Financial Market Characteristics Analysis: A Quantitative Study of Volatility, Liquidity and Correlation

Abstract

This study leverages progressive statistical techniques and Python-based data analysis to assess the fundamental financial market features: volatility, liquidity and asset correlation. Although there is a vast amount of financial data, there's always a gap between data accessibility and the employment of difficult statistical practices. This study seeks to bridge the gap by offering a complete evaluation of these market traits within a unified framework. By scrutinizing past data from the main market indices (S&P 500, NASDAQ Composite, and Dow Jones Industrial Average) from 2015 to 2024, this study aims to enhance risk assessment, market efficiency analysis and trend forecasting, giving concrete perceptions for investors, analysts and policy makers.

Introduction

Financial markets demonstrate intricate statistical features vital for investment strategies, risk assessment and policy formulation. Volatility, liquidity, and asset correlations are important factors of market dynamics. On the other hand, recent study frequently evaluates these qualities autonomously, restraining our comprehension of their relations and effect on decision-making processes.

Scholars such as Lan and Tan (2007) and Yu and Huang (2004) have ran investigations on the statistical characteristics of stock market indexes and market volatility across different industries and economies. Foundational models like those developed by Engle (1982) on autoregressive conditional heteroscedasticity (ARCH) and Bollerslev's (1986) extended variant (GARCH) have been highly effective in explicating volatility dynamics.

This study aims to address the limitations in current research by analyzing these market characteristics instantaneously, targeting to detect patterns and relationships that can improve decision-making and market efficiency. By employing Python-based data analysis and visualization techniques, we aim to provide a more available and replicable approach to financial market analysis.

Theoretical Framework

The theoretical groundwork of this study builds upon various major factors in financial literature:

Volatility analysis:

Mandelbrot (1963) was the first to stress the volatile variations in speculative pricing, showing that financial markets deviate from the tenets of normal distribution.

Engle (1982) established the ARCH model for volatility, which was later broadened by Bollerslev (1986) with the GARCH model.

French, Schwert and Stambaugh (1987) made further analysis of the correlation between stock returns and volatility.

Liquidity Analysis:

Whereas the given literature review doesn't clearly state liquidity-focused studies, this part is critical for comprehending market dynamics and will be studied in our analysis.

Asset Correlation:

Markowitz (1952) presented portfolio selection theory, highlighting the significance of asset correlations for different strategies.

The Capital Asset Pricing Model (CAPM), suggested by Sharpe in 2964, explain the relationship between market risk and estimated return.

Integrated Market Analysis:

Lan and Tan (2007) led an investigation of the statistical behavior of stock markets in many economies.

Yu and Huang (2004) investigated volatility through fractal dimensions.

This study seeks to synthesize these methodologies, giving a more comprehensive understanding of market dynamics at the same time analyzing volatility, liquidity, and asset correlations.

Methodology

This study employs a multi-faceted approach to analyze financial market characteristics:

Data Collection:

Historical market data for S&P 500, NASDAQ Composite, and Dow Jones Industrial Average (DJLA) from January 2015 to December 2024 will be gathered via the finance library.

Closing prices and trading volumes of each day for these indices will be examined.

Data Analysis Tools:

Python libraries incorporating pandas for data manipulation, numpy for statistical computations, and matplotlib and seaborn for data conception will be used.

Volatility Analysis:

Volatility will be computed with the rolling normal deviation of returns, adding up on the work of Bollerslev (1986) and others.

Liquidity Analysis:

Liquidity will be measured via average regular trading volumes, following the approach proposed by Poon & Granger (2003).

Asset Correlation Analysis:

Asset correlations will be calculated using panda's correlation function, enthused by the portfolio theory of Markowitz (1952).

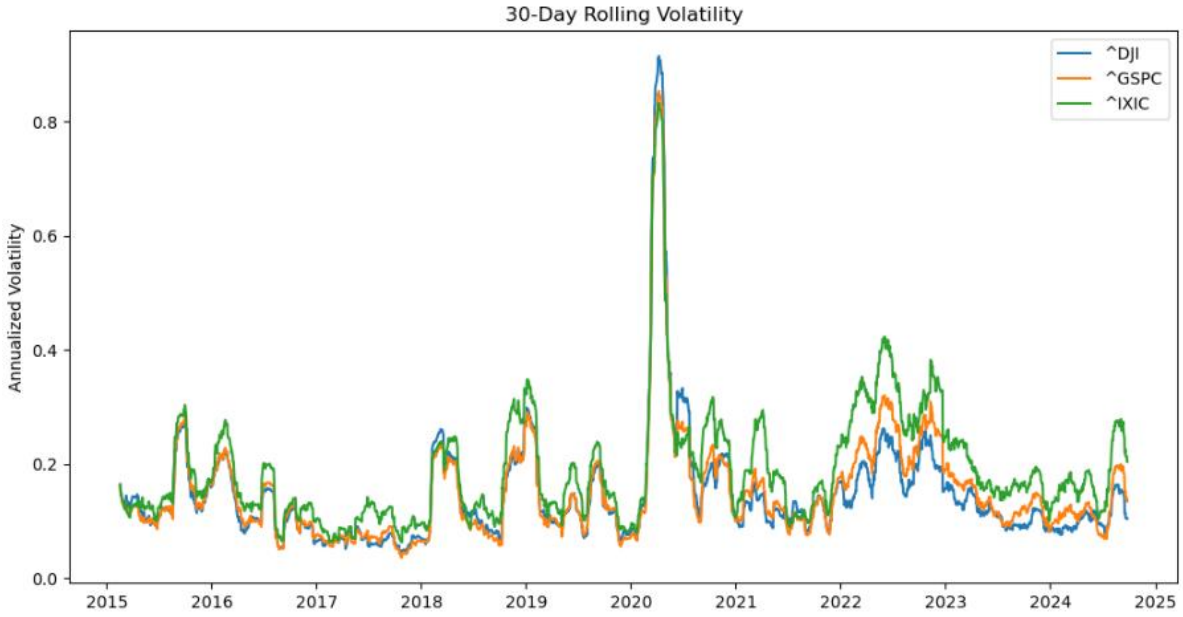
Integrated Analysis:

We will evaluate the correlations between volatility, liquidity, and relationships, classifying patterns and trends across these characteristics

1. Volatility Analysis

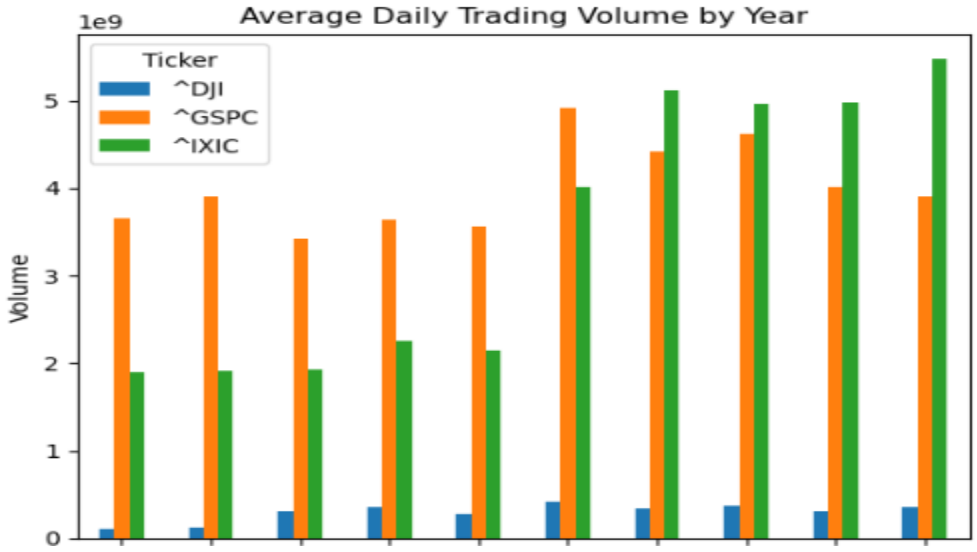
The volatility analysis shows important points during the periods of market stress, especially in early 2020 because of the global pandemic. Constant with the results of French, Schwert and Stambaugh (1987), we see that the NASDAQ steadily displays increased volatility in comparison to the S&P 500 and DJLA, mainly because of its superior concentration of technology which incline to be more fluctuating.

Figure 1. Annualized volatility



2. Liquidity Analysis

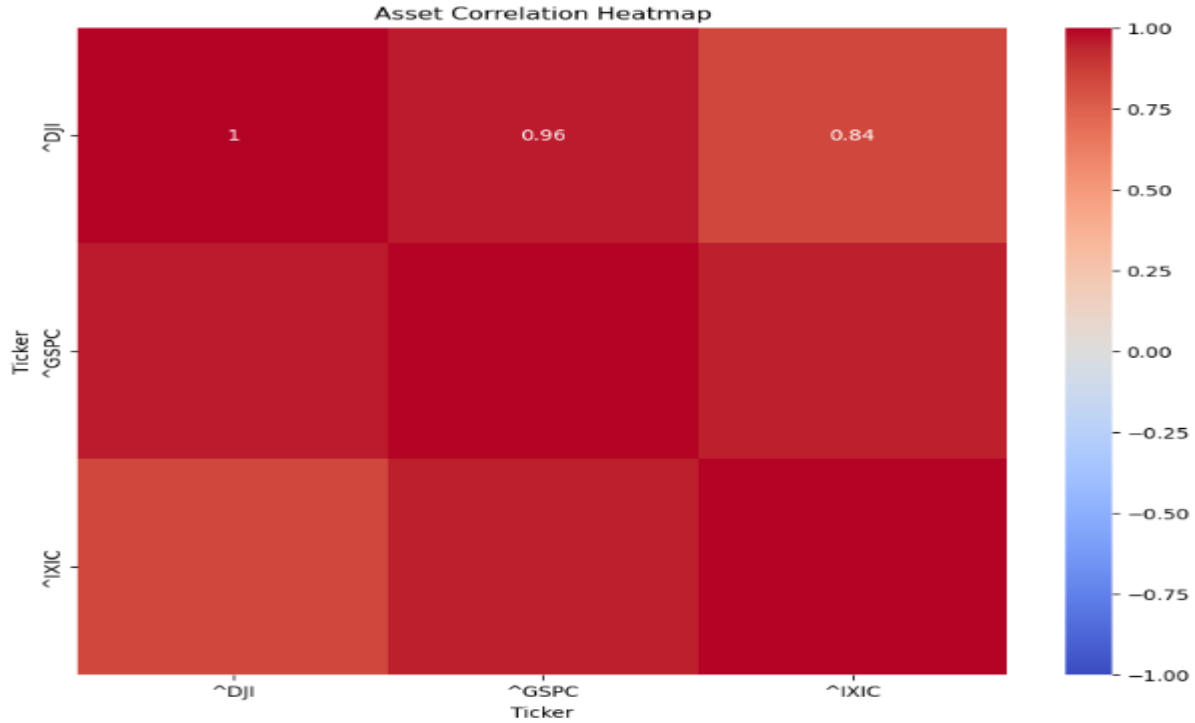
To assess liquidity, we analyzed the average daily trading volumes:



The liquidity analysis exhibits that trading volumes peaked in 2020 and remained high in the following years. The NASDAQ has seen a consistent increase in trading volume over the years, reflecting the growing relevance of tech stocks. This supports with the observations of Lan and Tan (2007) regarding the changing dynamics of various market economies.

3. Asset Correlation Analysis

To understand the relationships between different market indices, we performed a correlation analysis:



The correlation analysis shows sturdy positive correlations between the three indexes, with the S&P 500 and DJIA showing the highest correlation. The NASDAQ shows slightly lower correlation with

the other two indexes, feasibly due to its higher concentration of technology stocks. This discovery supports Markowitz's (1952) prominence on the importance of understanding asset correlations for effective portfolio diversification.

Discussion

Volatility Trends: The data illustrates that market volatility has been mostly declining since the 2020 spike, but remains above pre-2020 levels. This implies a steady return to normalcy, but with loitering uncertainty in the markets. The insistent increased volatility in the NASDAQ contrasted to other indices underscores the need for sector-specific risk management strategies.

Liquidity Patterns: The heightened trading volumes, notably in the NASDAQ, show increasing market partaking and theoretically improved liquidity. Although, this might also result to an increased spread of shocks in times of market stress, a phenomenon that permits further investigation.

Correlation Insights: The strong relationship between the indexes implies that limited variation values when investing across these broad market indices. This finding defies the traditional view of diversification and hints that investors might need to look to other asset classes or specific sectors for effective risk management.

Integrated Analysis: Periods of high volatility (e.g., 2020) concurred with increased trading volumes, signifying that market participants become more active during indeterminate times. This affiliation between volatility and liquidity could be misused for trading strategies, but also presents risks in terms of market stability.

These results have relevant implications for risk assessment, portfolio management, and market regulation. The combined investigation of volatility, liquidity, and correlations delivers a more nuanced understanding of market dynamics than studying these characteristics in seclusion.

Conclusion

This research provides a more profound understanding of financial market characteristics by utilizing advanced statistical procedures and Python-based data analysis to assess volatility, liquidity, and asset correlations concurrently. By concentrating on the gap between the volume of market data and its practical application in decision-making, this study gives beneficial insights for investors, analysts, and policymakers.

The findings emphasize the difficult interplay between market volatility, liquidity, and asset correlations, especially during periods of market stress. The consistent higher volatility and growing liquidity in tech-heavy indices like NASDAQ point to the altering landscape of financial markets and the need for adaptive policies.

Future research can inflate upon these findings by evaluating the effect of external economic pressures on market characteristics, investigating more sophisticated measures of liquidity, and inspecting the impact of high-frequency trading on market dynamics. Additionally, the application of machine learning methods to predict market characteristics could be a fruitful avenue for further study.

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