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Research Article

A Study On Equity Markets In The Top Five Global Economies

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1. Introduction

Investors operating in today's global financial markets require a comprehensive understanding of various factors such as risks, returns, historical trends, post-pandemic dynamics, and the interconnectedness among indices. This knowledge is necessary to construct an optimal portfolio comprising indices representing different countries. This study aims to analyze the equity markets of the world's top five economies, which include the United States, China, Japan, Germany, and India, by focusing on indexes that represent these markets. The study will uncover the risk-return characteristics, 10-year historical analysis, post-pandemic trends, and potential diversification benefits inherent in these markets. Furthermore, the study aims to create an optimal portfolio of indexes that represent these economies, giving investors insights into potential avenues for maximizing returns while managing risks.

2. Research Methodology

Objectives:

The objectives of the study are to:
1.Analyze and compare historical and post-pandemic trends in equity markets of the US, China, Japan, Germany, and India over the last decade.
2.Evaluate the level of interconnectedness between these markets post-pandemic.
3.Construct an optimum portfolio consisting of indices from these markets.

Research methodology:

This study will use a combination of quantitative and qualitative approaches to examine the equity markets of selected countries. The quantitative analysis will involve an in-depth study of ten years of historical data, with a focus on post-pandemic trends. We will analyze, trends, risks, and returns to identify patterns and variations in each market. A comparative analysis of long-term and short-term performance will highlight any significant shifts. In addition, we will use correlation analysis to evaluate the level of interconnectedness between the equity markets of these countries.

Source of Data:

The foundation for this study relies on trustworthy and dependable sources of data. To conduct a comprehensive analysis, we will collect historical market indices and price data from reputable financial databases like Yahoo Finance, investing.com, central bank publications, and academic journals, covering the last decade and the post-pandemic period. We will use the S&P 500 (US), CSI 300 (China), Nikkei 225 (Japan), DAX 40 (Germany), and NIFTY 50 (India) equity indices as proxies for their respective markets, providing a representative snapshot for analysis. The prices of the five selected indices are obtained from well-known sources such as Yahoo Finance and Investing.com. The data is then gathered in an Excel spreadsheet for further analysis. Any errors or inconsistencies are identified and corrected during the data cleaning process to ensure that the dataset is accurate. Also, the dates are synchronized across all indices to facilitate correlation and covariance analysis

Scope and Limitation:

The study will examine the historical performance of S&P 500, CSI 300, Nikkei 225, DAX 40, and NIFTY 50 for ten years to understand historical trends and the three years following the pandemic to understand short-term trends. The analysis will also include calculating risk, returns and the interconnectedness between these markets. The study aims to construct an optimal portfolio that will offer investors a strategic approach to capitalizing on each market's unique characteristics. By employing both quantitative and qualitative methods, this study will provide a nuanced understanding of market dynamics, contributing valuable insights for investors and policymakers.

3. Data Collection and Analysis:

3.1 Historical data collection and analysis:

The prices of the five selected indices are obtained from well-known sources such as Yahoo Finance and Investing.com. The data is then gathered in an Excel spreadsheet for further analysis. Any errors or inconsistencies are identified and corrected during the data cleaning process to ensure that the dataset is accurate. Also, the dates are synchronized across all indices to facilitate correlation and covariance analysis.
The following formulas were used:

1. To calculate the daily percentage change in stock prices, the following formula is utilized in Excel:

$$\text{Percentage Change}=\left(\frac{\text{Todays'sPrice-YesterdaysPrice}}{\text{Yesterday'sPrice}}\right)*100$$

2. The formula for calculating the risk, represented by the standard deviation of daily price changes

$$\text{Risk-STDEV.S (Historical Daily Changes)}*\sqrt{250}$$

3. The average returns of the indices are determined using the formula:

$$\textit{Average}\ \text{Returns}=\frac{\sum(\textit{Daily}\ \text{Price Change})}{\textit{Number}\ \text{of Years}}$$

4. The formula for CAGR in Excel is:

CAGR = Rate (Nper, Pmt – Price on Day 1, Price on last day)

3.1 Risks and returns of Market indices.

The following Table 1 below shows the risks and returns of the indices from 2014-2024.

Table 1: Risk and Returns of Indices from 2014-2024

Index	Nifty 50	S&P 500	Nikkei 225	Dax 40	CSI 300
Risk	16.22%	15.04%	16.25%	17.34%	21.75%
CAGR	13.82%	11.06%	10.12%	6.47%	4.12%
Avg Return	14.37%	11.68%	11.01%	7.80%	6.40%

Source: Data Analysis

Inference of table-1:

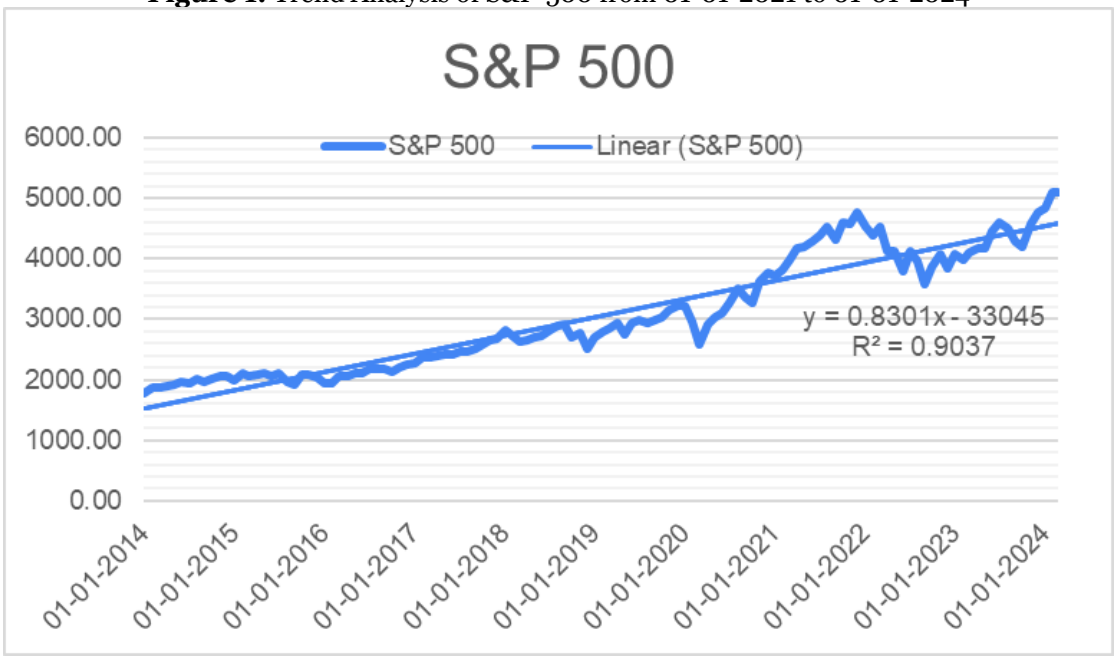
Between 2014 and 2024, the CSI 300 index was the most volatile among the considered indices with a risk percentage of 21.75%. Nifty 50 and S&P 500 had relatively lower risks, suggesting lower volatility in the Indian and U.S. equity markets. Nifty 50 had a robust compounded annual growth rate (CAGR) of 13.82%, while CSI 300 had the lowest CAGR at 4.12%. Nifty 50 also had the highest average return of 14.37%, while CSI 300 had the lowest at 6.40%. Overall, the Nifty 50 had favourable risk-adjusted returns compared to other indices, with lower risk and higher CAGR and average returns over the ten years. The CSI 300 and DAX 40 exhibited higher risk and lower returns, highlighting the varying performance of different global equity markets.

3.2 Trend Analysis:

a) S&P 500 (USA Equity Market Index)

The following Figure-2 shows the trend of S&P-500 index from 01-01-2014 to 01-01-2024:

Figure 1: Trend Analysis of S&P-500 from 01-01-2021 to 01-01-2024



Source: Data Analysis

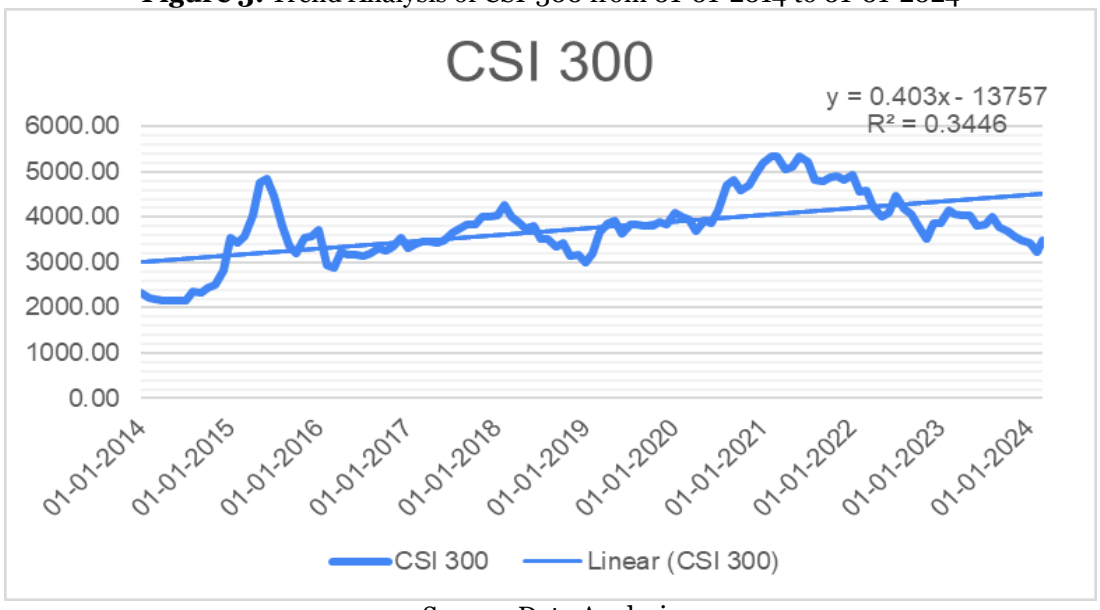
Long-term Trend Analysis of S&P 500:

The S&P 500 exhibited a positive and consistent upward trend over the past decade, as indicated by the equation $y=0.8301x-33045$. The overall positive slope suggests alignment with the general notion of a growing US economy during this period. The positive long-term trend in the US markets has been influenced by increased corporate profits, lower interest rates, investor confidence, economic recovery, and government stimulus measures. These factors have led to higher stock prices and increased buying activity. External factors such as trade disputes, geopolitical events, and the COVID-19 pandemic have caused periodic market volatility.

b) CSI-300 (Chinese Equity Market Index):

The following figure-3, shows the trend in CSI-300 from 01-01-2014 to 01-01-2024:

Figure 3: Trend Analysis of CSI-300 from 01-01-2014 to 01-01-2024



Source: Data Analysis

Long-term Trend Analysis in CSI 300:

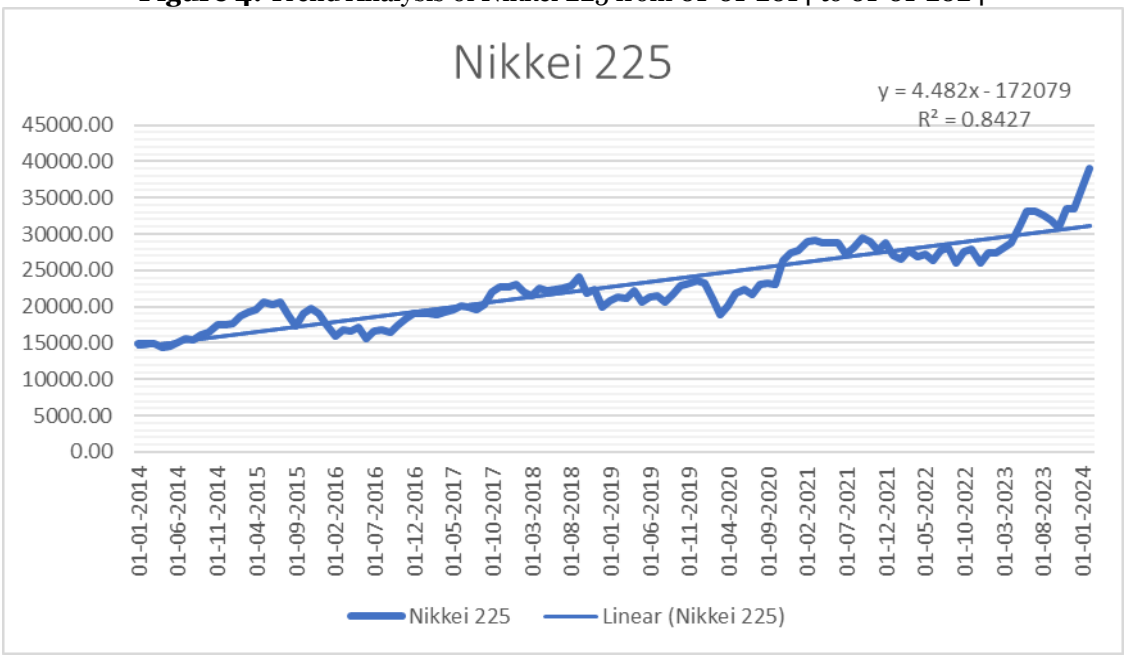
The CSI 300 index has experienced steady growth due to China's economic expansion, urbanization, infrastructure investments, and thriving middle class. The index's upward trend is closely linked to China's economic growth, consumption dynamics, and market reforms. Between 2014 and 2018, the CSI 300 surged due to China's urbanization, industrial development, and infrastructure investments. However, around 2018, the index faced volatility due to escalating trade tensions between China and the US. From 2020 onwards, the

CSI 300 index demonstrated partial recovery amidst the global COVID-19 pandemic, due to government stimulus measures. The continued volatility highlights the need for investors to navigate strategically.

c) Nikkei 225 (Japanese Equity Market Index):

The following figure-4 shows the trend in the Nikkei 225 index from 01-01-2014 to 01-01-2024:

Figure 4: Trend Analysis of Nikkei 225 from 01-01-2014 to 01-01-2024



Source: Data Analysis

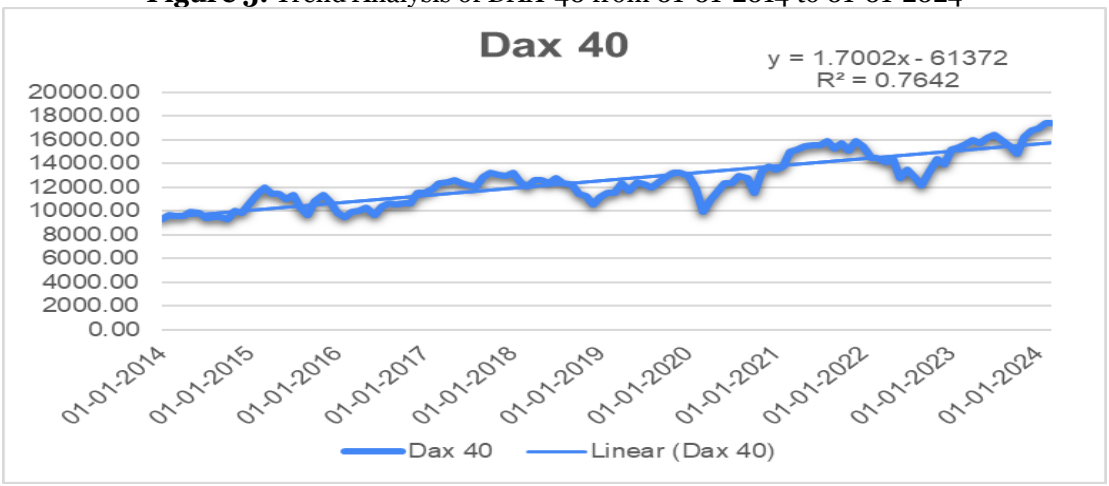
Nikkei 225 Long-Term Trend (2014-2024):

The equation y=4.482x-172079, with a positive slope, shows an upward trend, with an R- R-square of 0.8427 indicating constant growth. The Nikkei 225's trajectory from 2014 to 2024 shows a complex narrative characterized by alternating periods of growth and decline from 2014 to 2015, the Nikkei 225 surged due to Abenomics, former Prime Minister Shinzo Abe's economic policies, including aggressive monetary easing and fiscal stimulus. From 2015 to 2020, the market became volatile due to diminishing effects of Abenomics and global economic factors like US-China trade tensions, leading to stagnation and decline in the Nikkei 225. The recent downturn from 2021 to 2024 is due to the COVID-19 pandemic's global repercussions and geopolitical tensions. The Nikkei 225's fluctuations were caused by low interest rates, government incentive packages, a slow global economy, geopolitical tensions, and Japanese company performance. The future remains uncertain, and a robust global economic recovery, balanced monetary policies, fiscal measures, and competitiveness of Japanese companies will shape the market's course.

d) DAX-40 (German Equity Market Index):

The following figure-5, shows the trend in DAX-40 index from 2014-24:

Figure 5: Trend Analysis of DAX-40 from 01-01-2014 to 01-01-2024



Source: Data Analysis

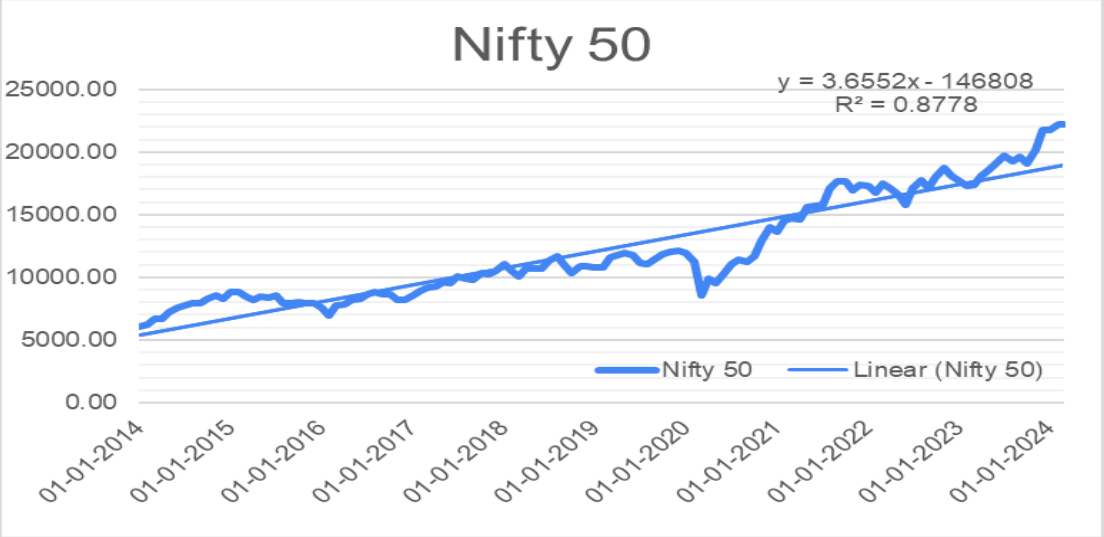
Long-term Trend Analysis of DAX-40:

There is an upward trend in the Dax 40 from 2014 to 2024. The equation y = 1.7002x - 61372, with an R-squared value of 0.7642, represents a strong positive correlation between time and price means that the price of the Dax 40 has generally increased over time. The DAX 40 has experienced significant volatility due to various events including geopolitical tensions (such as the Russia-Ukraine war), global trade tensions, the COVID-19 pandemic, and the Ever Grande crisis. Moreover, concerns over rising global inflation led to additional uncertainty in 2023, further impacting the DAX 40's performance. All these events demonstrate the intricate nature of volatility in German equity markets, shaping the behavior of the DAX 40 over time.

e) Nifty-50 (Indian Equity Market Index):

The following figure-6 shows the trend in NIFTY 50 from 2014 to 2024;

Figure 6: Trend Analysis of NIFTY-50 from 01-01-2014 to 01-01-2024



Source: Data Analysis

Long-term Trend in Nifty 50:

The Nifty 50 has demonstrated a substantial upward trend over the long term, spanning from 2014 to 2024, as evidenced by the equation y = 3.6552x - 146808 and an R-squared value of 0.8778, indicating a strong positive correlation between time and the Nifty 50's price.

India's sustained economic growth, favorable government reforms, and lower interest rates have contributed to the Nifty 50's upward trend. However, potential volatility arises from various factors, including global and domestic economic events, company-specific occurrences, and the RBI's monetary policy decisions.

Correlation among Indices:

The following table-2 shows the correlation among the indices:

Table 2: Matrix showing the correlation between Equity Indices.

Correlations among Markets					
Index	**S&P 500**	**CSI 300**	**Nikkei 225**	**DAX 40**	**NIFTY 50**
S&P 500	1	0.0496	0.1631	0.5181	0.2341
CSI 300	0.0496	1	0.2873	0.1062	0.2243
Nikkei 225	0.1631	0.2873	1	0.2230	0.3912
DAX 40	0.5181	0.1062	0.2230	1	0.4146
NIFTY 50	0.2341	0.2243	0.3912	0.4146	1

Source: Data Analysis

The S&P 500 has significant correlations with global indices. There is a moderate to strong positive correlation between the S&P 500 and DAX 40 and NIFTY 50, indicating interconnectedness between these markets. However, the weaker correlations with Nikkei 225 and CSI 300 suggest less direct influence from these indices.

CSI 300 has stronger correlations with Asian markets Nikkei 225 and NIFTY 50. Nikkei 225 shows stronger connections with other Asian markets, such as NIFTY 50 and CSI 300, but weaker correlations with S&P 500 and DAX 40. DAX 40 demonstrates significant connections with the US (S&P 500) and Indian (NIFTY 50)

markets, but weaker correlations with CSI 300 and Nikkei 225. NIFTY 50 displays moderate connections with the US (S&P 500) and European (DAX 40) markets and the Japanese (Nikkei 225) market. However, the weaker correlation with CSI 300 suggests a relatively limited influence from the Chinese market on NIFTY 50.

Covariance among Indices:

The following Table-3 shows the covariance among indices:

Table 3: Covariance among Indices

Covariance					
	S&P 500	CSI 300	Nikkei 225	DAX 40	NIFTY 50
S&P 500	0.00012	5.97E-06	2.002E-05	6.24E-05	2.29E-05
CSI 300	5.97E-06	0.00012	3.525E-05	1.28E-05	2.19E-05
Nikkei 225	2E-05	3.53E-05	0.0001252	2.74E-05	3.89E-05
DAX 40	6.24E-05	1.28E-05	2.739E-05	0.000121	4.05E-05
NIFTY 50	2.29E-05	2.19E-05	3.895E-05	4.05E-05	7.92E-05

Source: Data Analysis

The covariance matrix represents the pairwise covariance between the returns of selected market indices, including S&P 500, CSI 300, Nikkei 225, DAX 40, and NIFTY 50. Covariance is a measure of how two variables move together, and in the context of financial markets, it indicates the degree to which the returns of two indices are related.

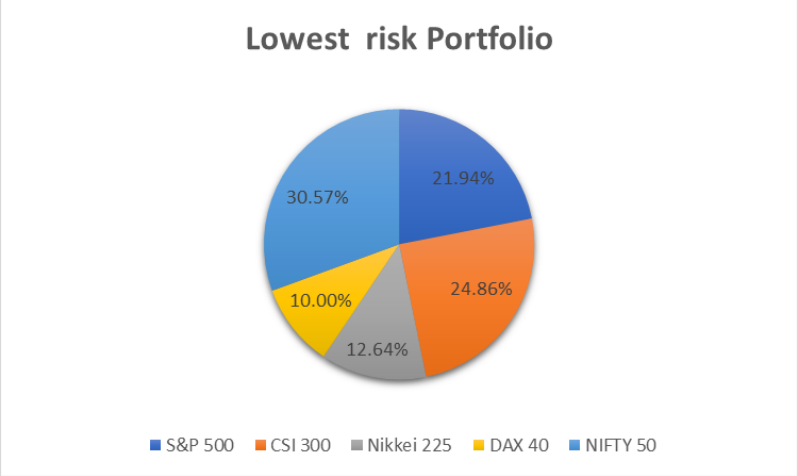
The covariance between the S&P 500 and DAX 40 is 6.23942E-05, indicating a positive relationship in their returns. This suggests that when the U.S. market performs well, there is a tendency for the German market to also show positive returns. The covariance between CSI 300 and Nikkei 225 is 3.5253E-05, signifying a positive relationship. This implies that the returns of the Chinese and Japanese markets are positively associated, suggesting some synchronization. The covariance between DAX 40 and NIFTY 50 is 4.04989E-05, indicating a positive relationship. This suggests that the returns of the German and Indian markets move in a positive direction, although the strength of the relationship is influenced by the magnitude of the covariance. The covariance between the S&P 500 and Nikkei 225 is 2.00202E-05, indicating a positive relationship. This implies that the U.S. and Japanese markets exhibit positive covariance, meaning their returns tend to move in the same direction. While positive covariance show general alignment in the directions of returns, the magnitudes are relatively small. This suggests that there may still be diversification potential in the portfolio, as the positive relationships are not excessively strong

3.5 Indices weightage for different types of portfolios:

I. Lowest Risk portfolio:

The following figure-7 shows the weights of each index in the lowest-risk portfolio:

Figure 7: Lowest Risk portfolio weights.



Source: Data Analysis

The following, table 4, shows the portfolio risk and return for the lowest-risk portfolio:

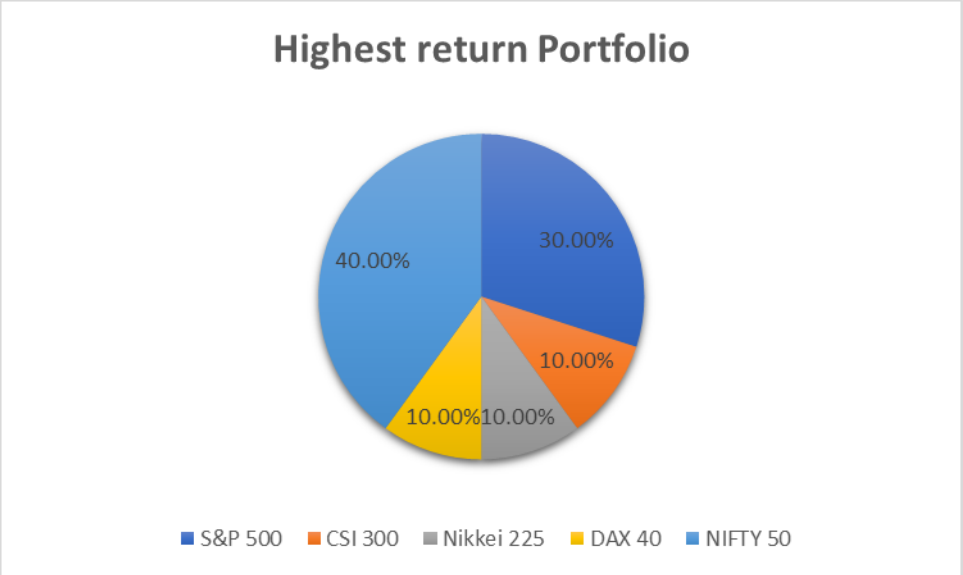
Table 4: Risk, returns and Sharpe ratio of lowest Risk portfolio

Daily Average Risk	*4.37436E-05*
Portfolio Risk	10.46%
Portfolio Return	5.49%
Sharpe Ratio	-0.15

Source: Data Analysis

Inference: The lowest-risk portfolio aims to minimize risk through a substantial allocation to NIFTY 50 and diversification across other indices. However, the negative Sharpe Ratio suggests that further evaluation is necessary to potentially improve the risk-adjusted performance of the portfolio.
The portfolio's highest allocation of 30.57% is NIFTY 50, which is known to have the lowest risk among the chosen indices. This indicates that the portfolio minimizes risk by favoring a less volatile index. The portfolio is diversified across multiple indices with varying risk allocations. While NIFTY 50 dominates the allocation, the inclusion of other indices contributes to risk diversification, spreading risk across different markets.
The daily average risk for the portfolio is calculated at 4.37436E-05, contributing to an overall portfolio risk of 10.46%. The portfolio return is 5.49%. The Sharpe Ratio, which measures risk-adjusted return, is calculated at -0.15. A negative Sharpe Ratio suggests that the portfolio's return may not be sufficient to compensate for the level of risk taken.
It is essential to note that a negative Sharpe Ratio indicates that the portfolio's risk-adjusted performance may not be favorable. Investors typically seek positive Sharpe Ratios as an indication of better risk-adjusted returns. The negative value suggests the need for a reassessment of the portfolio strategy to potentially improve the risk-return profile. Regularly reassess and rebalance the portfolio to adapt to changing market conditions and risk profiles. Periodic reviews are essential to ensure that the portfolio remains aligned with the investor's goals and market expectations. The following figure-8 shows the weights of each index in the Highest return portfolio:

Figure 82*:* Highest Return portfolio weights of Indices



Source: Data Analysis

The following, table 4, shows the portfolio risk and return for highest highest-return portfolio:

Table 5: Risk, returns and Sharpe ratio of Highest Return portfolio

Daily Average Risk	4.75623E-05
Portfolio Risk	10.90%
Portfolio Return	9.67%
Sharpe Ratio	0.2387

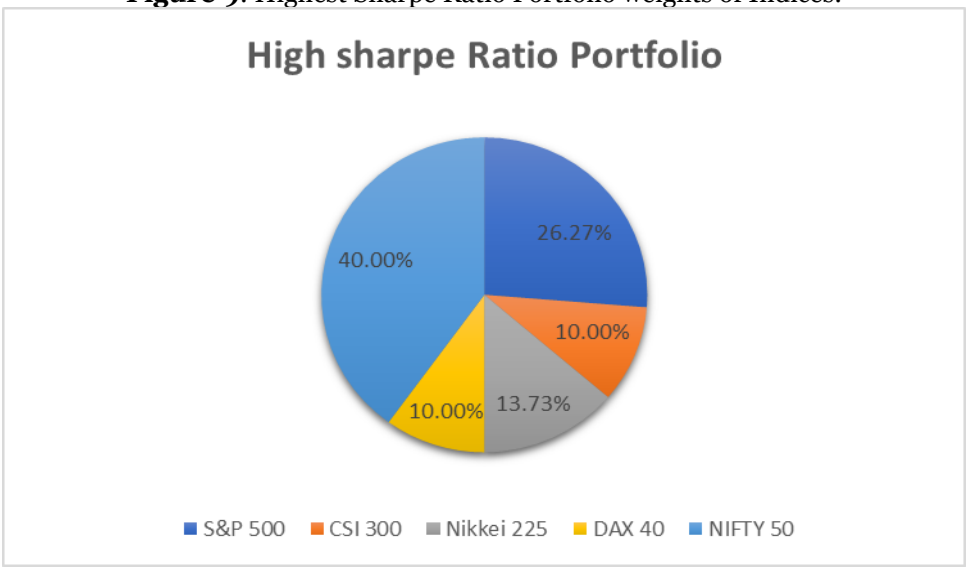
Source: Data Analysis

Inference: The highest-return portfolio, as indicated by the allocation percentages to different market indices, is strategically positioned to maximize potential returns. With a substantial 40.00% allocation to NIFTY 50, which is perceived to offer the highest return among the selected indices, the portfolio aims to capture significant upside. Diversification is maintained through allocations to other indices, such as the S&P 500, CSI 300, Nikkei 225, and DAX 40, suggesting a balanced approach to managing risk while seeking high returns. The positive Sharpe Ratio of 0.2387 indicates a favorable trade-off between risk and return, suggesting that the portfolio's performance is deemed satisfactory concerning the level of risk taken. Investors should remain vigilant in monitoring economic conditions and market dynamics, conducting regular reviews to ensure the portfolio remains aligned with their financial goals and risk tolerance.

II. Highest Sharpe Ratio Portfolio:

The following figure-9 shows the weights of each index in the Highest Sharpe ratio portfolio:

Figure 9: Highest Sharpe Ratio Portfolio weights of Indices:



Source: Data Analysis

The following, Table 6, shows the portfolio risk and return for the highest Sharpe ratio portfolio:

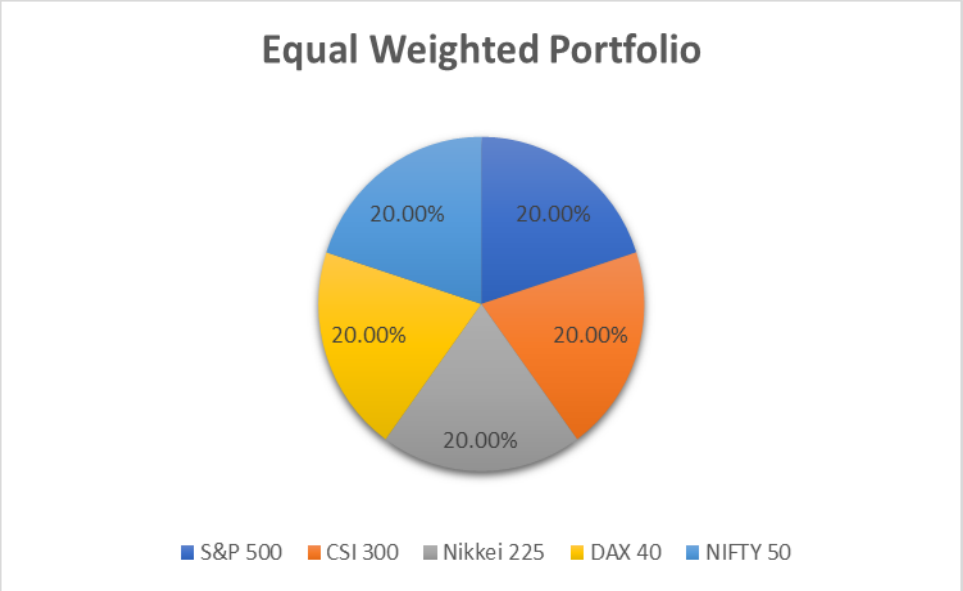
Table 6: Risks, Return and Sharpe Ratio of Highest Sharpe Ratio Portfolio

Daily Average Risk	*4.68258E-05*
Portfolio Risk	10.82%
Portfolio Return	9.66%
Sharpe Ratio	0.2394

Source: Data Analysis

Inference: The high Sharpe Ratio portfolio is strategically composed with a focus on achieving a favorable balance between risk and return. Notably, the allocation percentages to various market indices reflect an emphasis on capturing potential returns while maintaining risk diversification. The highest allocation of 40.00% to NIFTY 50, which is perceived to offer the highest return, suggests a pursuit of significant upside. Additionally, allocations to the S&P 500, CSI 300, Nikkei 225, and DAX 40 contribute to a well-diversified portfolio, spreading risk across different markets. The positive Sharpe Ratio of 0.2394 indicates that the portfolio's return is considered satisfactory concerning the daily average risk, reflecting a favorable risk-adjusted performance. Investors adopting this portfolio appear to be seeking a prudent trade-off between risk mitigation and return maximization, aligning with the principles of portfolio management. The following figure-10 shows the weights of each index for an equal-weighted portfolio:

Figure 30: Equally Weighted Portfolio weights of Indices:



Source: Data Analysis

The following, table-6, shows the portfolio risk and return for an equal-weighted portfolio.

Table 6: risk, return and Sharpe Ratio of Equal weighted Portfolio:

Daily Average Risk	*4.56594E-05*
Portfolio Risk	10.68%
Portfolio Return	3.75%
Sharpe Ratio	-0.3103

Source: Data Analysis

Inference: The equal-weighted portfolio, distributing investments evenly among the selected market indices (S&P 500, CSI 300, Nikkei 225, DAX 40, NIFTY 50), demonstrates a balanced and diversified approach. Each index holds an equal weight of 20.00%, promoting risk diversification across different global markets. However, the portfolio's daily average risk is calculated at 4.56594E-05, contributing to an overall portfolio risk of 10.68%. The portfolio return is 3.75%, resulting in a negative Sharpe Ratio of -0.3103. The negative Sharpe Ratio suggests that the portfolio's return may not be sufficient to compensate for the level of risk taken, indicating a less favorable risk-adjusted performance compared to other portfolios. While the equal-weighted strategy aims to spread risk evenly, investors may need to reconsider their asset allocation strategy or explore other weightings to achieve a more desirable risk-return profile in line with their investment objectives. Periodic reviews and adjustments are essential to ensure that the portfolio remains aligned with evolving market conditions and investor goals.

Findings and Conclusion:

a) Over the last decade (2014-2024), the S&P 500 index experienced a significant level of risk (15.04%) but with stable returns (11.68%). However, in the recent three years (2021-2024), the index displayed relatively higher risk (30.62%) but delivered substantial average returns (11.29%).
b) The CSI 300 index, on the other hand, showed high risk (21.75%) with consistently low returns, indicating ongoing challenges over the last decade. In the recent three years (2021-2024), the index exhibited intense volatility (30.61%) and negative average returns (-13.91%) post-pandemic.
c) Over the last ten years (2014-2024), the Nikkei 225 index demonstrated moderated risk (16.25%) with consistent returns (11.01%). However, in the recent three years (2021-2024), the index experienced high risk (31.23%) but maintained decent average returns (11.04%) in a volatile period.
d) Similarly, the DAX 40 index indicated moderate risk (17.34%) but with slightly lower returns (7.80%) over the last decade. In the recent three years (2021-2024), the index showed increased risk (30.64%) with moderate average returns (8.75%) amid global uncertainties.
e) Lastly, over the last decade (2014-2024), the NIFTY 50 index displayed moderate risk (16.22%) with consistently high returns, although slightly lower comparatively (14.37%).

Conclusions:

This article highlights trends in the performance of equity markets in the top five global economies and correlations among the indices. Optimal portfolio selection, based on the highest Sharpe Ratio, stood out as a smart strategy. Although different portfolios presented distinct risk-return profiles, the highest Sharpe Ratio portfolio demonstrated an efficient use of risk to generate returns, aligning with the principles of portfolio optimization. Investors who aim to achieve sustainable and efficient investment outcomes while maintaining an optimal balance between risk and return are likely to find the highest Sharpe Ratio portfolio as a wise choice.

Recommendation:

Indian investors who want to diversify their portfolio across the top five global economies should consider investing in indices that represent these economies. To choose the best portfolio, they should look for the portfolio with the highest Sharpe ratio, which will give maximum returns at the lowest possible risk. Investors should diversify their portfolio by having a minimum exposure of 10% to an individual index and a maximum of 40%. Based on the current macroeconomic conditions, investors should allocate their investment as follows: 40.00% to NIFTY 50, 27% to S&P 500, 10% to CSI 300, 13% to Nikkei 225, and 10% to DAX 40. This article is based on past trends, risks, returns, and existing macroeconomic conditions. Keeping in view the ever-changing market conditions and investor goals, periodic reviews and adjustments of portfolios are essential.

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II. "The Intelligent Asset Allocator: How to Build Your Portfolio to Maximize Returns and Minimize Risk" by William J. Bernstein - Bernstein provides practical guidance on asset allocation and portfolio construction based on modern portfolio theory principles.

Websites:

III. **Investopedia - S&P 500:** S&P 500 - This source provided comprehensive information about the S&P 500, including its definition, composition, and significance in the financial markets.
IV. **Investopedia - DAX:** DAX - This link offered insights into the DAX, explaining its role as the German stock market index, its components, and its importance in the European financial landscape.
V. **Investopedia - Chinese Stock Market Indicators:** Common Market Indicators for the Chinese Stock Market - An informative resource detailing key indicators for monitoring the Chinese stock market and economy.
VI. **Investopedia - Nikkei:** Nikkei - This link elucidates the Nikkei, offering insights into the Japanese stock market index, its components, and its significance in the context of Japan's economy.
VII. **Investopedia - Sharpe Ratio:** Sharpe Ratio - An explanation of the Sharpe Ratio, a key metric for evaluating the risk-adjusted performance of an investment portfolio.
VIII. **Investopedia - Sharpe Ratio:** Sharpe Ratio - An explanation of the Sharpe Ratio, a key metric for evaluating the risk-adjusted performance of an investment portfolio.

Historical data:

IX. **Yahoo Finance - NSE Nifty 50:** NSE Nifty 50 - A direct link to Yahoo Finance's page for NSE Nifty 50, providing real-time data, historical information, and other relevant details.
X. **Yahoo Finance - DAX 30:** DAX 30 - This link directs to Yahoo Finance's page for DAX 30, offering current and historical data, news, and market insights.
XI. **Yahoo Finance - S&P 500:** S&P 500 - Direct access to Yahoo Finance's S&P 500 page, featuring live updates, historical charts, and related financial news.
XII. **Yahoo Finance - Nikkei 225:** Nikkei 225 - A link to Yahoo Finance's page for Nikkei 225, offering real-time data and historical information on the Japanese stock market index.
XIII. **Yahoo Finance - CSI 300:** CSI 300 - Direct access to Yahoo Finance's CSI 300 page, providing information on the Chinese stock market index.
XIV. **Investing.com - Japan NI225:** Japan NI225 - Direct access to historical data for Japan's NI225, aiding in studying long-term trends and market behavior.