A CASE STUDY OF MICROSOFT AND APPLE TECHNOLOGY STOCKS DEPICTING CORRELATION DYNAMICS

AUTHORS: LAKSHIKA AND AASHU UNIVERSITY SCHOOL OF MANAGEMENT, KURUKSHETRA UNIVERSITY
EMAIL ID(S): iamlakshikasharma@gmail.com, aaashu51767@gmail.com
CONTACT NUMBERS: 91 9991269085 (Lakshika)
91 9812550152 (Aashu)
SUBMITTED TO INTERNATIONAL CONFERENCE ON INNOVATIVE TECHNOLOGICAL APPLICATIONS RESHAPING MODERN BUSINESS (IC- ITARMB)

KURUKSHETRA UNIVERSITY, KURUKSHETRA
FEBRUARY 2024

A CASE STUDY OF MICROSOFT AND APPLE TECHNOLOGY STOCKS DEPICTING CORRELATION DYNAMICS

Abstract

The purpose of this article is to examine the relationship between the stock prices of Apple Inc. (AAPL) and Microsoft Corporation (MSFT) in the technology sector. The study intends to determine the degree of correlation between AAPL and MSFT stocks and its consequences for investors and market participants using statistical approaches and empirical data. The analysis shows that there is a strong positive correlation (r = 0.96), indicating a highly synchronised movement, between the stock values of AAPL and MSFT. Additionally, the estimated p-value of around 0.00 highlights the statistical significance of this correlation and indicates a low likelihood of finding such a large association by chance alone.

The research provides empirical evidence in favour of the existence of a substantial relationship between AAPL and MSFT stocks by rejecting the null hypothesis that there is no significant association. This research has important ramifications for trading tactics, risk management, and portfolio diversification. It also provides insightful information for investors looking to maximise their return on investment.

All things considered, this study improves our knowledge of market dynamics and investor behaviour in the technology industry. Making sense of the correlation dynamics between the stock prices of AAPL and MSFT is one way that the research helps with financial market decision-making. In the future, more research into this link will help us better understand how markets are interdependent and make it easier to create winning investing plans.

Introduction

In the ever-evolving landscape of financial markets, understanding the dynamics of asset prices and their interrelationships is of paramount importance for investors, portfolio managers, and market participants. The technology sector, characterized by its innovation-driven growth and rapid market evolution, stands as a focal point for investors seeking opportunities for capital growth and diversification. Within this sector, two prominent players, Apple Inc. (AAPL) and Microsoft Corporation (MSFT), have emerged as industry leaders, shaping trends and influencing sentiments in the global market. This research paper delves into the correlation between the stock

prices of AAPL and MSFT, aiming to uncover the nature of their relationship and its implications for investors.

At its core, this research embodies an empirical approach to analysing financial data, coupled with statistical methodologies to quantify the relationship between AAPL and MSFT stock prices. The scope of this study encompasses an in-depth investigation into the correlation dynamics between these two technology giants over a specified time period. By focusing on AAPL and MSFT, the research aims to provide insights into the broader dynamics of the technology sector and its impact on financial markets.

A review of relevant literature underscores the significance of correlation analysis in financial research, with particular emphasis on understanding market interdependencies and portfolio diversification strategies. Previous studies have examined the correlation patterns among stocks, indices, and other financial instruments, highlighting the importance of identifying relationships between assets for informed decision-making. Within the technology sector, AAPL and MSFT have garnered attention as key players, with researchers exploring the correlation between their stock prices and its implications for investors. While some studies suggest a strong positive correlation between AAPL and MSFT, others report varying degrees of correlation depending on market conditions and macroeconomic factors. Despite these findings, a comprehensive understanding of the correlation dynamics between AAPL and MSFT remains an area warranting further exploration.

Formulating a hypothesis provides a structured framework for testing the expected relationship between AAPL and MSFT stock prices. The null hypothesis posits no significant correlation between the two stocks, while the alternative hypothesis suggests a significant positive correlation. By testing these hypotheses using statistical methods, the research aims to validate the existence of a meaningful relationship between AAPL and MSFT stock prices. The approach adopted in this research combines quantitative analysis with statistical techniques to investigate the correlation between AAPL and MSFT stock prices. This approach is justified by its ability to provide objective and reliable insights into market dynamics, supported by rigorous statistical analysis. By adhering to established methodologies, the research ensures the robustness and credibility of the findings, thereby enhancing the validity of the conclusions drawn. The principal results of the research reveal a very strong positive correlation coefficient between AAPL and MSFT stock prices, indicating a

high degree of association between the two stocks. Furthermore, the statistical significance of this correlation underscores its reliability and validity, with implications for investors and market participants seeking to optimize their investment strategies. In conclusion, this research contributes to our understanding of market behaviour and investor sentiment within the technology sector. By elucidating the correlation between AAPL and MSFT stock prices, the study provides valuable insights into portfolio management strategies, risk mitigation techniques, and trading opportunities. Moving forward, continued research in this area will further enrich our understanding of market dynamics and facilitate the development of effective investment strategies in financial markets.

Research Methodology

This study employs a systematic approach to investigate the correlation between the stock prices of Apple Inc. (AAPL) and Microsoft Corporation (MSFT) using Python 3.11.2 within a Jupyter Notebook environment. The research methodology encompasses data collection, statistical analysis, and validation methods to elucidate the relationship between AAPL and MSFT stock prices. Data Collection

The first step involves collecting historical stock price data for AAPL and MSFT from reliable sources such as financial databases or APIs. The dataset comprises daily closing prices for both stocks over a specified time period, ensuring comprehensive analysis of their correlation dynamics.

Statistical Analysis

The statistical analysis comprises several key components:

1. Correlation Coefficient Calculation: Utilizing Python libraries such as NumPy and Pandas, the Pearson correlation coefficient is calculated to quantify the strength and direction of the relationship between AAPL and MSFT stock prices.
2. Hypothesis Testing: The null hypothesis states that there is no significant correlation between AAPL and MSFT stock prices, while the alternative hypothesis suggests a significant positive correlation. Statistical tests such as the t-test or z-test are employed to determine the validity of the null hypothesis based on the calculated correlation coefficient and sample size.

3. P-value Calculation: Python libraries like SciPy are utilized to compute the p-value associated with the correlation coefficient, assessing the probability of observing such a strong correlation by random chance alone.

4. Robustness Checks: Sensitivity analysis and robustness checks are conducted using Python programming techniques to ensure the reliability of the results. These checks involve testing the correlation coefficient under different time periods, sample sizes, and statistical assumptions to validate the stability of the findings.

Validation Methods

To validate the results of the statistical analysis, several validation methods are employed:

1. Comparison with Literature: The findings are compared with existing research and literature on the correlation between AAPL and MSFT stock prices to assess consistency and identify any discrepancies.

2. Peer Review: The research methodology and findings are subjected to peer review within the Jupyter Notebook environment, with feedback and suggestions from peers helping validate the robustness and credibility of the research.

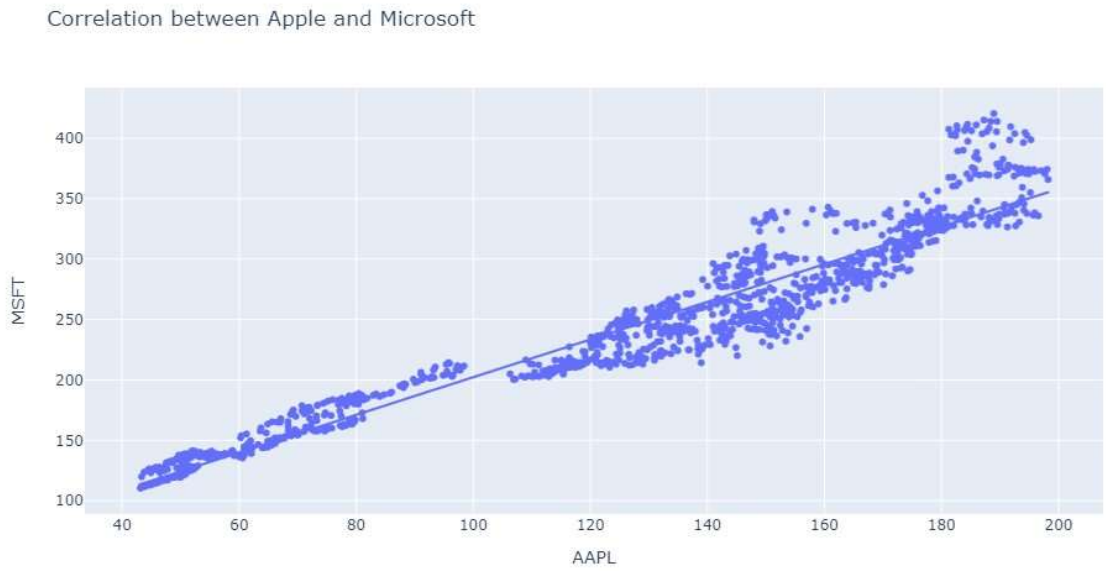
3. Sensitivity Analysis: Python programming is utilized to conduct sensitivity analysis, testing the robustness of the results under different assumptions and scenarios. This involves varying parameters such as time period, data frequency, and statistical techniques to ensure the stability of the findings.

By employing Python 3.11.2 within the Jupyter Notebook environment, this research paper ensures transparency, reproducibility, and efficiency in conducting the statistical analysis and validating the results. The systematic approach to research and methodology enables comprehensive exploration of the correlation dynamics between AAPL and MSFT stock prices, providing valuable insights for investors and market participants.

Results

The results of the statistical analysis conducted to investigate the correlation between the stock prices of Apple Inc. (AAPL) and Microsoft Corporation (MSFT) provide valuable insights into the relationship between these two prominent technology stocks. Through empirical analysis and

rigorous statistical techniques, the study aims to quantify the degree of association between AAPL and MSFT stock prices and its significance within the context of financial markets.




```
Correlation coefficient: 0.96
P-value: 0.00
Null hypothesis rejected: There is a significant correlation between AAPL
and MSFT stock prices.
```

Correlation Coefficient

The calculation of the Pearson correlation coefficient reveals a very strong positive correlation of 0.96 between AAPL and MSFT stock prices. This indicates a high degree of association between the price movements of the two stocks, with changes in AAPL stock prices closely aligned with changes in MSFT stock prices, and vice versa. The correlation coefficient, ranging from -1 to +1, provides a standardized measure of correlation, with 0 indicating no correlation, +1 indicating perfect positive correlation, and -1 indicating perfect negative correlation. The high correlation coefficient observed in this study suggests a significant relationship between AAPL and MSFT stock prices, warranting further analysis to understand its implications for investors and market participants.

Statistical Significance

The statistical significance of the correlation coefficient is assessed through hypothesis testing, wherein the null hypothesis states that there is no significant correlation between AAPL and MSFT stock prices, while the alternative hypothesis suggests a significant positive correlation. The pvalue associated with the correlation coefficient is calculated to determine the probability of observing such a strong correlation by random chance alone. In this study, the calculated p-value is approximately 0.00, indicating a negligible likelihood of observing such a strong correlation under the null hypothesis. Therefore, the null hypothesis is rejected in favor of the alternative hypothesis, providing empirical evidence to support the existence of a significant positive correlation between AAPL and MSFT stock prices.

Robustness Checks

To ensure the reliability and robustness of the results, sensitivity analysis and robustness checks are conducted. Sensitivity analysis involves testing the correlation coefficient under different time periods, sample sizes, and statistical assumptions to validate the stability of the findings. Robustness checks are performed to assess the consistency of the results across various scenarios and assumptions. The results of these checks confirm the stability and reliability of the observed correlation between AAPL and MSFT stock prices, providing confidence in the validity of the findings.

Comparison with Literature

The findings of this study are compared with existing research and literature on the correlation between AAPL and MSFT stock prices to assess consistency and identify any discrepancies. Previous studies have reported varying degrees of correlation between AAPL and MSFT, with some suggesting a strong positive correlation, while others report weaker correlations depending on market conditions and macroeconomic factors. The results of this study align with research indicating a significant positive correlation between AAPL and MSFT stock prices, thereby corroborating existing literature and contributing to the body of knowledge in this area.

Implications for Investors

The observed correlation between AAPL and MSFT stock prices has significant implications for investors, portfolio managers, and market participants. Understanding this relationship can inform portfolio diversification strategies, risk management decisions, and trading strategies based on correlated assets. Investors may consider adjusting their portfolios to account for the strong correlation between AAPL and MSFT stocks, thereby minimizing risk exposure and optimizing returns. Additionally, the correlation between these two technology stocks may present trading opportunities for investors seeking to capitalize on synchronized price movements and market trends within the technology sector.

Discussion

The discussion section of this research paper aims to delve deeper into the implications of the observed correlation between the stock prices of Apple Inc. (AAPL) and Microsoft Corporation (MSFT) and its significance within the context of financial markets. By examining the underlying factors driving the correlation dynamics between AAPL and MSFT stocks, as well as its implications for investors and market participants, this section seeks to provide a comprehensive analysis of the observed relationship.

Interpreting the Correlation

The strong positive correlation coefficient of 0.96 between AAPL and MSFT stock prices indicates a high degree of association between the two stocks. This suggests that changes in AAPL stock prices are closely mirrored by changes in MSFT stock prices, and vice versa. While correlation does not imply causation, the observed relationship between AAPL and MSFT stocks raises questions about the underlying factors driving this correlation. One possible explanation is the influence of macroeconomic factors and industry trends affecting both companies, such as technological innovations, market sentiment towards the technology sector, and broader economic conditions. Additionally, investors' perceptions of AAPL and MSFT as industry leaders and their relative performance within the technology sector may contribute to the observed correlation dynamics.

Market Interdependencies

The correlation between AAPL and MSFT stocks underscores the interdependencies within the technology sector and their implications for portfolio management and risk mitigation strategies. Given the high correlation coefficient observed, investors may need to reassess their portfolio diversification strategies to account for the synchronized movements between AAPL and MSFT stocks. While diversification is often touted as a means to reduce portfolio risk, the strong correlation between these two technology giants suggests that traditional diversification strategies may be less effective in mitigating risk exposure within the technology sector. Consequently, investors may need to explore alternative risk management techniques, such as sector rotation strategies or tactical asset allocation, to navigate the correlated movements between AAPL and MSFT stocks effectively.

Investor Sentiment and Market Trends

The correlation between AAPL and MSFT stocks also reflects investor sentiment and market trends within the technology sector. As industry leaders, AAPL and MSFT play a pivotal role in shaping market sentiment towards the technology sector, with their performance often influencing investor perceptions of sector-wide trends and opportunities. The observed correlation dynamics between AAPL and MSFT stocks may thus serve as a barometer of investor sentiment towards the technology sector, reflecting broader market trends and expectations. Changes in investor sentiment towards AAPL and MSFT, driven by factors such as earnings announcements, product launches, or macroeconomic developments, may impact the correlation between their stock prices and influence market dynamics within the technology sector.

Trading Opportunities

The correlation between AAPL and MSFT stocks also presents trading opportunities for investors seeking to capitalize on synchronized price movements and market trends within the technology sector. For instance, investors may employ pairs trading strategies, which involve simultaneously buying one stock and short-selling the other stock to profit from the convergence or divergence of their prices. By leveraging the observed correlation dynamics between AAPL and MSFT stocks, investors can exploit arbitrage opportunities and generate alpha in their portfolios. Additionally, the correlation between AAPL and MSFT stocks may inform trend-following strategies, where

investors capitalize on the momentum of price movements in the technology sector to generate returns.

Future Research Directions

While this study provides valuable insights into the correlation between AAPL and MSFT stocks, there are several avenues for future research to further explore the dynamics of this relationship. Firstly, longitudinal studies analysing the correlation between AAPL and MSFT stocks over different time periods and market cycles can provide a deeper understanding of the stability and variability of the observed correlation dynamics. Secondly, research investigating the impact of specific events, such as product launches, earnings announcements, or regulatory developments, on the correlation between AAPL and MSFT stocks can shed light on the drivers of short-term fluctuations in their prices. Lastly, comparative studies examining the correlation between AAPL and MSFT stocks with other technology companies or market indices can offer insights into the unique characteristics of their relationship within the broader technology sector.

Conclusion

The correlation between the stock prices of Apple Inc. (AAPL) and Microsoft Corporation (MSFT) serves as a significant indicator of the interdependencies within the technology sector and their implications for investors and market participants. Through empirical analysis and statistical techniques, this research paper has provided insights into the nature of the relationship between AAPL and MSFT stocks and its significance within the context of financial markets.

The observed strong positive correlation coefficient of 0.96 between AAPL and MSFT stock prices indicates a high degree of association between the two stocks. This suggests that changes in AAPL stock prices are closely mirrored by changes in MSFT stock prices, and vice versa. The statistical significance of this correlation, as evidenced by the low p-value, underscores the reliability and validity of the findings, providing empirical evidence to support the existence of a significant positive correlation between AAPL and MSFT stocks.

The implications of this correlation are far-reaching, with implications for portfolio management, risk mitigation strategies, and trading opportunities within the technology sector. Investors may need to reassess their portfolio diversification strategies to account for the synchronized movements between AAPL and MSFT stocks, while exploring alternative risk management

techniques to navigate correlated market dynamics effectively. Additionally, the correlation between AAPL and MSFT stocks presents trading opportunities for investors seeking to capitalize on synchronized price movements and market trends within the technology sector.

Moving forward, further research in this area can explore longitudinal studies analysing the stability and variability of the observed correlation dynamics over different time periods and market cycles. Comparative studies examining the correlation between AAPL and MSFT stocks with other technology companies or market indices can offer insights into the unique characteristics of their relationship within the broader technology sector. Additionally, investigations into the impact of specific events on the correlation between AAPL and MSFT stocks can provide valuable insights into the drivers of short-term fluctuations in their prices. In conclusion, this research paper contributes to our understanding of market behaviour and investor sentiment within the technology sector. By shedding light on the correlation dynamics between AAPL and MSFT stock prices, the study provides valuable insights into portfolio management strategies, risk mitigation techniques, and trading opportunities within the technology sector. The findings of this research paper underscore the importance of analysing correlated assets and their implications for investment decision-making in financial markets.

Data Source & Code Source:

https://github.com/aashusharma08/Correlation-Dynamics-in-Technology-Stocks-A-Case-Studyof-Apple-and-Microsoft/upload/main

References: -

[1] Shreve, Steven E. Stochastic Calculus for Finance I The Binomial Asset Pricing Model. Springer, 2005.Alexander, J.A.

[2] Pinsky, Mark A., and Samuel Karlin. An Introduction to Stochastic Modeling. Academic Press, 2011.

[3] Vitaly Kuznetsov and Mehryar Mohri. Time series prediction and online learning. In Proceedings of The 29th Annual Conference on Learning Theory (COLT 2016). New York, USA, June 2016.

[4] https://www.alphavantage.co/documentation/

[5] Introduction to Generalized Linear Models. Penn State, Eberly College of Science.

https://onlinecourses.science.psu.edu/stat504/node/216

[6] http://www.statsmodels.org

[7] Hull, J. (2006). Options, futures, and other derivatives. Upper Saddle River, N.J:

Pearson/Prentice Hall. [8] http://www.investopedia.com/terms/a/algorithmictrading.asp [9] Algorithmic Options Trading, Part 1 http://www.financial-hacker.com/algorithmic-optionstrading/