Financial Internet Quarterly 2026, vol. 22 / no. 1, p. 35-45
https://dx.doi.org/10.65748/fiqf-2026-0003

Financial Internet Quarterly

IMPACT OF SELECTED MACROECONOMIC FACTORS ON FINANCIAL MARKETS: A CASE STUDY OF THE USA

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Abstract The financial environment is under great pressure as a result of dynamically changing macroeconomic factors. In this situation, full of uncertainty, understanding the relationship between macroeconomic factors and financial markets becomes a key issue. Market analysts and investors are constantly studying the impact of various variables on the stability of the economy and the performance of financial markets. The purpose of this study is to analyze the impact of selected macroeconomic factors on financial markets over the 2018-2022 period, using the Nasdaq 100 index. Variables such as GDP, inflation, interest rate, consumer confidence, unemployment and changes in commodity prices are examined in terms of their relationship to the returns of the US technology index. The results of the analysis allow researchers of the topic, as well as stock market investors, to draw conclusions about potential market trends, providing valuable guidance for portfolio managers in a dynamic macroeconomic environment. The main value of the study is to assess how these selected factors affect stock market indices.

JEL classification: N2, E22, G32
Keywords: Capital Market, Macroeconomic Factors, Investment Risk

Received: 22.01.2025 Accepted: 17.07.2025

Cite this:
Tymoshchuk, T. & Spirzewski, K. (2026). Impact of selected macroeconomic factors on financial markets: a case study of the USA. Financial Internet Quarterly 21(4), pp. 35-45.

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Introduction

In a volatile financial environment, understanding the complex relationship between macroeconomic factors and financial markets becomes a key issue. Market analysts and investors are constantly required to analyse a variety of variables that affect the stability of the economy and performance in financial markets (Blake, 2020). This study focuses on a deep understanding and identification of existing relationships between macroeconomic factors and one of the most important stock market indices - the Nasdaq 100 index. The analysis covers the period from 2018 to 2022, which allows us to take into account the diverse and dynamic economic events that occurred during this period.

The article puts forward the following thesis: "key macroeconomic indicators such as GDP, inflation rate, interest rate, consumer confidence, unemployment rate and changes in commodity prices have a significant impact on the stock market index." This problem is deliberately defined broadly so that the study can confirm which of the listed indicators are more important.

The main objective of this study is to precisely identify potential relationships between the returns on the selected market index and key macroeconomic indicators. These were chosen as follows: Gross Domestic Product (GDP), inflation rate, interest rate, consumer confidence, unemployment rate and changes in commodity prices.

The novelty of the study is related to the wide range of indicators studied and the study period. At that time, there was unprecedented government interference in the functioning of large enterprises as a remedy for the COVID-19 pandemic. Many sectors of the economy were frozen. An additional event that often has an impact on the economy was the presidential elections held in the USA during that period.

Given the existing research, it is worth noting that machine learning techniques have been used to forecast the stock market for more than two decades. Some of the first articles analyzing this technique were published in 2000 and concerned the artificial neural network technique - ANN (Kumbure et al., 2022).

The article consists of three sections including an introduction. The second section contains a literature review that examines in detail the relationship of various macroeconomic factors on stock market returns. Section three presents the methodology of the study and presents the econometric model used. Section four examines the topic under discussion empirically. The final section contains the conclusions and discussion.

Literature review

Forecasting stock market indices is a key focus for many capital market stakeholders. Methods have evolved over the years from traditional time series methods to new techniques that lead to more effective forecasts (Chen & Hao, 2017). In addition to methodology, data is an essential element of stock market forecasting and plays a key role in the forecasting process. In particular, all the analysis methods discussed above use selected data (variables) for a specific time period to build a model, and are a key element in the forecasting process.

The impact of macroeconomic variables on the stock market is the subject of an article by Cebrián et al. (2019) titled "Macroeconomic variables and stock markets: an international study". The authors examined the potential correlation between stock markets operating in six advanced economies, i.e. Germany, Italy, Spain, France, the UK and the US, and selected macroeconomic variables. The variables chosen were Gross Domestic Product (GDP), Consumer Price Index (CPI), Industrial Production Index (IPI) and Unemployment. The study was conducted for the years 2000 - 2014, a period that includes the global financial crisis that began in 2007, as the purpose was to examine whether the relationship changes under the influence of the economic cycle, and in particular such a major global financial crisis. Accordingly, the period under study was divided into three sub-periods: the pre-crisis period (2000-2006), the crisis period (2007-2010) and the post-crisis period (2011-2014). The most commonly used macroeconomic variables in the literature to date, listed in Table 1, were taken into account.

Table 1: Relationship between stock markets and macroeconomic factors: expected signs

	GDP	CPI	IPI	Unemployment
Stock Market	Positive	Uncertain	Positive	Negative

Source: Cebrián et al. (2019).

Over the past three decades, numerous studies have been conducted on the relationship between stock markets and macroeconomic factors. Many of them do not present uniform conclusions. Based on these studies, the authors of this article have selected the most significant macroeconomic variables. In Table 1 above, the authors summarized the impact on the stock market of the most frequently used macroeconomic variables in the literature. They examined the potential correlation between stock markets operating

in six developed economies and selected macroeconomic variables: GDP, CPI, IPI and Unemployment. For the period encompassing the global financial crisis, which began in 2007, the following results were obtained: GDP and IPI have a positive impact, Unemployment has a negative impact, and CPI has an uncertain impact.

The study of the impact of macroeconomic variables on stock market indexes was also undertaken by Sirucek (2012) and the results were published in the article "Macroeconomic variables and stock market: US review." The author chose as variables: inflation rate, interest rates, money supply, producer price index, industrial production index, oil price and unemployment. The impact of these variables on selected US stock market indexes from 1999 to 2012 was examined, and these were the S&P 500 and the Dow Jones Industrial Average (DJIA).

The stock market plays a key role in both developed and developing countries. In a study conducted by Ali et al. (2015) to analyze the development of the stock market in Pakistan (dependent variable), gross domestic savings (GDS), money supply (MS) and remittances abroad (FR) were considered as explanatory variables. The results were published in the article Macroeconomic Indicators and Stock Market Development.

A broader approach to the issue under discussion was presented by Celebi and Hönig (2019). In the article titled: "The Impact of Macroeconomic Factors on the German Stock Market: Evidence for the Crisis, Pre- and Post-Crisis Periods." This article presents the results of a study on the impact of various macroeconomic factors, but also German government bond yields, sentiment and other leading economic indicators on the main German stock market index, namely the DAX30, in the period from 1991 to 2018. Thus, the authors chose a very broad set of variables to study the level of returns vs. stocks.

In the article by Chien et al. (2021), the authors examined the time-frequency relationship between the recent COVID-19 pandemic and instability in the economy. Based on daily observations (from 31 December 2019 to 1 August 2020), the relationship between the spread of COVID-19 and the price of crude oil, the US geopolitical risk index and the US stock price index was examined. The results illustrate reduced industrial productivity, which increased as the severity of the pandemic increased, such that a 1% increase is a 10.57% decrease in the productivity index. Similar declines were recorded for stock market indices (1% increase equals a 0.67% decrease) and for GDP change (1% increase equals a 1.12% decrease). The stock market crash caused by COVID-19 in March 2020 was one of the biggest stock market crashes in history, with the market falling 26% in four days. US GDP in the first quarter of 2020 fell by 4.8%, while the unemployment rate was over 20%. In addition, the results show that the effects were most strongly felt after 5 April 2020, when there was a sharp drop in oil prices and share prices.

In the article by Gao et al. (2022) the focus was on comparing the impact of COVID-19 on stock market volatility between the US and China. The study results show that the impact of COVID-19 on the stock market showed a significant leverage effect in both the US and China. However, the impact on the US stock market in the early stage of the outbreak was stronger than in China. In turn, with the ongoing epidemic, the US stock market became insensitive to new infections, while the Chinese stock market remained very sensitive.

Hasanudin (2025) in his article investigated how selected factors such as the interest rates, inflation, the Dow Jones Index and the exchange rate of the Indonesian rupiah affect the performance of the Indonesian Stock Exchange index (specifically the Composite Stock Price Index - CSPI). The study was conducted for the years 2018-2022. The data was analysed using multiple linear regression. The results suggest that only inflation has a positive effect on the Composite Stock Price Index. The next factor, the Dow Jones Index, has a positive effect, but it is not significant. Interest rates and exchange rates did not have a positive effect on the index under consideration.

The dynamic stock market reactions to unexpected changes in the number of COVID-19 cases and the uncertainty surrounding the pandemic were examined by Xu (2021). During a serious pandemic like COVID-19, the increase in cases outlines the potential trajectory of the economy. Additionally, heavy regulatory interventions by the government apply, such as quarantines for the population and lockdowns for certain sectors of the economy. Therefore, the financial market should react to unexpected changes in the number of COVID-19 cases. A structural vector autoregressive (VAR) model was used, which was modified to include GARCH-in-mean errors. The results of a study using daily data from Canada and the USA confirm that an increase in the number of COVID-19 cases had a negative impact on the stock market in general. In addition, the reactions of the stock market are asymmetrical in terms of the increase and decrease in the number of cases in Canada. This asymmetry is caused by the negative impact of the uncertainty surrounding the pandemic. Uncertainty also has a negative impact on the US stock market. However, the scale of this phenomenon is small.

The next article investigated whether stock markets are subject to contagion (understood as a chain reaction or domino effect) in connection with the reaction of indices to government decisions to close entire

cities and countries. (Okorie et al., 2021). The study covers the stock markets of 32 of the world's largest economies. The data (as of 31 March 2020) was collected for an ex-ante and ex-post analysis of the COVID-19 epidemic using Detrended Moving Cross-Correlation Analysis (DMCA) and Detrended Cross-Correlation Analysis (DCCA) techniques. The results show that there was a significant but short-lived contagion effect on stock markets as a result of the COVID-19 pandemic. These contagion effects are observed in both stock market returns and volatilities.

Research method

Data selection

Multiple regression makes it possible to examine how a change in one explanatory variable explains a change in another explanatory variable. The representation of the relevant variables is key. In the case of this study, we want to find out whether changes in the Nasdaq 100 index can be explained by variables from the economic field, such as GDP, inflation, interest rate, consumer confidence, unemployment and changes in commodity prices. In other words, whether there is a relationship between the returns of the US technology index and the macroeconomic situation.

The choice of these variables and the elimination of others results from the authors' subjective assessment resulting from the observations of a financial analyst whose task was to answer the question of whether it is possible for a change in one explanatory variable to explain the change in the explained variable.

The general form of the model is as follows:

$$NASDAQ100Returns = \beta_0 + \beta_1 GDP + \beta_2 Inflation + \beta_3 UnemploymentRate + \beta_4 S\,\&\,PCommodityIndex + \beta_5 ConsumerSentiment + \beta_6 InterestRate$$

Where:

β_0, β_1, β_2, β_3, β_4, β_5, β_6 - regression coefficients.

Definition of variables

GDP - An index based on monthly changes in the real GDP of the U.S. economy. Real GDP is calculated at constant market prices without the effect of inflation U.S. Bureau of Labor Statistics (2012).

Inflation - is an indicator that measures changes in the Consumer Price Index (CPI). Including this variable in the model allows us to understand how changes in the overall price level affect the relationship between variables, holding other variables constant U.S. Bureau of Labor Statistics (2023a).

Unemployment Rate - Unemployment rate as a key indicator of economic health, affects investor sentiment, consumer spending and overall market dynamics U.S. Bureau of Labor Statistics (2023b).

S&P Commodity Index - an index that shows price fluctuations on raw materials. In the context of this study, it is assumed that raw material prices can have a significant impact on the technology sector. This causes an increase in operating costs which affects their profitability and market value and ultimately affects the Nasdaq 100 index S&P Goldman Sachs Commodity Index (2023).

Consumer Sentiment - is considered a useful economic indicator, helping to gauge the public's reaction to the state of the economy, unemployment levels and long-term growth prospects. In the financial sector, where trust and confidence are key, the consumer confidence index acts as a signal to banks and brokers OECD reports (2023).

Interest Rate - the Fed funds rate, which is an indicator of the central bank's monetary policy, is important for analysis. The introduction of this factor allows us to understand the impact of interest rate decisions on the financial market Federal Reserve Bank of St. Louis. (2023).

For the sake of clarification, it is worth noting that the information on consumer confidence, GDP, inflation, the unemployment rate and the interest rate is based on data from the US economy for the period from 2018 to 2022. The commodity price index, although tied to the Chicago stock exchange, reflects fluctuations in commodity prices on a global scale (Levine, 2005).

Results

Table 2 shows the regression results based on Equation 1 (with a significance level of 95%). A comparison of the results of the different types of models can be found in Table 3.

The intercept value of -53004.56 in the regression analysis is difficult to interpret practically, as it suggests the expected average return of the Nasdaq 100 when all explanatory variables are zero. However, such a situation may not be realistic in the context of financial markets. Let's focus mainly on the interpretation of the coefficients for the individual explanatory variables, as they provide more concrete information about the impact of individual factors on the Nasdaq 100. The intercept value has a more theoretical role, and its self-interpretation may be limited.

Table 2: Regression results

SUMMARY OUTPUT					
Regression Statistics					
Multiple R					0.9688
R Square					0.9386
Adjusted R Square					0.9315
Standard Error					817.7545
Observations					59
ANOVA					
	df	**SS**	**MS**	**F**	**Significance F**
Regression	6	531778720.4000	88629786.7300	132.5360	1.02995E-29
Residual	52	34773568.7100	668722.4753		
Total	58	566552289.1000			
Variables		**Coefficients**	**Standard Error**	**t Stat**	**P-value**
Intercept		-53004.5606	8232.0494	-6.4388	3.87979E-08
GDP		3.2734	0.3558	9.1993	1.71092E-12
Inflation		164.1537	185.7254	0.8838	0.3808
Unemployment rate		475.4006	122.5375	3.8796	0.0003
S&P Commodity Index		0.8056	2.2338	0.3606	0.7198
Consumer Sentiment		-9.4625	18.2710	-0.5179	0.6067
Interest Rate		-1421.9776	146.4004	-9.7129	2.81457E-13

Source: Author's own study.

Intercept (Point of Intersection): the value of -53004.56 means that when all explanatory variables are zero, the expected average return of the Nasdaq 100 is -53004.56 points.

GDP (Gross Domestic Product): the coefficient of 3.27 suggests that a one percentage point increase in real GDP correlates with a 3.27 point increase in the Nasdaq 100. Thus, economic growth appears to favour index growth.

Inflation: the coefficient of 164.15 is not statistically significant, meaning that there is no clear relationship between inflation and Nasdaq 100 returns during the period analyzed.

Unemployment Rate: a ratio of 475.40 means that a one percentage point increase in the unemployment rate is associated with a 475.40 point increase in the Nasdaq 100. Higher unemployment can be interpreted positively for the technology sector.

S&P Commodity Index: the coefficient of 0.81 is not statistically significant, suggesting no strong relationship between commodity prices and returns on the Nadaq 100.

Consumer Sentiment (Consumer Confidence): the coefficient of -9.46 is not statistically significant, meaning that there is no clear relationship between consumer confidence levels and returns on the Nasdaq 100.

Interest Rate: the ratio of -1421.98 means that a one percentage point increase in the interest rate correlates with a 1421.98 point decrease in the Nasdaq 100. Higher interest rates appear to be associated with a decline in the value of the index.

The period analyzed is 2018-2022, and the regression model aims to understand the impact of various macroeconomic factors on the Nasdaq 100 index. The regression analysis found a significant impact of GDP, the unemployment rate and the interest rate on the Nasdaq 100. However, the lack of significance for inflation, the commodity index and the consumer sentiment index suggests that these factors did not play a key role during the period studied. Investors in the Nasdaq 100 index should pay attention to macroeconomic variables such as GDP and the unemployment rate to better understand potential market movements (Mishkin, 2016).

Analysis of Variance (ANOVA) provides information on the overall significance of the model. ANOVA values are statistically significant, indicating that at least one explanatory variable has an impact on the Nasdaq 100. The model does a good job of explaining much of the variability in the data.

- Multiple R: Strong overall association between explanatory variables and Nasdaq 100.
- R^2 (Coefficient of Determination): Volatility in the Nasdaq 100 is explained by the explanatory variables.
- Adjusted R^2: Despite the addition of variables, the model still effectively explains variation in the data.

The study attempted to examine different forms of the regression model, taking into account both the changes on both sides of the regression, i.e. log-lin, lin-log and log-log models. The goal was to examine whether the relationship between variables is nonlinear, which may be more appropriate for economic and financial data. A comparative analysis was carried out, noting the coefficients of determination (R^2) and the significance of each variable.

Table 3: Comparison of different forms of models

Regression Statistics	Linear	lin-log	log-log	
F	132.5360	1.9546	3.6911	
R Square	0.9386	0.1840	0.2987	
Linear				
	Coefficients	**Error**	**t Stat**	**P-value**
Intercept	-53004.5606	8232.0495	-6.4388	3.87979E-08
GDP	3.2734	0.3558	9.1993	1.71092E-12
Inflation	164.1537	185.7254	0.8839	0.3808
Unemployment rate	475.4006	122.5375	3.8796	0.0002
S&P Commodity Index	0.8056	2.2338	0.3606	0.7198
Consumer Sentiment	-9.4625	18.2710	-0.5179	0.6067
Interest Rate	-1421.9776	146.4004	-9.7129	2.81457E-13
lin-log				
	Coefficients	**Error**	**t Stat**	**P-value**
Intercept	10327.9981	401.5731	25.7189	3.06295E-31
GDP	-46110.1258	42771.1314	-1.0781	0.2860
Inflation	4899.3267	3371.2734	1.4533	0.1522
Unemployment rate	-3978.5450	5177.4005	-0.7684	0.4457
S&P Commodity Index	11693.9620	5374.3519	2.1759	0.0341
Consumer Sentiment	-8866.5408	7256.8426	-1.2218	0.2273
Interest Rate	1190.1876	1647.4639	0.7224	0.4733
log-lin				
	Coefficients	**Error**	**t Stat**	**P-value**
Intercept	-0.3973	0.6054	-0.6563	0.5145
GDP	1.36348E-05	2.60796E-05	0.5228	0.6033
Inflation	-0.0142	0.0135	-1.0458	0.3005
Unemployment rate	0.0148	0.0089	1.6606	0.1028
S&P Commodity Index	0.0002	0.0002	0.9309	0.3562
Consumer Sentiment	0.0004	0.0013	0.2983	0.7667
Interest Rate	0.0075	0.0096	0.7780	0.4401
log-log				
	Coefficients	**Error**	**t Stat**	**P-value**
Intercept	0.0028	0.0076	0.3731	0.7106
GDP	0.9245	0.8074	1.1451	0.2574
Inflation	0.0464	0.0636	0.7284	0.4696
Unemployment rate	0.0389	0.0977	0.3985	0.6919
S&P Commodity Index	0.3524	0.1014	3.4738	0.0010
Consumer Sentiment	-0.2260	0.1370	-1.6496	0.1051
Interest Rate	-0.0535	0.0311	-1.7219	0.0910

Source: Author's own work.

The table shows the results for the linear (linear), log-lin, lin-log and log-log models. Determination coefficients (R^2) and F-statistics values are important for assessing the quality of the models.

1) Linear Model:
a) The best coefficient of determination (R^2 = 0.9386) and a high F-statistic value (132.54), suggesting that the linear model best describes the data.
b) Significance of variables confirmed by low p-values.
2) Log-lin model:
a) R^2 and F-statistics are much lower than in the linear model.
b) The significance of the variables is limited, which may be due to the non-linearity of the relationship.
3) Lin-log model:
a) The coefficients of determination and F-statistics are lower than in the linear model.
b) The significance of the variables is also limited.
4) Log-log model:
a) The coefficients of determination and F-statistics improve, but are still lower than in the linear model.
b) S&P Commodity Index variable appears to be relevant.

Despite the attempt to include nonlinear relationships, the linear model performed best. Nevertheless, it is worth noting that different models may have different interpretations of the effects of variables, especially in the context of logarithmic transformations. The significance of individual variables varies between models, suggesting that there are differences in the interactions between explanatory variables and the explanatory variable depending on the form of the model.

Efforts have been made to understand non-linear relationships in the data, but the linear model still appears to be the most adequate to describe the relationships studied. Further research and the inclusion of more complex models may help to better understand the structure of the data and improve the precision of predictions.

Further testing

In this section, an attempt was made to move to the final form of the model, which will be a linear model, but slightly modified. In fact, it is worth doing a reduction of the model, focusing only on the important coefficients, i.e. GDP, unemployment rate and interest rate. In order to justify the choice of variables, the Hellwig method was also used. This method allowed the selection of explanatory variables according to the principle: the explanatory variables should be weakly correlated with each other, while there must be a strong correlation with the explanatory variable. The results of this analysis are shown in Table 4.

Table 4: Ranking of combinations of variables

	H (Information Capacity Index)	Combination of variables
1	0.831580	X1, X5, X6
2	0.780801	X1, X2, X5, X6
3	0.773541	X1, X4, X5, X6
4	0.755898	X2, X5, X6
5	0.745374	X4, X5, X6

Source: Author's own work.

X1: GDP
X2: Inflation
X3: Unemployment level
X4: Raw Material Price Index
X5: Consumer confidence
X6: Interest rate

According to this method, the best combination of variables are GDP, Consumer Confidence and the interest rate. The choice of these variables seems to coincide with the previous logic based on the significance analysis. The model was reduced to these three variables, and a forecast was created from the reduced model using a trend model. The regression results of the reduced model are shown in Table 5.

Coefficient of Determination (R^2): 91%: The model explains 91% of the volatility of the Nasdaq 100 index with the included variables.

F-statistic level: 196.67. The model is statistically significant, meaning that at least one explanatory variable has an impact on the Nasdaq 100.

P-values: all explanatory variables are statistically significant, confirming their significance in the model.

Table 5: Regression results for the reduced model

SUMMARY OUTPUT					
Regression Statistics					
Multiple R					0.955675514
R Square					0.913315688
Adjusted R Square					0.908671886
Standard Error					936.676721000
Observations					60
ANOVA					
	df	**SS**	**MS**	**F**	**Significance F**
Regression	3	517663914.1000	172554638.0000	196.6741	1.05959E-29
Residual	56	49132343.6600	877363.2796		
Total	59	566796257.8000			

	Coefficients	Standard Error	t Stat	P-value
Intercept	-24714.4857	4550.5916	-5.4310	1.25458E-06
GDP	2.2149	0.2125	10.4211	1.00405E-14
Interest Rate	-1663.7262	118.8248	-14.0015	6.11455E-20
Consumer Sentiment	-63.3618	9.9104	-6.3935	3.45714E-08

Source: Author's own work.

The estimated model is of the form (regression coefficients are rounded for presentation convenience):

$$Predicted\ NASDAQ100\ Returns = -24714.49 + 2.22GDP - 63.36Consumer\ Sentiment - 1663.73Interest\ Rate$$

Where:
Intercept (Free Expression): -24714.49. This is the theoretical value of the Nasdaq 100 when all explanatory variables are zero.
GDP (Gross Domestic Product): 2.22. If the GDP of the U.S. economy grows by $1 trillion, we can expect the Nasdaq 100 to rise by 2.22 points.
Interest Rate: -1663.73. A 1 percent increase in the interest rate causes the Nasdaq 100 Index to fall by 1663.73 points.
Consumer Sentiment (Consumer Confidence): -63.36. With consumer confidence up 1 point, the Nasdaq 100 is down 63 points.

To evaluate the effectiveness of the model, a forecasting test was conducted using a simple trend model. The model was used to predict future values of GDP, consumer confidence and the interest rate. These predictions were then compared with actual data to assess the discrepancy. The trend model for each variable is shown in Table 6 and the forecasting results in Table 7.

Table 6: Trend model for each variable

Variable	Trend Model
GDP	y = 28.969x + 18272
Conmsumer Sentiment	y = -0.8039x + 107.02
Interest Rate	$y = 0.0022x^2 - 0.1509x + 3.124$

Source: Author's own work.

Table 7 show the observation number, date, actual Nasdaq 100 values, projected GDP, interest rate, consumer confidence, projected Nasdaq 100, and the discrepancy between the projected and actual results.
1. Trend Model Forecast:
a) The trend model was used to predict the value of GDP, interest rate and consumer confidence for future periods.
b) These forecasts were used to predict the value of the Nasdaq 100 index.
2. Discrepancy:
a) Differences between the projected and actual values of the Nasdaq 100 are apparent.
b) These forecasts are subject to some error due to the simplicity of the trend model.
3. Disparity Analysis:
a) In the case of the interest rate, there is considerable inconsistency between forecasts and actual data. This may be due to the non-linearity of the interest rate trend and its dependence on changing economic conditions.
4. Assessing the Correctness of Projections:
a) The GDP forecast seems to coincide with reality, which may indicate the model's effectiveness in predicting this variable.
b) Consumer confidence forecast is improving compared to actual data.

Table 7: Forecasting results based on the trend model

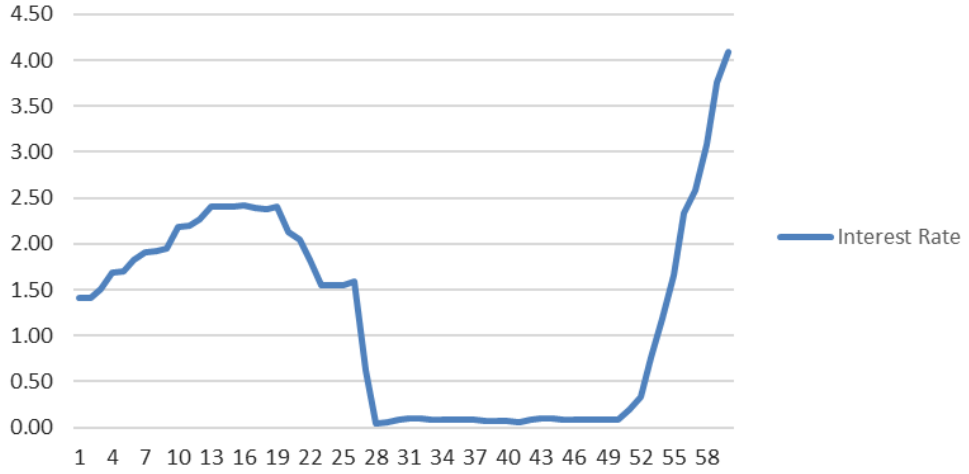
t	Date	Nasdaq 100	GDP	Interest Rate	Consumer Sentiment	Nasdaq 100 forecast	Disparity
58	10/01/2022	11406	20138.71	3.08	59.90		
59	11/01/2022	12030	20224.78	3.76	56.80		
60	12/01/2022	10940	20184.71	4.09	59.70		
61	01/01/2023	12102	20039.11	2.11	57.98	12494	-392
62	02/01/2023	12042	20068.08	2.23	57.18	12410	-368
63	03/01/2023	13181	20097.05	2.35	56.37	12318	863

t	Date	Nasdaq 100	GDP	Interest Rate	Consumer Sentiment	Nasdaq 100 forecast	Disparity
64	04/01/2023	13246	20126.02	2.48	55.57	12220	1026
65	05/01/2023	14298	20154.99	2.61	54.77	12114	2185

Source: Author's own work.

Attempting to use a different model (e.g., y = 0.0022x2 - 0.1509x + 3.124) to forecast the interest rate can introduce significant differences in the forecasts of the Nasdaq 100 index. The reason is the non-linearity of the interest rate trend and its fluctuations are dependent on monetary policy plus the economic situation (chart below).

Table 8: Chart of trend models



Source: Author's own work.

The trend model's forecasting results show some limitations, especially in the case of the interest rate. The inability to account for the full complexity of variables affecting the financial market can lead to underestimates and overestimates. Further analysis, incorporating more sophisticated models, may improve the precision of forecasts.

Conclusions and Discussion

In a financial environment that is uncertain and volatile, it is crucial to understand the relationship between macroeconomic factors and financial markets. In the above study, the focus was on an in-depth analysis of the existing relationships between macroeconomic factors and a selected single stock market index, i.e. the Nasdaq 100 index. The main objective of this analysis was to precisely identify potential relationships between the returns of the Nasdaq 100 US technology index and key macroeconomic indicators: Gross Domestic Product, inflation rate, interest rate, consumer confidence, unemployment rate and changes in commodity prices.

The results of the study indicate that the most important factors are GDP, consumer confidence and interest rates. The other indicators studied, such as inflation rate, unemployment level and changes in commodity prices have less of an impact. The chosen period of research, including the pandemic and the presidential election, posed a challenge to forecasting based on historical data.

It is precisely the originality of these findings that is related to the aforementioned research period, which covers the years 2020-21, a period of great market uncertainty related to the COVID-19 pandemic.

The results of this study have important implications for carrying out an effective investment strategy. Thus, mainly for analysts of capital markets and investors who are required to constantly analyze a number of selected variables (or most of them if possible) that affect the development of the economy and the performance of financial markets. The implications of the results may also be of interest to companies planning to raise capital from the stock exchange for new investments. By observing the analysed indicators, they can more likely plan an effective bond issue.

A significant limitation of the conducted study was observed in the forecast results of the trend model in the case of the interest rate. In the case of this indicator, there is a significant inconsistency between the forecasts and the actual data. This may be due to the

non-linearity of the interest rate trend and its dependence on changing economic conditions. On the other hand, the justified claim is the fact that in the period under review, there was a rare situation on the market, when interest rates balanced on the verge of zero percent for a number of months due to the unprecedented situation caused by the actions of the authorities in connection with the threat of the COVID-19 epidemic. It is worth adding that this threat led, for example, to negative interest rates on the euro currency market. These economic conditions, unprecedented in recent decades, lead to the inability to take into account the full complexity of variables affecting the financial market, which may lead to underestimations or overestimations. The limitation is also the chosen trial period (five years) and limitations related to the use of the linear regression model in the financial market analysis (e.g. limited flexibility, susceptibility to the occurrence of outliers).

Potential future research directions are suggested in the area of more sophisticated models, which may improve the precision of forecasts. As mentioned above, a significant limitation of the conducted study was the forecasting results of the trend model in the case of the interest rate. In the case of this indicator, there is a significant discrepancy between the forecasts and the actual data. These limitations related to this feature of the input variable can be removed in prediction algorithms using machine learning models. They can analyze historical data (taking into account the period of the COVID-19 impact) on the volatility of interest rates to predict future stock market indices or identify key factors influencing these indices. Despite its advantages, it should be strongly emphasised that the use of machine learning is not within the scope of the methodology used in this study, and the topic has only been raised as a suggested direction for future research.

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