stocks.

Based on this, the working hypotheses will be evaluated. Furthermore, examining the correlation at the sector level can provide additional valuable insights for investors.

The S&P 500 sectors and selected stocks are defined as independent variables that influence the dependent variable STOXX Europe 600 sector and selected stocks performance based on the significance due to the market capitalization during the investigation period.

The correlation analysis assesses both the strength and direction of the relationship between the variables on a scale ranging from -1 to +1. A correlation coefficient of +1 indicates a perfect positive correlation, -1 indicates a perfect negative correlation and 0 indicates no correlation. The performance data of the indices sectors and selected stocks is analyzed during the pandemic from 2020 to 2021 and with the regime shift in 2022. It is applied to test whether there is a significant correlation between the stock performance in Europe and the U.S. during the investigation period.

The composition of individual stocks within the information technology and financial sectors in the STOXX Europe 600 and S&P 500 changes over time based on the indices methodology. The calculation of the STOXX Europe 600 is based on a weighted average method and is performed in several steps. The Index is reviewed regularly to ensure that it reflects current market trends and company changes (Quontigo 2023).

The S&P 500 (Standard & Poor's 500) represents the performance of the 500 largest listed companies in the USA and is calculated by the Standard & Poor's rating agency. The calculation of the S&P 500 is also based on a weighted average method and is performed in several steps. The index is not adjusted for dividend payments and corporate actions such as stock splits have no influence. The S&P 500 Index is reviewed regularly to ensure that it reflects current market trends and company changes (Standard & Poor's 2023).

Although the STOXX Europe 600 and the S&P 500 are two different indices, there are still some sectors that are represented in both indices. The sectors are financials, healthcare, industrial, information technology, real estate, materials, and utilities. Therefore, the potential correlation between the selected sub-sectors of both indices is calculated with Pearson analysis.

In addition, some companies of the selected sectors can be considered representative for both indices based on their market capitalization for the period from 2020 to 2022. For the information technology sector, these companies are SAP, Infineon and ASML Holding for the STOXX Europe 600. For the S&P 500, the companies are Apple Inc, Microsoft Corporation

and Alphabet Inc. In the financial sector, these are HSBC, BNP Paribas, and Deutsche Bank for Europe. For the U.S., these companies are JPMorgan Chase, Bank of America, and Citigroup. Based on this information, the potential correlation between the selected single stocks of the STOXX Europe 600 and S&P 500 is calculated in the next step.

For the U.S. and European indices public available daily performance data from the data provider will be analyzed. There are 258 observations values for 2020 and 2021 and 257 values for 2022.

4.1. STOXX Europe 600 and S&P 500 Sub-Sector Correlation

In the first step the potential correlation between the STOXX Europe 600 and S&P 500 and the comparable sub-sectors of both indices is calculated with Pearson analysis. It is applied to test whether there is a significant correlation between the selected sub-sectors from 2020 to 2022. Table 2 shows the correlation between the selected sub-sectors of STOXX Europe 600 and S&P 500 in 2020.

Table 2.
Correlation between STOXX Europe 600 and S&P 500 sub-sectors in 2020

	r	P-value
Financials	0,69	0,00*
Health Care	0,48	0,00*
Industrials Index	0,49	0,00*
Information Technology	0,60	0,00*
Real Estate Index	0,32	0,00*
Materials	0,54	0,00*
Utilities Index	0,49	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo

All p-values in Table 2 are .00. The correlations are significant, with all p-values being below .05. The coefficients range from .32 to .69 and the Pearson values demonstrate that there is a significant correlation between selected sub-sectors of STOXX Europe 600 and S&P 500 in 2020. The financial and information technology sectors show the highest correlation and the real estate and health care sectors the lowest.

Table 3 shows the correlation between STOXX Europe 600 and S&P 500 sub-sectors in 2021. All p-values are .00, therefore the correlations for all sub-sectors are significant, with all p-values being below .05. The coefficients range from .14 to .58. The values are lower compared to 2020 examinations. This can be explained by the higher variance for the year 2021. The financial and information technology sectors show the highest correlation and the industrial and real estate sectors the lowest.

Table 3.
Correlation between STOXX Europe 600 and S&P 500 sub-sectors in 2021

	r	P-value
Financials	0,47	0,00*
Health Care	0,44	0,00*
Industrials Index	0,25	0,00*
Information Technology	0,58	0,00*
Real Estate Index	0,14	0,00*
Materials	0,32	0,00*
Utilities Index	0,28	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo

To summarize, there is a significant correlation between selected sub-sectors of STOXX Europe 600 and S&P 500 in 2021.

Table 4 shows the correlation between the selected sub-sectors of STOXX Europe 600 and S&P 500 in 2022. All p-values are .00 and the correlations are significant, with all p-values being below .05. The coefficients range from .24 to .63 and the Pearson values demonstrate that there is a significant correlation between selected sub-sectors of STOXX Europe 600 and S&P 500 in 2022. The financial and information technology sectors show the highest correlation, and the real estate and utilities sectors the lowest.

Table 4.
Correlation between STOXX Europe 600 and S&P 500 sub-sectors in 2022

	r	P-value
Financials	0,60	0,00*
Health Care	0,48	0,00*
Industrials Index	0,35	0,00*
Information Technology	0,63	0,00*
Real Estate Index	0,24	0,00*
Materials	0,36	0,00*
Utilities Index	0,28	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo

In summary it can be said that at sector level, the highest correlation between the indices is shown for the financial and information technology sectors for all three years of the investigation period. This supports the initial hypothesis of a potential correlation between selected stocks of the European and U.S. information technology and financial sector from 2020 to 2022.

4.2. Information Technology Stocks Correlation

In the second step, the correlation for SAP, Infineon and ASML Holding for the STOXX Europe 600, and Apple Inc, Microsoft Corporation and Alphabet Inc. for the S&P 500 is analyzed. Table 5 shows the correlation between European IT Stocks and Apple in 2020. The correlation ranges between r = .46 to r = .51. The correlations are significant, with all p-values being below .05. SAP shows the highest correlation and Infineon the lowest. In Table 5, Pearson values demonstrate that there is a significant correlation between selected European IT Stocks and Apple in 2020.

Table 5.
Correlation between European IT Stocks and Apple in 2020

	r	P-value
SAP	0,51	0,00*
Infineon	0,46	0,00*
ASML	0,49	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 6 shows the correlation between European IT Stocks and Apple in 2021. The correlations are significant, with all p-values being below .05. The coefficients range from .42 to .47 and the Pearson values demonstrate that there is a significant correlation between the selected European IT Stocks and Apple in 2021. ASML shows the highest correlation and Infineon the lowest.

Table 6.
Correlation between European IT Stocks and Apple in 2021

	r	P-value
SAP	0,44	0,00*
Infineon	0,42	0,00*
ASML	0,47	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 7 shows the correlation between European IT Stocks and Apple in 2022. The correlation ranges between r = .55 to r = .69. The correlations are significant, with all p-values being below .05. ASML shows the highest correlation and SAP the lowest. In Table 7, Pearson values demonstrate that there is a significant correlation between the selected European IT stocks and Apple in 2022.

Table 7.
Correlation between European IT Stocks and Apple in 2022

	r	P-value
SAP	0,55	0,00*
Infineon	0,58	0,00*
ASML	0,69	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 8 shows the correlation between European IT stocks and Microsoft in 2020. The correlations 4 are significant, with all p-values being below .05. The coefficients range from .52 to .59 and the Pearson values demonstrate that there is a significant correlation between the selected European IT Stocks and Microsoft in 2020. ASML shows the highest correlation and Infineon the lowest.

Table 8.
Correlation between European IT Stocks and Microsoft in 2020

	r	P-value
SAP	0,58	0,00*
Infineon	0,52	0,00*
ASML	0,59	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 9 shows the correlation between European IT stocks and Microsoft in 2021. The correlation ranges between r = .47 to r = .55. The correlations are significant, with all p-values being below .05. ASML shows the highest correlation and SAP the lowest. In Table 9, Pearson values demonstrate that there is a significant correlation between selected European IT Stocks and Apple in 2021.

Table 9.
Correlation between European IT Stocks and Microsoft in 2021

	r	P-value
SAP	0,47	0,00*
Infineon	0,48	0,00*
ASML	0,55	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 10 illustrates the correlation between European IT stocks and Microsoft in 2022. The correlations are significant, with all p-values being below .05. The coefficients range from .59 to .71 and the Pearson values demonstrate that there is a significant correlation between the selected European IT Stocks and Microsoft in 2022. ASML shows a significant thigh correlation and SAP the lowest.

Table 10.
Correlation between European IT Stocks and Microsoft in 2022

	r	P-value
SAP	0,59	0,00*
Infineon	0,61	0,00*
ASML	0,71	0,00*

 Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 11 shows the correlation between European IT stocks and Alphabet in 2020. The correlation ranges between $r = .49$ to $r = .56$. The correlations are significant, with all p-values being below .05. ASML shows the highest correlation and Infineon the lowest. In Table 11, Pearson values demonstrate that there is a significant correlation between selected European IT Stocks and Alphabet in 2020.

Table 11.
Correlation between European IT Stocks and Alphabet in 2020

	r	P-value
SAP	0,55	0,00*
Infineon	0,49	0,00*
ASML	0,56	0,00*

 Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 12 shows the correlation between European IT stocks and Alphabet in 2021. The correlations are significant, with all p-values being below .05. The coefficients range from .36 to .50 and the Pearson values demonstrate that there is a significant correlation between the selected European IT Stocks and Alphabet in 2021. ASML shows a significantly high correlation and SAP the lowest.

Table 12.
Correlation between European IT Stocks and Alphabet in 2021

	r	P-value
SAP	0,36	0,00*
Infineon	0,38	0,00*
ASML	0,50	0,00*

 Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 13 shows the correlation between European IT Stocks and Alphabet in 2022. The correlation ranges between $r = .54$ to $r = .66$. The correlations are significant, with all p-values being below .05. ASML shows the highest correlation and SAP the lowest. In Table 13, Pearson values demonstrate that there is a significant correlation between European IT Stocks and Alphabet in 2022.

Table 13.
Correlation between European IT Stocks and Alphabet in 2022

	r	P-value
SAP	0,54	0,00*
Infineon	0,61	0,00*
ASML	0,66	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

To summarize, the result for the selected information technology stocks shows a significant correlation for the selected stocks for the entire investigation period.

4.3. Financial Stocks Correlation

In the next step, the correlation for HSBC, BNP Paribas, and Deutsche Bank for the STOXX Europe 600 and JPMorgan Chase, Bank of America and Citigroup for the S&P 500 is analyzed. Table 14 shows the correlation between European Financial Stocks and JPMorgan Chase in 2020. The correlations in Table 14 are all significant, with all p-values being below .05. The coefficients range from .47 to .75 and the Pearson values demonstrate that there is a significant correlation between the selected European Financial Stocks and JPMorgan Chase in 2020. BNP Paribas shows the highest and HSBC the lowest correlation.

Table 14.
Correlation between European Financial Stocks and JPMorgan Chase in 2020

	r	P-value
HSBC	0,47	0,00*
BNP Paribas	0,75	0,00*
Deutsche Bank	0,57	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 15 shows the correlation between selected European Financial stocks and JPMorgan Chase in 2021.

Table 15.
Correlation between European Financial Stocks and JPMorgan Chase in 2021

	r	P-value
HSBC	0,36	0,00*
BNP Paribas	0,58	0,00*
Deutsche Bank	0,60	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

The correlation in Table 15 ranges between r = .36 to r = .60. The correlations are significant, with all p-values being below .05. Deutsche Bank shows the highest correlation and HSBC the lowest. In Table 15, Pearson values demonstrate that there is a significant correlation between selected European Financial Stocks and JPMorgan Chase in 2022.

Table 16 shows the correlation between European Financial stocks and JPMorgan Chase in 2022.

Table 16.
Correlation between European Financial Stocks and JPMorgan Chase in 2022

	r	P-value
HSBC	0,47	0,00*
BNP Paribas	0,57	0,00*
Deutsche Bank	0,53	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

The correlations in Table 16 are significant, with all p-values being below .05. The coefficients range from .47 to .53 and the Pearson values demonstrate that there is a significant correlation between the selected European Financial stocks and JPMorgan Chase in 2022. BNP Paribas shows the highest correlation and HSBC the lowest.

Table 17 shows the correlation between European Financial stocks and Bank of America in 2020.

Table 17.
Correlation between European Financial Stocks and Bank of America in 2020

	r	P-value
HSBC	0,48	0,00*
BNP Paribas	0,67	0,00*
Deutsche Bank	0,57	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

The correlations in Table 17 are significant, with all p-values being below .05. The coefficients range from .48 to .67 and the Pearson values demonstrate that there is a significant correlation between the selected European Financial Stocks and Bank of America in 2020. BNP Paribas shows a significant thigh correlation and HSBC the lowest.

Table 18 shows the correlation between European Financial stocks and Bank of America in 2021. The correlation ranges between r = .39 to r = .61. The correlations are significant, with all p-values being below .05. Deutsche Bank shows the highest correlation and HSBC the lowest. In Table 18, Pearson values demonstrate that there is a significant correlation between selected European Financial Stocks and Bank of America in 2021.

Table 18.
Correlation between European Financial Stocks and Bank of America in 2021

	r	P-value
HSBC	0,39	0,00*
BNP Paribas	0,56	0,00*
Deutsche Bank	0,61	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 19 shows the correlation between European Financial stocks and Bank of America in 2022.

Table 19.
Correlation between European Financial Stocks and Bank of America in 2022

	r	P-value
HSBC	0,48	0,00*
BNP Paribas	0,54	0,00*
Deutsche Bank	0,57	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

The correlations in Table 19 are significant, with all p-values being below .05. The coefficients range from .48 to .57 and the Pearson values demonstrate that there is a significant correlation between the selected European Financial stocks and Bank of America in 2022. BNP Paribas shows a significant thigh correlation and HSBC the lowest.

Table 20 shows the correlation between European Financial Stocks and Citigroup in 2020.

Table 20.
Correlation between European Financial Stocks and Citigroup in 2020

	r	**P-value**
HSBC	0,51	0,00*
BNP Paribas	0,73	0,00*
Deutsche Bank	0,59	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

The correlation in Table 20 ranges between r = .51 to r = .73. The correlations are significant, with all p-values being below .05. BNP Paribas shows the highest correlation and HSBC the lowest. In Table 20, Pearson values demonstrate that there is a significant correlation between European Financial Stocks and Citigroup in 2020.

Table 21 shows the correlation between European Financial Stocks and Citigroup in 2021. The correlations in Table 21 are significant, with all p-values being below .05. The coefficients range from .33 to .55 and the Pearson values demonstrate that there is a significant correlation between the selected European Financial Stocks and Citigroup in 2021. Deutsche Bank shows the highest correlation and HSBC the lowest.

Table 21.
Correlation between European Financial Stocks and Citigroup in 2021

	r	**P-value**
HSBC	0,33	0,00*
BNP Paribas	0,53	0,00*
Deutsche Bank	0,55	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

Table 22 shows the correlation between European Financial Stocks and Citigroup in 2022.

Table 22.
Correlation between European Financial Stocks and Citigroup in 2022

	r	**P-value**
HSBC	0,48	0,00*
BNP Paribas	0,50	0,00*
Deutsche Bank	0,51	0,00*

Note: * indicate significance with value P<0.05
Source: Own representation based on Qontigo & Fed data

The correlation in Table 22 ranges between r = .48 to r = .51. The correlations are significant, with all p-values being below .05. Deutsche Bank shows the highest correlation and HSBC the lowest. In Table 22, Pearson values demonstrate that there is a significant correlation between European Financial stocks and Citigroup in 2022. In summary, the result for the financials stocks is comparable to information technology stocks. There is a significant correlation between selected STOXX Europe 600 and S&P 500 stocks performance indicating sector correlation for the entire investigation period from 2020 and 2022.

5. Conclusion

This research paper provides comprehensive insights on the empirical analyses and statistical models used to analyze stock valuation, debt, and discounting of future cash flow relationships. Based on this, the data examination is focused on time series analysis for the two variables daily performance of selected stocks for the high-growth technology and the financial sector in Europe and the U.S.

The potential performance correlation for the selected stocks is examined for the European and the U.S. stock market based on the STOXX Europe 600 and S&P 500 indices respectively, which represent broad market performance in Europe and the United States. The analysis is used to indicate potential overall sector correlations for both regions for the years 2020 to 2022. This investigation period is substantial because it covers different central bank regimes during the COVID-19 pandemic with changes in the interest rates of the Federal Reserve and the European Central Bank.

The technology and financial sectors of the selected indices are of particular interest for this paper due to their index weightings as well as the potential sensitivity to interest rate changes from 2020 to 2022 based on the outcome of the literature review. The composition of individual stocks within the in sectors in the STOXX Europe 600 and S&P 500 changes over time based on the indices methodology. Nevertheless, for this analysis some companies are considered as representative for both indices based on their market capitalization for the investigation period.

Pearson analyses for the selected technology and financial stocks show significant correlation between European and the U.S. stocks for the entire observation period from 2020 to 2022. Interestingly, the result suggests similar performance sensitivity for the selected European and U.S. stocks. This indicates that interest rate policy and other factors including the economic situation, central bank monetary policy, investor sentiment and geopolitical events may have a performance impact, highlighting the complexity of the relationship between interest rates and stock market performance. To summarize, the initial assumption of a significant correlation between selected technology and financial stocks in Europe and the U.S. has been confirmed. Another important conclusion of the paper is that the assumption may also be an indication for the entire technology and financial sector in both regions.

To conclude, the research offers valuable insights on the performance correlation of selected technology and financial stocks of the S&P 500 and the STOXX Europe 600 in the context of the COVID-19 pandemic and the subsequent central bank regimes. It supports the prevailing academic opinion about the complex relationship and performance impact of factors like the economic situation, central bank monetary policy, investor sentiment and geopolitical events. The paper contributes to the academic discussion on the subject, providing a basis for future research in the field. In addition, the findings of this paper can be used by investors to make more informed decisions regarding their investment strategies and business plans. It is recommended that further research be conducted on the impact of various factors on stock markets to obtain a more comprehensive picture of the interrelationships.

Finally, conducting research on overall sector sensitivity and other variables is recommended to further analyze the identified correlation.

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