

INNOVATIVE RESILIENCE: ASSESSING VACCINE PORTFOLIO PERFORMANCE DURING THE PANDEMIC THROUGH ALTERNATIVE DATA SOURCES

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Abstract. This study investigates the investment potential of vaccine-developing companies during the COVID-19 pandemic by comparing two portfolios: one weighted by public sentiment (via Google Trends data) and an equal-weighted portfolio. The study analyzes daily stock data from Pfizer, Johnson & Johnson, Moderna, AstraZeneca, and Novavax between 2020 and 2023, benchmarking performance against the S&P 500. Results show that the trends-informed portfolio achieved a 67.8% annualized return, significantly outperforming the market's 7.9%, though with higher volatility. The statistically significant difference in returns (p-value: 0.046) against the benchmark highlights the potential of sentiment-driven strategies. However, no significant difference in returns was found between the two vaccine portfolios (p-value: 0.331). These findings suggest that biomedical stocks demonstrate resilience during crises, and that alternative data, such as public interest, can enhance portfolio construction in times of heightened sector focus, but future research is required.

Keywords: Vaccine portfolio; COVID-19 pandemic; Google Trends; Alternative data

INTRODUCTION

The global outbreak of the COVID-19 pandemic not only posed unprecedented challenges to public health systems but also significantly disrupted financial markets worldwide. Among the most critical responses to the crisis was the rapid development of vaccines, positioning the biomedical sector at the forefront of both public interest and investor attention. This study examines whether vaccine-developing companies exhibited superior market performance during the pandemic and evaluates whether a novel sentiment-based weighting mechanisms, such as Google Trends data, could enhance portfolio construction.

While prior studies have analyzed stock market volatility and sectoral shifts during economic downturns, there is limited empirical evidence on whether biomedical stocks, particularly those involved in vaccine development, provided sustained excess returns relative to the broader market. Additionally, while investor sentiment has been widely discussed in behavioral finance (Moat et al., 2013; Ahmed et al., 2017), its application in portfolio construction during financial crises remains underexplored.

The object of this research is the stock performance of vaccine-developing companies, while its purpose is twofold: to determine whether these stocks provided superior returns relative to the market during the COVID-19 pandemic and to assess whether sentiment-based portfolio construction could enhance investment outcomes. To address these questions, the study compares two vaccine-focused portfolios (an equal-weighted portfolio and a sentiment-weighted portfolio based on Google Trends data) against the S&P 500 benchmark.

The central research question guiding this study is: "Did vaccine-producing companies exhibit superior market performance during the COVID-19 pandemic, and can alternative data sources, such as Google Trends, enhance portfolio returns?" This study hypothesizes that vaccine-producing companies outperformed the broader market during the pandemic and that a sentiment-weighted portfolio would yield higher returns than an equal-weighted portfolio.

From a scientific perspective, this research contributes to the literature on financial market resilience during crises by analyzing a sector directly involved in global pandemic response. From a practical perspective, the findings provide insights for investors seeking sector-specific opportunities in times of market uncertainty, demonstrating the viability of vaccine stocks as an alternative crisis investment strategy and assessing the potential role of alternative portfolio construction.

By situating this analysis within the pandemic's context, the research sheds light on the unique investment landscape of the biomedical sector during a public health crisis, offering empirical insights into its potential for risk-adjusted returns and volatility considerations.

SAMPLE AND METHODOLOGY

This research focuses on five companies engaged in vaccine development and production: Pfizer (PFE), Johnson & Johnson (JNJ), Moderna (MRNA), AstraZeneca (AZN), and Novavax (NVAX). Although there are currently 12 vaccines approved by the World Health Organization (WHO) from different companies, the sample is limited to these

five firms, as they are the only vaccine developers listed on U.S. stock exchanges. By restricting the sample to these companies, it ensured homogeneity across firms, making comparisons more reliable and relevant.

The study collects daily closing price data for these companies from Yahoo Finance, covering the period from January 30, 2020, to May 5, 2023. This timeframe aligns with the WHO's official declaration of a public health emergency of international concern, making it particularly relevant for studying the impact of the pandemic on vaccine-related stocks. Utilizing data from Yahoo Finance enhances the study's credibility, as it provides reliable, real-time financial data. Focusing specifically on daily closing prices allows for a consistent benchmark to evaluate the performance and fluctuations of each stock at the conclusion of each trading day, providing a clear view of price behavior over time. In analyzing portfolio performance, simple nominal annualized returns and simple nominal weekly returns are used. This approach provides an intuitive and straightforward representation of each investment's actual percentage gain or loss (Brown and Warner, 1985).

Table 1

Descriptive statistics, weekly company returns

Variable	Mean	Std. Dev.	Median	Min	Max
Pfizer	0.000	0.037	0.000	-0.113	0.127
Johnson & Johnson	0.001	0.026	0.001	-0.107	0.089
Moderna	0.012	0.114	0.007	-0.313	0.515
AstraZeneca	0.003	0.036	0.003	-0.127	0.137
Novavax	0.021	0.197	-0.001	-0.332	1.329

To assess the risk-adjusted performance of the portfolios, the Sharpe Ratio is calculated, which measures the excess return per unit of risk. The Sharpe Ratio considers the portfolio's return, standard deviation, and a risk-free rate (Sharpe, 1998). For this study, a constant risk-free rate of 4.73% is used, based on the 1-year U.S. Treasury bill rate at the end of the sample period (May 5, 2023), as a representation of the risk-free return available to investors during this timeframe. Google Trends data is incorporated to measure public interest and sentiment related to COVID-19 vaccines and drug development. Google Trends is a publicly accessible tool that provides indexed data on the relative popularity of search terms over time, which allowed us to capture the flow of public sentiment throughout the pandemic. This alternative data source enhances the understanding of market sentiment and its impact on investment strategies within the biomedical sector (Mavragani et al., 2018).

Google Trends does not give the absolute volume of searches but instead indexes the data to 100. Thus, after standardizing the trends data, portfolio weights are assigned to each company based on the level of public interest they attracted, with higher interest translating to a larger weight in the portfolio. Weight distribution depicted in Figure 1. To maintain consistency and robustness, all Google Trends queries were conducted within the same timeframe, region, and category, ensuring comparable data across companies.

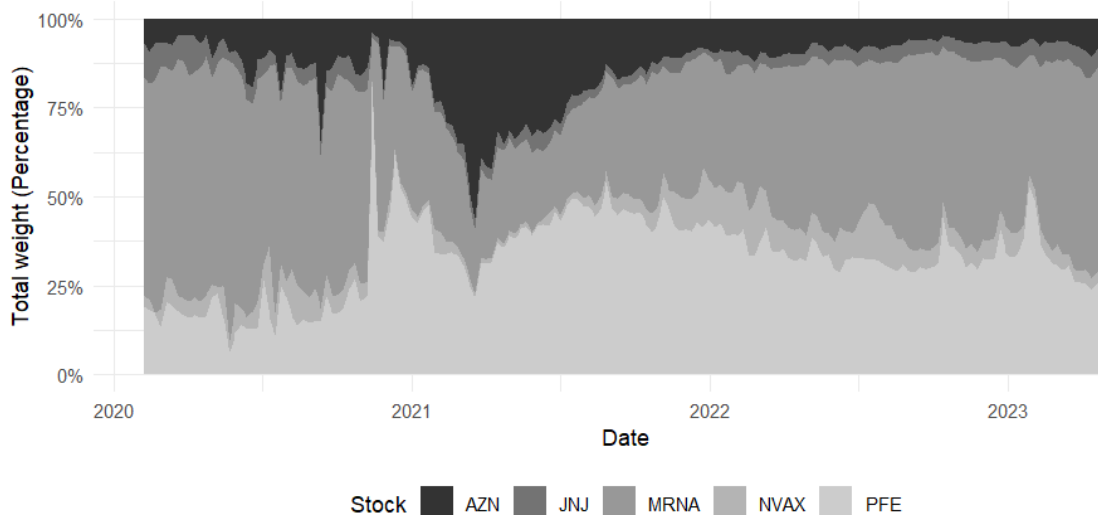


Figure 1. Weight distribution

The annualized returns of the vaccine portfolio are calculated as

$$R_{\text{annual}} = \left(\prod_{t=1}^T \left(1 + \sum_{i=1}^5 w_{i,t} \times R_{i,t} \right) \right)^{\frac{52}{T}} - 1;$$

where $w_{i,t}$ is the weight of stock i in the portfolio at week t , $R_{i,t}$ is the weekly return of stock i at week t , T is the total number of weeks in the analysis period.

An equal-weighted portfolio that assigns identical weights to each stock of the vaccine portfolio is used as a secondary portfolio (Windcliff and Boyle, 2004; Benartzi and Thaler, 2001). To benchmark the portfolios, the S&P 500 index is used as a standard market proxy (Indices, 2019).

RESULTS/DISCUSSION

The impact of the COVID-19 pandemic on stock market performance, particularly among companies involved in developing vaccines, has garnered considerable attention. Prior research points to the potential for abnormal or positive returns in biomedical stocks and portfolios during pandemics and health crises (Zhang & Haskins, 2021; Ambelal & Sebastian, 2021; Oncu, 2021; Yacob & Abdullah, 2021; Pushpa et al., 2021; Mittal & Sharma, 2021; Ramos, 2023; Alberti et al., 2023). The analysis reveals similar trends, with the trends-portfolio of vaccine-producing firms yielding a 0.678 (67.8%) annualized return, significantly outperforming the market's return of (0.079) 7.9% over the same period. Consistent with prior literature, heightened volatility is observed in the portfolio, with a standard deviation of 0.550, which is considerably higher than the market's standard deviation of 0.232. This increased volatility likely reflects the amplified speculative interest and market sensitivity tied to vaccine development efforts. Although the volatility matches prior findings (Ambelal & Sebastian, 2021; Mason & Elkassabgi, 2022; Umar et al., 2021), it suggests that investors in vaccine stocks faced greater risk, introducing complexity to the portfolio's favorable returns. This dual nature of investing in vaccine-related stocks during a pandemic, potentially high returns paired with significant risk, offers insight into the dynamics at play during such periods. The portfolio's Sharpe ratio, at 1.147, is markedly higher than the market's ratio of 0.137, highlighting its strong risk-adjusted performance. This favorable ratio supports the portfolio's appeal for returns that sufficiently compensate for the associated risk.

To confirm the statistical significance of these observations, a one-sided Welch Two-Sample t-test was applied. This test indicates that the trends-informed vaccine portfolio's returns are statistically significantly greater than the market's at a 5% significance level (p-value: 0.046). The positive result from this t-test reinforces that the observed outperformance is not likely due to random variation but instead reflects a genuine difference in returns. These statistically significant findings underscore the distinctive impact that the COVID-19 pandemic had on the stock performance of vaccine-producing companies, suggesting that their observed outperformance is rooted in sector-specific factors rather than random variation. The Welch test is appropriate here given the higher volatility observed in the vaccine portfolio, which would violate the equal variances assumption required for a standard t-test. Moreover, it underlines the potential effectiveness of leveraging market sentiment and trends data in portfolio construction, especially during periods of market stress or heightened public interest in specific sectors, such as healthcare during a pandemic.

In contrast, the equal-weighted portfolio achieved an annualized return of 41%, with a standard deviation of 0.467 and a Sharpe ratio of 0.777. This time, the test fails to reject the null hypothesis of the weekly returns being greater than those of the benchmark (p-value: 0.092), indicating no statistically significant difference at the 5% significance level. Figure 2 illustrates these performance metrics, showing the contrast in risk-adjusted returns between the vaccine-focused and market portfolios.

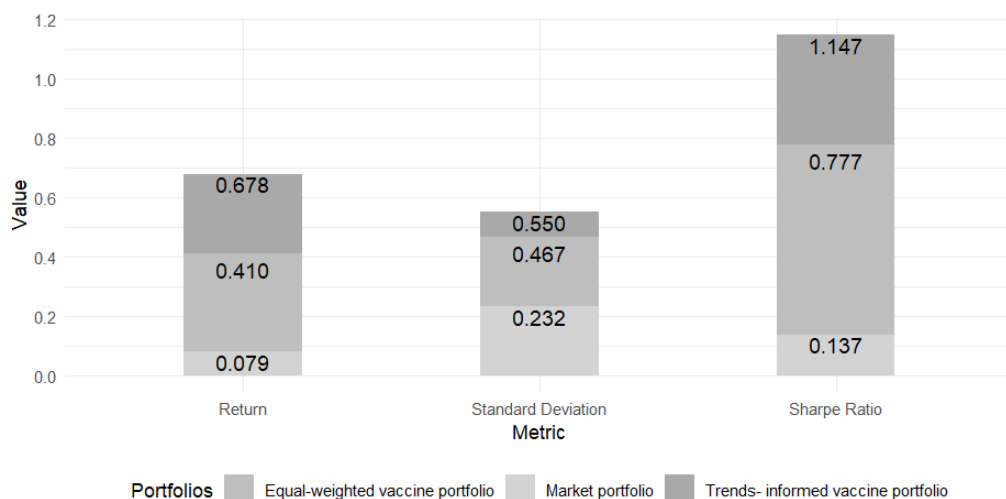


Figure 2. Financial metrics

By juxtaposing the results of the trends-informed and equal-weighted portfolios, it can be observed that the trends-informed strategy may offer a more effective approach for investors aiming for higher returns in this sector. However, the Welch test for the difference in mean returns between the trends-informed and equal-weighted portfolios fails to reject the null, specifically regarding the trends portfolio having a higher mean return (p-value: 0.331). This result indicates that the apparent return advantage of the trends-informed portfolio over the equal-weighted one may not be statistically significant. Therefore, unfortunately, it reduces the expected impact of using alternative data. Moreover, the

increased return potential in the trends-informed portfolio is accompanied by higher volatility, which may not suit all investors' risk tolerance levels.

CONCLUSIONS

This study demonstrates that stocks of vaccine-developing companies displayed both resilience and potential for market outperformance during the COVID-19 pandemic. The Google Trends-informed vaccine portfolio achieved substantial annualized returns, significantly outperforming the S&P 500 benchmark. This result supports the hypothesis that vaccine-related stocks offered distinct market advantages during the pandemic.

By incorporating Google Trends data into portfolio construction, this research highlights the potential of alternative data sources in investment strategy. The findings suggest that investor sentiment, as reflected in search volumes, can serve as a valuable tool for weighing portfolios, especially during periods of heightened public focus on specific sectors. This approach provides actionable insights for investors, showing how real-time public interest data can capture trends that traditional financial metrics might overlook. Nevertheless, the trend portfolio failed to show statistically significant results compared to an equal-weighted portfolio. Therefore, future research could explore other alternative data sources and work to optimize the Google Trends approach. This refinement could unlock more robust ways to capture and utilize public interest data, further enhancing investment strategies.

Overall, this study underscores the dynamic role that vaccine-related stocks played during the COVID-19 pandemic, providing evidence that public sentiment can be a powerful factor in portfolio construction. The findings suggest that biomedical stocks and their portfolios have the ability to outperform the market and that trends-informed investing holds promise as a strategy for outperforming the market during crises, adding a valuable tool to the modern investor's toolkit.

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