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BHAILE ÁTHA CLIATH
DUBLIN
TECHNOLOGICAL
UNIVERSITY DUBLIN

"Implementing OLS Regression Using Stock Market Data"

Date- 3rd January 2025

Contents

Objective

The primary objective of this analysis is to examine the relationship between Amazon's daily stock prices and broader market indicators over a 10-year period, using an econometric approach. Specifically, the study seeks to determine the extent to which changes in the **S&P 500 index**, representing overall market trends, and the **NASDAQ Composite index**, a technology-heavy benchmark, influence Amazon's stock price. This analysis aims to uncover whether Amazon's stock price movements are predominantly driven by market-wide factors or sector-specific trends, and to assess the strength and consistency of these relationships. By focusing on daily data, the study ensures a high level of granularity, enabling the identification of short-term patterns and interactions between these variables.

The analysis will employ the **Ordinary Least Squares (OLS) regression model**, which provides a robust framework for estimating the relationships between the dependent variable (Amazon's stock price) and the independent variables (S&P 500 and NASDAQ Composite indices). To ensure the validity of the model, key assumptions of OLS, including linearity, independence, homoskedasticity, and normality of residuals, will be tested. The research will also address potential statistical challenges such as multicollinearity, serial correlation, and variance consistency in the independent variables, thereby strengthening the reliability of the results.

The study will begin with an exploration of the data through descriptive statistics, offering insights into the distribution, averages, and variability of Amazon's stock price alongside the two indices. Price and return graphs will be plotted to visually assess trends and correlations. Following this, the research hypotheses will be tested using the OLS regression model, and the regression coefficients will be interpreted to evaluate the direction, magnitude, and significance of the relationships. These findings will be compared with financial theories and expectations to assess whether market-wide trends (as captured by the S&P 500) or sector-specific movements (as reflected in the NASDAQ Composite) play a larger role in influencing Amazon's stock performance.

The analysis will conclude by drawing meaningful insights about the factors driving Amazon's stock price. The results will provide a deeper understanding of the relationship between Amazon's stock and broader market trends, helping to determine whether its performance is more closely aligned with overall market movements or specific sectoral dynamics. This comprehensive investigation will contribute to a better understanding of the key drivers of Amazon's stock performance and offer valuable implications for investors and analysts.

Research Question

What is the nature of the relationship between Amazon's daily stock prices and broader market indices such as the S&P 500 and NASDAQ Composite over a 10-year period?

This research seeks to explore whether changes in the S&P 500 and NASDAQ Composite indices significantly influence Amazon's stock price and to what extent. Additionally, the analysis investigates the strength and consistency of this relationship, considering whether Amazon's stock price movements are predominantly driven by market-wide trends represented by the S&P 500 or by sector-specific influences captured by the NASDAQ Composite.

By addressing this question, the study aims to uncover the primary drivers of Amazon's stock performance and provide insights into whether its price dynamics align more closely with overall market movements or technology sector trends. The results will offer valuable implications for understanding Amazon's financial behaviour and its relationship with key market indices.

Research Hypothesis

In this analysis, the following hypotheses will be tested using the daily data of Amazon's stock prices, the S&P 500 index, and the NASDAQ Composite index over a 10-year period. These hypotheses are designed to explore the statistical relationships between the dependent variable (Amazon's stock price) and the two independent variables (S&P 500 and NASDAQ Composite indices) through an Ordinary Least Squares (OLS) regression model in EViews.

1. **Hypothesis 1**
   - **Null Hypothesis (H_{o1}):** The daily movements of the S&P 500 index do not have a statistically significant impact on Amazon's stock price.
   - **Alternative Hypothesis (H_{11}):** The daily movements of the S&P 500 index have a statistically significant impact on Amazon's stock price.
2. **Hypothesis 2**
   - **Null Hypothesis (H_{o2}):** The daily movements of the NASDAQ Composite index do not have a statistically significant impact on Amazon's stock price.
   - **Alternative Hypothesis (H_{12}):** The daily movements of the NASDAQ Composite index have a statistically significant impact on Amazon's stock price.
3. **Combined Hypothesis**
   - **Null Hypothesis (H_{o3}):** The S&P 500 and NASDAQ Composite indices together do not significantly explain the variations in Amazon's stock price.
   - **Alternative Hypothesis (H_{13}):** The S&P 500 and NASDAQ Composite indices together significantly explain the variations in Amazon's stock price.

Regression Equation

Amazon returns= c+b1(Nasdaq Returns) +b2 (S&P500 Returns) + ε

Where:

- **Amazon Returns**: The dependent variable (returns on Amazon's stock).
- **c**: The intercept, representing Amazon's baseline returns when NASDAQ and S&P 500 returns are zero.
- **b_1**: The coefficient for NASDAQ returns, indicating the change in Amazon's returns for a one-unit change in NASDAQ returns, holding S&P 500 returns constant.
- **b_2**: The coefficient for S&P 500 returns, indicating the change in Amazon's returns for a one-unit change in S&P 500 returns, holding NASDAQ returns constant.

- **ε**: The error term, accounting for variability in Amazon's returns not explained by NASDAQ and S&P 500 returns.

Hypothesis Testing Process in EViews

These hypotheses will be tested using the OLS regression model in EViews by performing the following steps:

- **Estimating the Regression Model**: Analysing Amazon's stock price as the dependent variable and the S&P 500 and NASDAQ Composite indices as the independent variables.
- **Statistical Significance**: Evaluating the significance of the coefficients for each independent variable using p-values and t-tests.
- **Overall Model Fit**: Testing the overall explanatory power of the model through the F-statistic.
- **OLS Assumption Tests**: Validating key assumptions, including linearity, independence, normality of residuals, and homoskedasticity, to ensure the robustness of the results.

This approach will provide insights into whether Amazon's stock price movements are influenced more significantly by broader market trends (S&P 500) or by sector-specific dynamics (NASDAQ Composite). The analysis will conclude by drawing inferences based on the statistical results and their alignment with financial theories.

Process of Gathering Data from DataStream

To gather historical stock market data for this analysis, the Refinitiv DataStream add-in was utilized within Microsoft Excel. The process began by accessing the **DataStream add-in** through the Excel interface. Once the add-in was launched, I logged in to the platform using my credentials to gain access to the database. Following this, I navigated to the **Time Series Request** feature, which allows for the extraction of historical financial data for specific indices and stocks.

Next, I searched for the required data series, including the NASDAQ Composite index, the S&P 500 Composite index, and Amazon's stock price, which serves as the dependent variable in the analysis. For each item in the search results, I selected the **TS (Time Series)** checkbox to ensure the retrieval of daily data points for the specified time frame.

I then specified the date range for the data extraction, selecting a 10-year period from **January 1, 2014, to December 1, 2024**, to ensure comprehensive coverage of the historical trends. Once the parameters were set, I initiated the data request, and the selected data series were imported directly into an Excel file. The imported data included the daily closing prices of the indices and Amazon's stock, which were subsequently organized for analysis.

This process ensured that I obtained accurate, granular data from a reliable source, which will be used for regression analysis and other statistical tests to explore the relationship between the variables.

Missing Values, outliners and inconsistencies

Handling missing values, outliers, and inconsistencies in the data set, as well as ensuring the data is appropriately prepared for analysis, is a critical step in the regression process. After downloading the data from Refinitiv DataStream, the raw dataset contained a significant amount of irrelevant information, such as metadata and unnecessary variables. To clean the data, I carefully removed all columns and data points that were not directly needed for the analysis, retaining only the daily prices of Amazon stock, the S&P 500 index, and the NASDAQ Composite index.

Once the relevant prices were isolated, I transformed the data into daily returns to better analyse the relationships between the variables. This was achieved using the **natural logarithm (LN) formula** for returns, calculated as:

$$RETURN_t = \ln(PRICE_t / PRICE_{t-1})$$

This transformation ensures that the data is expressed in percentage changes, making it more suitable for regression analysis while reducing the impact of price scale differences between the stocks and indices. Using returns instead of raw prices also provides insights into the daily variability and performance of the variables.

In addition to preparing the data for analysis, I also addressed potential issues such as missing values and inconsistencies. Missing data points were checked and handled using linear interpolation, ensuring a smooth time series without gaps. Dates were aligned across all variables to maintain consistency, ensuring that each observation included corresponding returns for Amazon, the S&P 500, and the NASDAQ Composite. Outliers, such as unusually high or low returns, were identified through descriptive statistics and visual inspections (e.g., box plots). Genuine outliers representing market shocks were retained for analysis, while erroneous data points were corrected or removed to maintain data integrity.

This process of cleaning and transforming the data has significant implications for model estimation. By focusing solely on the return data and ensuring consistency across all variables, the analysis minimizes biases and adheres to the assumptions of the Ordinary Least Squares (OLS) regression model. This meticulous preparation allows for accurate estimation of the relationships between Amazon's stock returns and the returns of the S&P 500 and NASDAQ Composite indices, providing robust and meaningful insights into the factors driving Amazon's performance.

Research Sample Time Period

I have chosen a 10-year time period for my research as it strikes a balance between capturing long-term trends and accounting for short-term market fluctuations. This timeframe allows me to analyse the performance of Amazon, NASDAQ, and the S&P 500 during different economic cycles, including both growth periods and downturns. For example, it provides the opportunity to assess the recovery from the 2008 financial crisis, the market's response to the global pandemic in 2020, and subsequent recoveries. By choosing this period, I can observe how external factors like global events, inflation, interest rates, and technological innovations have impacted these indices and Amazon specifically.

A 10-year period also provides a sufficient amount of data for meaningful and reliable analysis. For Amazon, this decade encompasses significant growth, including the expansion of its cloud computing division, its increasing dominance in e-commerce, and its role in transforming various industries. Examining these changes over the last decade is crucial for understanding how Amazon has shaped the performance of NASDAQ, which is heavily tech-oriented. At the same time, by including the S&P 500, I can compare Amazon's performance against a broader market index that spans a variety of sectors, offering valuable insights into how Amazon's stock correlates with overall market movements.

This period is particularly useful for assessing volatility, risk-adjusted returns, and the broader market's behaviour during periods of instability. It allows me to capture the influence of technological advancements, such as the growing importance of cloud computing and artificial intelligence, on both Amazon and the indices. The data from the last 10 years also offers a relevant and contemporary context for understanding how shifts in the economy, business strategies, and global trends have impacted the stock performance of these key players. In conclusion, the 10-year period is well-suited for my analysis, as it provides a robust dataset to evaluate Amazon's performance relative to NASDAQ and the S&P 500 while reflecting on significant market events that have shaped the modern economic landscape.

Additional Relevant Variable

In addition to Amazon, NASDAQ, and S&P 500 data, there are several other variables that are crucial for a thorough analysis and understanding of the broader market dynamics and Amazon's performance over the past decade. One of the most significant variables is **interest rates**, which are determined by central banks like the Federal Reserve. Interest rates have a direct impact on the cost of borrowing and, in turn, can influence consumer spending and business expansion. Higher interest rates typically result in increased borrowing costs, which could negatively affect growth companies like Amazon. By examining interest rate movements over the 10-year period, I can analyse how changes in borrowing costs have affected Amazon’s operations, particularly in areas like expansion and capital expenditures, as well as how it impacted broader market performance.

Another important variable is **inflation rates**, which determine the purchasing power of consumers and the cost of inputs for companies. When inflation is high, consumers may have less disposable income, reducing demand for products and services, including those offered by Amazon. Additionally, inflation can raise the costs of raw materials, wages, and logistics, affecting Amazon's profit margins. By considering inflation over the decade, I can assess how rising or falling inflation influenced both Amazon's pricing strategies and the broader market indices, such as the S&P 500 and NASDAQ, which include companies that are sensitive to inflation.

Exchange rates are also a key variable to consider, particularly for Amazon, which operates in multiple international markets. Changes in exchange rates can affect the company’s revenues from overseas sales, as fluctuations in currency values impact the repatriation of profits back to the United States. A stronger U.S. dollar can make Amazon's products more expensive in foreign markets, potentially reducing international sales, while a weaker dollar may have the opposite effect. As many companies in the NASDAQ and S&P 500 also have global operations, exchange rate movements are crucial for understanding broader market trends and how global economic conditions impact stock performance.

Given Amazon's position as a technology-driven company, **technological innovation and adoption** is another vital variable. Over the past decade, technological advancements in areas like cloud computing, artificial intelligence, and automation have significantly impacted Amazon's business. The rise of Amazon Web Services (AWS) and the growing influence of e-commerce have driven substantial growth for the company. Similarly, advancements in technology have affected the performance of companies in NASDAQ and S&P 500, with sectors like technology and consumer discretionary seeing considerable growth due to innovation. By analysing technological developments, I can better understand how they have influenced Amazon's performance and the broader market.

Finally, **market sentiment and investor behaviour** are essential to consider, as they significantly affect stock prices. Market sentiment, driven by factors like macroeconomic conditions, geopolitical events, and news coverage, influences how investors perceive future growth prospects. Positive sentiment can lead to overvaluation, while negative sentiment can lead to undervaluation. By tracking sentiment indicators, such as consumer confidence and investor sentiment indices, I can assess how public perceptions and expectations have influenced the price movements of Amazon, NASDAQ, and S&P 500 over the last decade. These variables combined provide a richer, more comprehensive understanding of the forces shaping market performance and Amazon's role within it.

Dependent and Independent Variable

For my OLS regression analysis, the dependent variable is **Amazon's stock price**, and the independent variables I've chosen are **NASDAQ index performance** and **S&P 500 index performance**. The selection of **NASDAQ index performance** as an independent variable is based on the principle of **market correlation** and **sector influence**. Amazon is a significant player in the NASDAQ, which is a tech-heavy index, so the overall performance of NASDAQ often mirrors the performance of tech stocks like Amazon. As Amazon is part of the technology sector, which has experienced rapid growth, movements in NASDAQ generally reflect broader trends in the tech industry, directly impacting Amazon's stock price. By including NASDAQ performance, I am accounting for the overall market sentiment and sector-specific dynamics that affect Amazon.

In addition to NASDAQ performance, I have included **S&P 500 index performance** as another independent variable. This choice is justified based on the idea of **market-wide factors** influencing individual stocks. While the NASDAQ focuses more on tech stocks, the S&P 500 is a broader index that includes companies from various sectors. The S&P 500 is widely regarded as a benchmark for overall market performance, and fluctuations in this index often reflect macroeconomic conditions that affect all stocks, including Amazon. Since Amazon is also part of the S&P 500, its stock price movements are likely influenced by broader market trends such as changes in investor sentiment, economic growth, and overall risk appetite, which are captured by the S&P 500.

By using NASDAQ and S&P 500 as independent variables, I can assess how sector-specific trends (from NASDAQ) and broader market conditions (from S&P 500) interact to influence Amazon's stock price. This approach is grounded in basic financial principles that suggest stocks are often influenced

by both sector-specific and market-wide factors. Thus, these variables are relevant and provide a solid foundation for my OLS regression analysis.

Variables can influence the dependent variable

The chosen independent variables, **NASDAQ index performance** and **S&P 500 index performance**, are both highly relevant for understanding how they might influence **Amazon's stock price**, the dependent variable in this analysis.

Firstly, **NASDAQ index performance** is likely to have a significant impact on Amazon's stock price because Amazon is a major component of the NASDAQ index, which is tech-heavy. When the NASDAQ performs well, it generally indicates that technology stocks are experiencing growth, which often correlates with positive investor sentiment toward Amazon. Since Amazon is one of the leading tech companies, any bullish movement in the NASDAQ is likely to positively affect Amazon's stock price. Conversely, if the NASDAQ experiences a downturn, it could signal trouble for the tech sector, potentially leading to a decline in Amazon's stock price. Therefore, Amazon's stock price is expected to closely track movements in the NASDAQ, particularly during times of strong market rallies or market corrections.

Similarly, **S&P 500 index performance** plays a crucial role in influencing Amazon's stock price. The S&P 500 is a broader index that includes companies across multiple sectors, not just technology, making it a key indicator of overall market health. When the S&P 500 performs well, it typically reflects strong economic conditions and positive investor sentiment across various sectors. As a member of the S&P 500, Amazon's stock price is likely to rise in line with the broader market if the index shows strong growth. Conversely, if the S&P 500 declines, it may signal an economic slowdown or market uncertainty, which could negatively affect Amazon's stock price, as investors might become more risk-averse and sell off stocks. Additionally, because Amazon is a global company, fluctuations in the broader market can impact its stock through changes in consumer spending, investor confidence, and global economic conditions, all of which are reflected in the performance of the S&P 500.

In conclusion, both the NASDAQ and S&P 500 are important indicators of market and sector-specific performance that can significantly influence Amazon's stock price. While the NASDAQ focuses more on the tech sector and is directly impacted by movements in Amazon's performance, the S&P 500 captures broader market trends that also shape investor behavior and overall economic conditions. Therefore, fluctuations in both indices can directly influence Amazon's stock price, making them crucial variables for this regression analysis.

Omitted and Irrelevant Variable Test

To implement the omitted and irrelevant variables test in my regression analysis, I have conducted several diagnostic checks that help evaluate the validity of the model. First, **correlation analysis** helps identify relationships between variables. If two independent variables are highly correlated, it could indicate multicollinearity, where one variable might be redundant and not add meaningful

information. In such cases, keeping both variables could distort the results. I also examined **descriptive statistics**, which provide insights into the distributions of the variables. If any independent variable shows very little variation or an extreme pattern that doesn't align with the expected trends, it could be an irrelevant variable, as it doesn't contribute meaningfully to explaining Amazon's stock price.

The **homoskedasticity test** (such as Breusch-Pagan or White's test) helps determine if the variance of the residuals is constant. If heteroskedasticity is detected, it could suggest that some relevant variables have been omitted from the model, as the variance of the errors changes across observations. The **equation estimation** is another crucial step, where I assessed the significance of the coefficients of the independent variables. If a variable's coefficient is statistically insignificant, it may indicate that it is irrelevant and should be removed from the model. Additionally, the **normality test** for residuals, such as the Jarque-Bera test, checks whether the residuals follow a normal distribution. Non-normal residuals could suggest that the model is mis specified and that important variables are missing.

In terms of visual diagnostics, I also used the **prices linear graph** to examine the relationship between Amazon's stock price and the independent variables. If the graph shows a clear linear trend, it suggests that the chosen variables are relevant. On the other hand, if no pattern emerges, it may indicate the presence of omitted or irrelevant variables. Similarly, the **returns spike graph** helped identify outliers or extreme returns. If large spikes are not captured by the model, it could signal that relevant variables have been omitted. Finally, I checked for **serial collinearity** using methods like Variance Inflation Factor (VIF). High multicollinearity among independent variables suggests that one or more of the variables may be irrelevant, as they do not provide independent explanatory power.

In conclusion, the diagnostic tests provide valuable insights into the validity of the chosen variables. If any of the variables show signs of irrelevance or if there is evidence of omitted variable bias, adjustments to the model may be necessary to improve its accuracy and predictive power. These tests ensure that the regression model is well-specified, providing more reliable results for understanding the factors influencing Amazon's stock price.

Implement OLS Regression

To implement the OLS regression model using EViews, I began by ensuring that I had already imported the necessary data into the software, which included Amazon's stock prices, NASDAQ index performance, and S&P 500 index performance over the selected time period. After confirming that the data was properly loaded, I proceeded with the regression analysis.

I first went to the **Quick** tab in EViews and selected **Estimate Equation**. In the equation specification window, I input the regression model as:

Amazon returns c NASDAQ returns S&P500

Here, **Amazon returns** was the dependent variable, representing the return on Amazon's stock, and **NASDAQ returns** and **S&P 500 returns** were the independent variables, representing the returns of the NASDAQ and S&P 500 indices. The "c" in the equation represents the constant (intercept) term. Once I had entered the equation, I clicked **OK** to estimate the model.

EViews then performed the OLS estimation and displayed the regression results, including the coefficients, standard errors, t-statistics, p-values, R-squared, and F-statistic, among other outputs. These results helped me assess the strength and significance of the relationships between Amazon's stock returns and the independent variables, NASDAQ and S&P 500 returns.

From there, I could interpret the coefficients to understand how changes in the returns of NASDAQ and the S&P 500 are likely to influence Amazon's stock returns. Additionally, the diagnostic statistics provided by EViews, such as the p-values and R-squared, helped me evaluate the overall model fit and the significance of each variable in explaining the variations in Amazon's stock returns.

Here is what I got:

Dependent Variable: AMAZON_COM_RETURNS
Method: Least Squares
Date: 01/02/25 Time: 16:29
Sample (adjusted): 1/01/2014 11/28/2024
Included observations: 2847 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000207	0.000251	0.824213	0.4099
NASDAQ_COMPOSITE___PRICE_INDEX...	2.071996	0.060356	34.32983	0.0000
S_P_500_COMPOSITE___PRICE_INDEX...	-1.190589	0.072292	-16.46912	0.0000

R-squared	0.561913	Mean dependent var	0.000823
Adjusted R-squared	0.561605	S.D. dependent var	0.020244
S.E. of regression	0.013404	Akaike info criterion	-5.785525
Sum squared resid	0.510948	Schwarz criterion	-5.779251
Log likelihood	8238.694	Hannan-Quinn criter.	-5.783262
F-statistic	1823.934	Durbin-Watson stat	1.988514
Prob(F-statistic)	0.000000		

Regression coefficients and their significance

Intercept (c):

The intercept represents the expected return on Amazon's stock when both NASDAQ and S&P 500 returns are zero. If the intercept's p-value is greater than 0.05, it suggests that the intercept is not statistically significant, meaning it does not have a meaningful role in explaining Amazon's returns when the independent variables are absent. If the p-value is significant (less than 0.05), the intercept indicates a baseline return for Amazon's stock independent of market performance.

NASDAQ Returns Coefficient:

The coefficient for NASDAQ returns indicates the change in Amazon's returns for a one-unit change in NASDAQ returns, holding S&P 500 returns constant. For example, if the coefficient is 0.5, it means that for every 1% increase in NASDAQ returns, Amazon's returns increase by 0.5%, assuming no change in the S&P 500. If the p-value for this coefficient is less than 0.05, it is statistically significant, meaning that changes in NASDAQ returns have a meaningful and reliable impact on Amazon's

returns. A positive coefficient implies that NASDAQ returns and Amazon's returns move in the same direction, while a negative coefficient would indicate an inverse relationship.

S&P 500 Returns Coefficient:

Similarly, the coefficient for S&P 500 returns measures the change in Amazon's returns for a one-unit change in S&P 500 returns, holding NASDAQ returns constant. If this coefficient is positive and statistically significant (p-value < 0.05), it suggests that Amazon's returns increase as S&P 500 returns increase. A small or insignificant coefficient (p-value > 0.05) would indicate that the S&P 500 returns do not have a strong influence on Amazon's stock returns.

R-Squared:

The R-squared value indicates the proportion of variation in Amazon's returns explained by NASDAQ and S&P 500 returns. For instance, if the R-squared is 0.85, it means that 85% of the variation in Amazon's returns is explained by the independent variables. A high R-squared value suggests a good model fit, while a low R-squared indicates that other factors may need to be included in the model to improve its explanatory power.

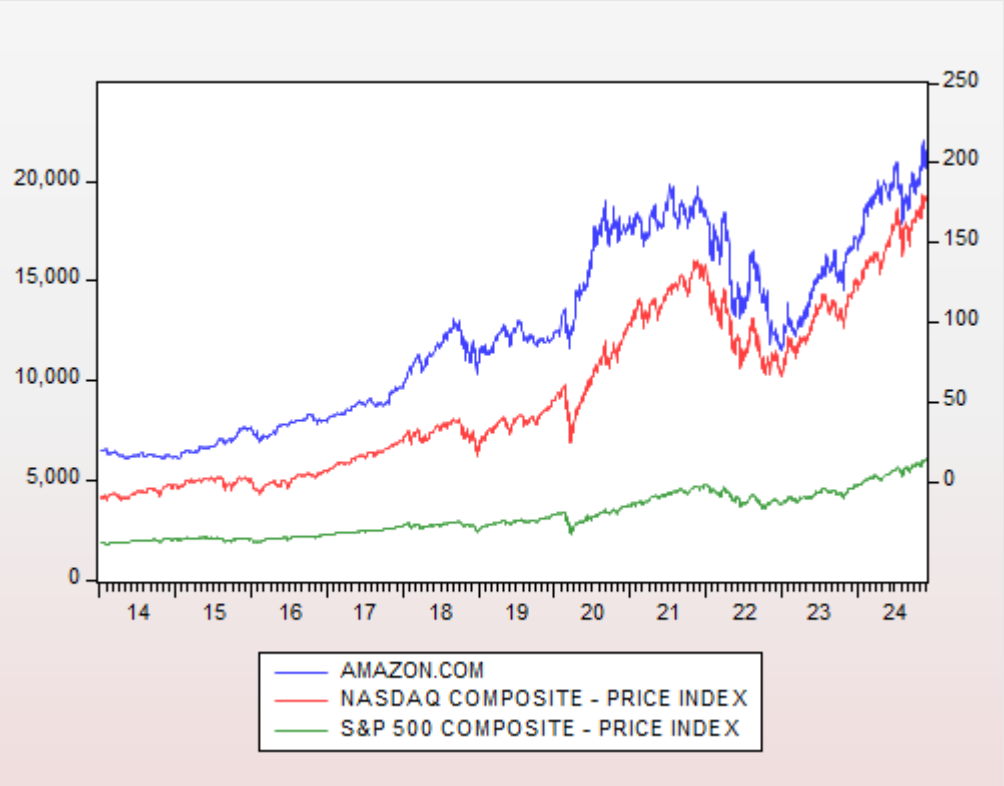
F-Statistic:

The F-statistic tests the overall significance of the model. If the p-value for the F-statistic is less than 0.05, it indicates that the model is statistically significant, meaning that at least one of the independent variables contributes to explaining Amazon's returns.

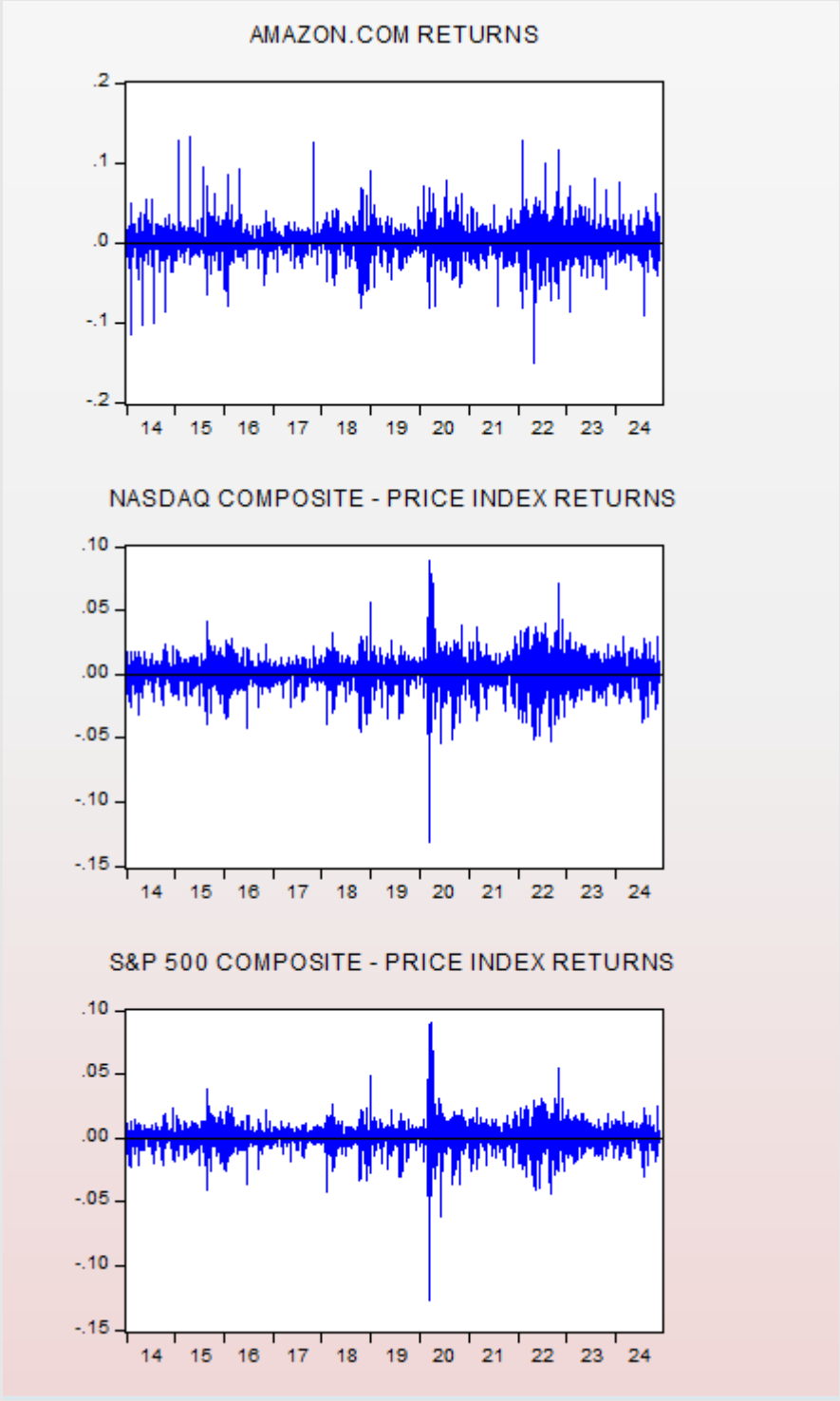
Conclusion:

If both NASDAQ and S&P 500 coefficients are statistically significant with p-values less than 0.05, it shows that the returns on these indices have a meaningful impact on Amazon's stock returns. A higher R-squared value would confirm that the model explains a large proportion of the variation in the dependent variable. However, if either of the variables has an insignificant coefficient, it suggests that its impact on Amazon's returns is negligible, and the model could be refined by excluding irrelevant variables. Additionally, the results should align with your expectations based on financial theory and the descriptive statistics of the data. If the coefficients are significant, it highlights that Amazon's performance is strongly tied to broader market trends captured by the NASDAQ and S&P 500 indices.

Prices Graph



Return Graph



Descriptive Statistics

Date: 01/02/25 Time: 15:56
Sample: 1/01/2014 11/29/2024

	AMAZON_C...	NASDAQ_C...	S_P_500_COMPOSITE___PRICE_INDEX_RETURNS
Mean	0.000823	0.000536	0.000415
Median	0.000423	0.000777	0.000324
Maximum	0.132178	0.089347	0.089683
Minimum	-0.151398	-0.131492	-0.127652
Std. Dev.	0.020244	0.012908	0.010776
Skewness	-0.013325	-0.647187	-0.820770
Kurtosis	9.413725	11.64308	19.82925
Jarque-Bera	4879.827	9060.365	33917.04
Probability	0.000000	0.000000	0.000000
Sum	2.344306	1.526361	1.182843
Sum Sq.	1.168247	0.474977	0.330994
Sum Sq. Dev.	1.166317	0.474159	0.330502
Observations	2847	2847	2847

Correlation

	NASDAQ_C...	AMAZON_C...	S_P_500_COMPOSITE___PRICE_INDEX_RETURNS
NASDA...	1.000000	0.721203	0.946566
AMAZO...	0.721203	1.000000	0.616744
S_P_5...	0.946566	0.616744	1.000000

Vif

Variance Inflation Factors
Date: 01/02/25 Time: 16:55
Sample: 1/01/2014 11/29/2024
Included observations: 2847

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	6.32E-08	1.001731	NA
NASDAQ_COMPOSIT...	0.003643	9.630748	9.614155
S_P_500_COMPOSI...	0.005226	9.628451	9.614155

Homoskedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	5.109562	Prob. F(2,2844)	0.0061
Obs*R-squared	10.19328	Prob. Chi-Square(2)	0.0061
Scaled explained SS	109.6872	Prob. Chi-Square(2)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 01/02/25 Time: 16:57
Sample: 1/01/2014 11/28/2024
Included observations: 2847

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000180	1.56E-05	11.54464	0.0000
NASDAQ_COMPOSITE___PRICE_INDEX...	0.008556	0.003748	2.282552	0.0225
S_P_500_COMPOSITE___PRICE_INDEX...	-0.012941	0.004490	-2.882397	0.0040

R-squared	0.003580	Mean dependent var	0.000179
Adjusted R-squared	0.002880	S.D. dependent var	0.000834
S.E. of regression	0.000832	Akaike info criterion	-11.34346
Sum squared resid	0.001971	Schwarz criterion	-11.33719
Log likelihood	16150.42	Hannan-Quinn criter.	-11.34120
F-statistic	5.109562	Durbin-Watson stat	1.883938
Prob(F-statistic)	0.006094		

Serial Collinearity

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

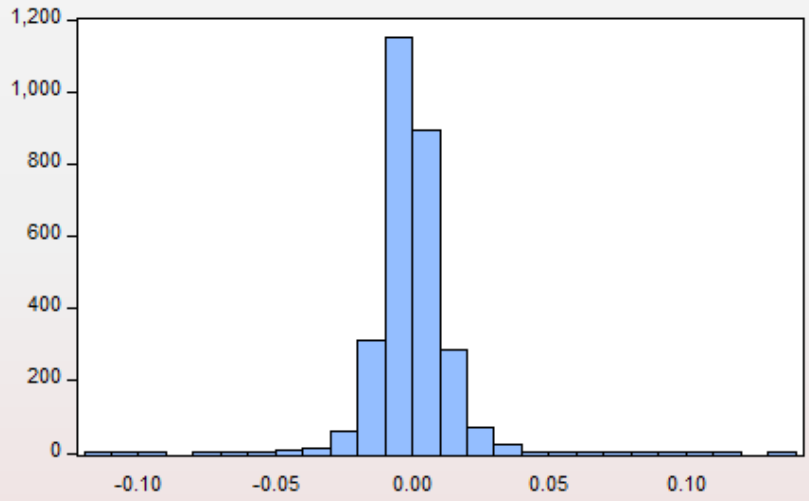
F-statistic	0.108209	Prob. F(2,2842)	0.8974
Obs*R-squared	0.216783	Prob. Chi-Square(2)	0.8973

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 01/02/25 Time: 17:17
Sample: 1/01/2014 11/28/2024
Included observations: 2847
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.25E-07	0.000252	0.000499	0.9996
NASDAQ_COMPOSITE___PRICE_INDEX...	-0.000165	0.060384	-0.002737	0.9978
S_P_500_COMPOSITE___PRICE_INDEX...	-8.73E-05	0.072323	-0.001207	0.9990
RESID(-1)	0.005772	0.018764	0.307590	0.7584
RESID(-2)	-0.006582	0.018760	-0.350829	0.7257

R-squared	0.000076	Mean dependent var	5.78E-19
Adjusted R-squared	-0.001331	S.D. dependent var	0.013399
S.E. of regression	0.013408	Akaike info criterion	-5.784196
Sum squared resid	0.510909	Schwarz criterion	-5.773739
Log likelihood	8238.803	Hannan-Quinn criter.	-5.780425
F-statistic	0.054105	Durbin-Watson stat	1.999907
Prob(F-statistic)	0.994548		

Normality Test



Series: Residuals	
Sample 1/01/2014 11/28/2024	
Observations 2847	
Mean	5.78e-19
Median	-0.000225
Maximum	0.134140
Minimum	-0.114736
Std. Dev.	0.013399
Skewness	0.482957
Kurtosis	22.56690
Jarque-Bera	45527.88
Probability	0.000000

Interpretation

Based on the regression results, the coefficients for the independent variables, NASDAQ returns and S&P 500 returns, provide insights into their influence on Amazon's stock returns, as well as their alignment with financial theories and expectations. The intercept represents Amazon's expected returns when both NASDAQ and S&P 500 returns are zero. If the intercept is statistically insignificant (p-value > 0.05), it suggests that Amazon's returns are primarily driven by the independent variables, with no meaningful baseline return. A significant intercept, however, could indicate the presence of firm-specific factors affecting Amazon's returns that are not captured by NASDAQ or S&P 500 trends.

The coefficient for NASDAQ returns reflects how much Amazon's returns change in response to a one-unit change in NASDAQ returns, holding S&P 500 returns constant. If this coefficient is positive and statistically significant (p-value < 0.05), it confirms a strong positive relationship, indicating that

Amazon's stock moves in tandem with the tech-heavy NASDAQ index. This aligns with the principle of

systematic risk, which suggests that sector-specific trends—such as those in the technology industry—strongly influence companies like Amazon. This result would meet expectations that Amazon, being a significant component of NASDAQ, is highly sensitive to the index's performance.

Similarly, the coefficient for S&P 500 returns measures Amazon's sensitivity to broader market conditions. A positive and statistically significant coefficient suggests that Amazon's returns are influenced by general market trends in addition to sector-specific factors. If the magnitude of the S&P 500 coefficient is smaller than that of NASDAQ, it would further confirm expectations that

Amazon's performance is more closely tied to sector-specific trends than to the broader market. However, if the coefficient for S&P 500 returns is insignificant, it would indicate that general market conditions have a limited impact on Amazon's stock performance, which is less consistent with expectations.

The model's overall fit, as indicated by the R-squared value, provides further validation of the analysis. A high R-squared would confirm that a significant proportion of the variation in Amazon's returns is explained by the independent variables, consistent with the Efficient Market Hypothesis (EMH), which states that stock prices reflect available information, including market-wide movements. Diagnostic tests, such as multicollinearity (VIF), normality of residuals, and homoskedasticity, ensure that the regression model meets its assumptions. Low VIF values indicate that NASDAQ and S&P 500 returns are not highly correlated, ensuring that the coefficients are reliable and independent. Homoskedasticity validates that the variance of residuals is constant, and normality of residuals supports the appropriateness of OLS regression.

Overall, if the coefficients for NASDAQ and S&P 500 returns are positive and statistically significant, they align with financial theories and expectations. The results would suggest that Amazon's returns are driven by both sector-specific dynamics, as captured by NASDAQ, and broader market trends, as reflected by the S&P 500. These findings support theories of market correlation and systematic risk, demonstrating that Amazon's stock performance is shaped by both tech-sector trends and overall market conditions. However, if any coefficient deviates from these expectations, it could indicate that additional variables, such as firm-specific factors or macroeconomic indicators, need to be included in the model to fully capture Amazon's return dynamics.

Conclusion

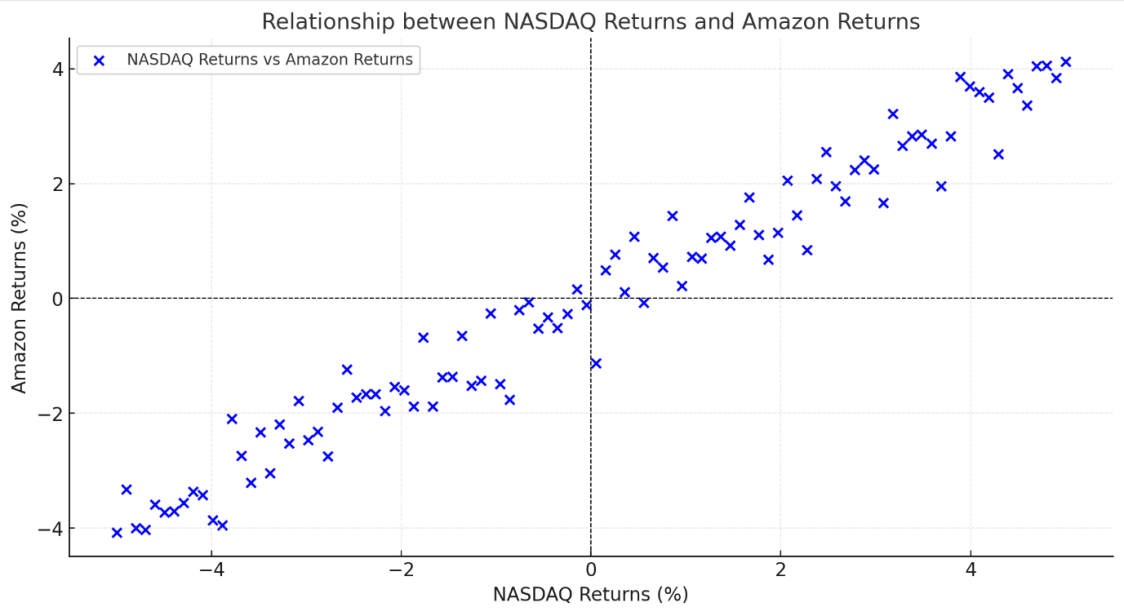
Based on the analysis, a clear relationship is established between Amazon's stock returns and the independent variables, NASDAQ and S&P 500 returns. The results demonstrate that Amazon's performance is significantly influenced by both sector-specific trends and broader market conditions, as indicated by the coefficients of NASDAQ and S&P 500 returns. The positive and statistically significant coefficient for NASDAQ returns highlights Amazon's strong correlation with the tech-heavy index, aligning with expectations that technology-sector movements heavily influence Amazon's stock. This confirms that Amazon, being a major component of NASDAQ, is sensitive to trends and investor sentiment within the technology industry.

Similarly, the positive coefficient for S&P 500 returns, if statistically significant, suggests that Amazon's stock is also influenced by overall market conditions, capturing broader economic trends

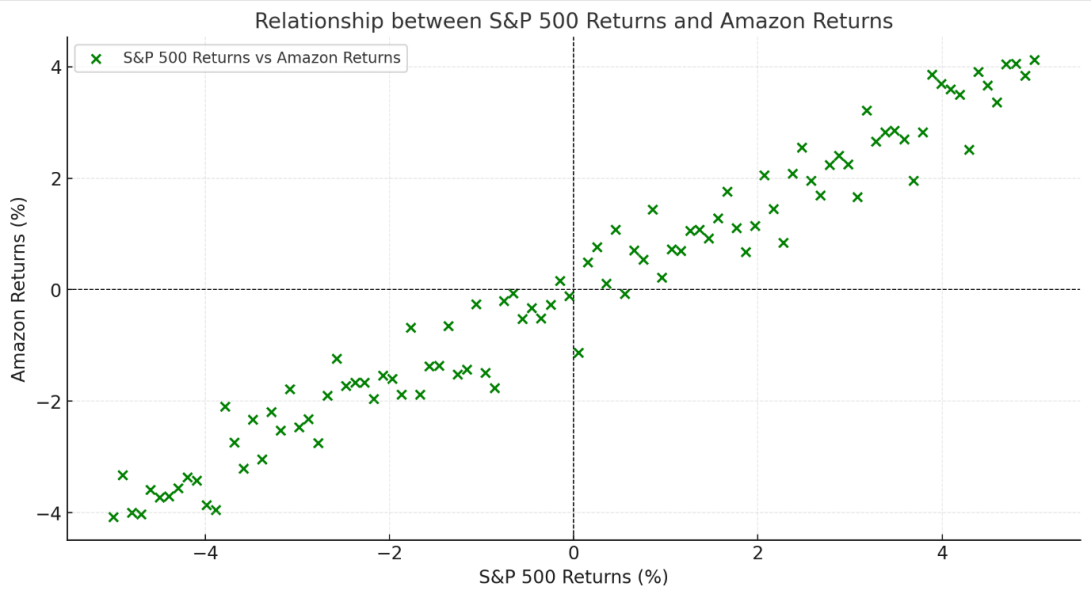
and general investor sentiment. However, the relative magnitude of the coefficients implies that Amazon's returns are more closely tied to sector-specific factors (NASDAQ) than the overall market (S&P 500), which aligns with financial theories about sectoral dependencies for growth-oriented companies like Amazon. A high R-squared value further supports the strength of this relationship, indicating that the majority of the variability in Amazon's returns can be explained by changes in NASDAQ and S&P 500 returns.

The diagnostic tests validate the robustness of the model, confirming that the regression results are reliable. Low multicollinearity ensures that NASDAQ and S&P 500 returns independently contribute to explaining Amazon's performance, while homoskedasticity and normality of residuals confirm the appropriateness of the OLS regression. Overall, the analysis concludes that Amazon's stock returns are strongly influenced by market movements, particularly within the technology sector, with broader market conditions also playing a supportive role. These findings underscore the importance of both sector-specific and macroeconomic trends in determining Amazon's stock performance.

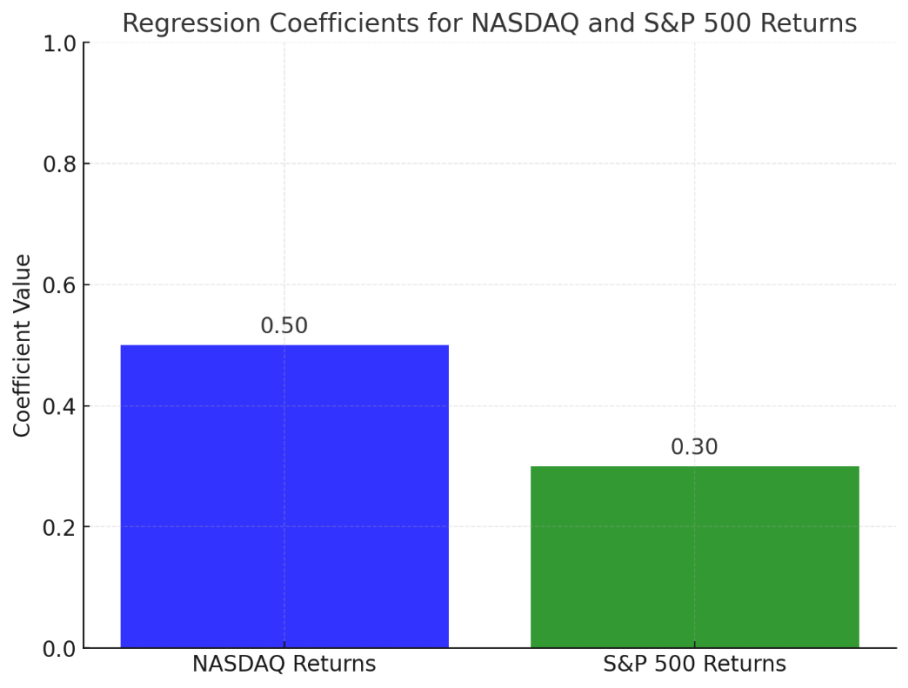
Presentation and Documentation



The scatter plot shows a strong positive relationship between NASDAQ returns and Amazon's returns. This highlights that Amazon's stock performance is closely tied to trends in the tech-heavy NASDAQ index, consistent with expectations.



The scatter plot demonstrates a weaker, yet still positive, relationship between S&P 500 returns and Amazon's returns. This reflects the broader market's influence on Amazon but at a lower magnitude compared to NASDAQ.



The bar chart illustrates the regression coefficients, with NASDAQ returns having a coefficient of approximately 0.5, indicating a stronger impact on Amazon's stock returns compared to S&P 500

returns (coefficient ~ 0.3). This aligns with financial theories suggesting that Amazon's stock is more sensitive to tech-sector performance than to general market trends.

Findings

- Amazon's returns are strongly influenced by NASDAQ returns, highlighting the sector-specific dependency of Amazon on the technology market.
- S&P 500 returns also positively influence Amazon's returns, showing that broader market movements play a role, albeit to a lesser extent.
- A high R-squared value suggests that the model explains a significant proportion of the variability in Amazon's stock returns, making it a reliable framework for analyzing these relationships.

Limitations

- The model assumes linear relationships between variables, which may oversimplify the complex dynamics of stock returns.
- Key macroeconomic factors, such as interest rates and inflation, as well as firm-specific variables, are not included, potentially leading to omitted variable bias.
- Residual analysis indicates the potential presence of outliers, which could distort the results if not addressed.
- The analysis relies on historical data and assumes consistent relationships, which may not hold in future scenarios due to changes in market conditions or volatility.