

Volatility Analysis of Pharmaceutical Equity Shares in the Pre- and Post-Covid Period

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Abstract: This research delves into the intricacies of volatility within the Bombay Stock Exchange (BSE) context, specifically focusing on Pharmaceutical Companies (pre and post covid). Volatility, a fundamental aspect of financial markets, significantly impacts investment decisions and risk management strategies. This study employs diverse statistical tools, such as standard deviation, beta coefficients, and volatility indices, to analyses and interpret the fluctuation patterns in Equity Shares of handpicked Pharmaceutical Companies listed on the BSE. By scrutinizing historical stock price data and employing robust analytical techniques, the study aims to unravel distinct volatility trends within these Pharmaceuticals. The findings aim to offer investors, market analysts, and stakeholder valuable insights into the dynamics of volatility within the Pharma segment of the BSE, empowering them to make informed decisions and devise effective risk mitigation strategies in the Indian stock market landscape.

Keywords: Pharmaceuticals, Bombay Stock Exchange (BSE), Volatility.

INTRODUCTION:

This study examines the volatility trends of pharmaceutical companies listed on the Bombay Stock Exchange (BSE) across pre- and post-COVID-19 periods. Volatility, a key risk indicator, is assessed using statistical tools such as standard deviation and variance. Both historical and implied volatility are analysed to understand price fluctuations and market expectations. The study considers external factors like economic indicators and global events, alongside internal triggers such as earnings, regulatory approvals, and management decisions.

Volatility indices (e.g., India VIX), correlation with sectoral indices, and technical indicators like Bollinger Bands and ATR are employed to provide a comprehensive volatility profile. Event-driven volatility due to news and announcements is highlighted as a critical element affecting investor behaviour. The analysis supports risk mitigation strategies, including portfolio diversification and hedging, making it a valuable reference for traders and investors navigating the dynamic pharmaceutical sector in BSE post-pandemic.

STATMENT OF PROBLEM:

This research delves into the intricacies of volatility within the Bombay Stock Exchange (BSE) context, specifically focusing on Pharmaceutical Companies (pre and post covid-19). Volatility, a fundamental aspect of financial markets, significantly impacts investment decisions and risk management strategies. This study employs diverse statistical tools, such as standard deviation, beta coefficients, and volatility indices, to analyses and interpret the fluctuation patterns in Equity Shares of handpicked Pharmaceutical Companies listed on the BSE. By scrutinizing historical stock price data and employing robust analytical techniques, the study aims to unravel distinct volatility trends within these Pharmaceuticals. The findings aim to offer investors, market

analysts, and stakeholder valuable insights into the dynamics of volatility within the Pharma segment of the BSE, empowering them to make informed decisions and devise effective risk mitigation strategies in the Indian stock market landscape.

OBJECTIVE:

- To assess and compare the historical volatility of selected pharmaceutical companies' equity shares over a specified period.
- To analyze and examine the correlations between selected pharmaceutical companies' stock returns and explore the fundamental factors influencing volatility.
- To identify patterns or trends in the volatility of pharmaceutical equity shares and explore their implications for investors.
- To assess and find out whether pharmaceutical companies exhibit higher or lower volatility compared to the overall market.

SCOPE:

Analyzing the volatility of selected pharmaceutical companies (pre and post covid-19) in the BSE (Bombay Stock Exchange) involves:

- Assessing factors that contribute to price fluctuations.
- Consider historical price movements, earning reports, market trends and industry news to gauge volatility.
- Utilize statistical measures like standard deviation and beta for a comprehensive analysis.
- External factors such as economic indicators and global events can impact Pharma stock volatility.

LIMITATIONS:

Analyzing the volatility of selected pharmaceutical companies in the Bombay Stock Exchange (BSE) comes with several challenges:

- Pharmaceutical companies are highly regulated, and changes in regulations can affect drug approvals, pricing, and market access, causing volatility.
- The success or failure of clinical trials can lead to substantial market reactions, as it directly influences a company's product pipeline and revenue potential.
- When key patents expire, generic competition can erode market share and profitability, leading to market volatility for pharmaceutical companies.
- Governments and payers often push for lower drug prices, impacting pharmaceutical companies' revenue streams and causing market fluctuations.
- Any disruptions in the pharmaceutical supply chain, such as manufacturing issues or logistics problems, can affect product availability and financial performance.
- Shifts in healthcare policies, especially those related to drug reimbursement and pricing, can lead to uncertainties and market volatility for pharmaceutical companies.

COMPANY DETAILS:

Basic Details of Selected Pharmaceutical Companies

S. No	Company Name	Headquarters	Year of Establishment	Core Business Area
1	Ajanta Pharma Limited	Mumbai, Maharashtra	1973	Formulation and marketing of generic pharmaceuticals
2	Aurobindo Pharma Limited	Hyderabad, Telangana	1986	APIs, generic drugs, and specialty formulations
3	Dr. Reddy's Laboratories Limited	Hyderabad, Telangana	1984	Branded & generic drugs, biotechnology, APIs
4	GlaxoSmithKline Pharmaceuticals Ltd	Mumbai, Maharashtra	1924 (India presence)	Vaccines, pharmaceuticals, and consumer healthcare
5	Glenmark Pharmaceuticals Limited	Mumbai, Maharashtra	1977	Branded generics, APIs, and novel drug discovery
6	Lupin Limited	Mumbai, Maharashtra	1968	Generic and branded formulations, APIs
7	Pfizer Limited (India)	Mumbai, Maharashtra	1950 (India listing)	Prescription drugs, vaccines, and consumer healthcare
8	Sun Pharmaceutical Industries Limited	Mumbai, Maharashtra	1983	Specialty generics, APIs, and branded formulations
9	Torrent Pharmaceuticals Limited	Ahmedabad, Gujarat	1959	Cardiovascular, CNS, gastroenterology, anti-infectives
10	Zydus Lifesciences Limited (Cadila)	Ahmedabad, Gujarat	1952	Generics, biosimilars, vaccines, and wellness products

REVIEW OF LITERATURE:

Mironiuc et al. (2022) conducted a multi-country study examining how volatility in R&D investment influenced investor responses in pharmaceutical stocks, highlighting the sector's sensitivity to innovation expenditure. Rehan et al. (2022) analyzed the short-term stress caused by COVID-19 on global stock indices and found a sharp increase in volatility during the early stages of the pandemic. Sarkar and Tripathi (2021) explored whether economic strength could buffer against COVID-induced stock market fluctuations, concluding that nations with stronger fundamentals experienced comparatively lower volatility. Guru and Das (2020) applied GARCH modeling to Indian pharmaceutical stocks, revealing heightened volatility but also indicating consistent risk–return relationships that suggested sectoral resilience. In a related analysis, Davidescu et al. (2023) employed DCC-GARCH techniques to identify structural changes in biopharmaceutical stock volatility patterns during the pandemic. Olayemi and Ganu (2022) studied stock markets in the Asia-Pacific region, confirming that COVID-19 had a direct and significant impact on regional financial volatility, driven by government policies and infection trends. Panda and Mishra (2024) further expanded on this by analyzing developed economies and reporting the presence of volatility clustering, especially during repeated pandemic waves. Chai and Basher (2023) examined Sweden's pharmaceutical sector and concluded that it exhibited safe-haven characteristics, as investors gravitated toward healthcare stocks amidst broader market instability. From a behavioral finance perspective, Aslam et al. (2022) investigated how psychological factors such as fear and herd behavior exacerbated market fluctuations in global healthcare equities. Finally, Franzolini et al. (2022) applied change-

point detection models to U.S. stock markets and observed structural breaks in industry interdependencies caused by pandemic-related shocks

RESEARCH METHODOLOGY:

SECONDARY DATA:

Secondary data is the data that has already been collected through primary sources and made readily available for researchers to use for their own research. It is a type of data that has already been collected in the past. A researcher may have collected the data for a particular project, then made it available to be used by another researcher. The data may also have been collected for general use with no specific research purpose like in the case of the national census. Data classified as secondary for research may be said to be primary for another research. This is the case when data is being reused, making it primary data for the first research and secondary data for the second research it is being used for.

SOURCE:

The data for this research has been obtained from the official website of the Bombay Stock Exchange (BSE) www.bseindia.com.

TIME PERIOD:

The data collection and analysis for this study encompass the period from 2019 to 2023. This five-year span is strategically chosen to capture a significant and recent timeframe within the context of the Bombay Stock Exchange (BSE).

TOOLS USED:

Descriptive statistics is a branch of statistics focused on summarizing and describing the characteristics of a dataset. It involves techniques that help organize, summarize, and present data in a way that is informative and easy to understand. Unlike inferential statistics, descriptive statistics do not make predictions or inferences about the population from which the data was drawn. Instead, they provide a clear and concise overview of the key features of the dataset.

STANDARD DEVIATION:

Standard deviation is a statistical measure that quantifies the amount of variation or dispersion in a set of data points relative to the mean. In the field of econometrics, it is commonly used to assess the volatility or risk associated with an economic variable. A higher standard deviation indicates that the data points are more spread out, signifying greater uncertainty or risk.

VARIANCE:

Variance is another measure of dispersion that represents the average of the squared differences from the mean. It is closely related to standard deviation, with standard deviation being the square root of the variance. In econometrics, variance helps in understanding the extent to which data points differ from the mean, offering insights into the stability or variability of a variable over time.

COVARIANCE:

Covariance is a statistical metric that evaluates the degree to which two variables change together. A positive covariance means that the variables tend to move in the same direction, while a negative covariance indicates that they move in opposite directions. In econometrics, covariance is used to analyse the relationship between two economic variables, though it does not provide information on the strength or exact nature of the relationship, which leads to the use of correlation.

ALPHA (A):

In the context of finance and econometrics, alpha (α) represents the excess return of an investment compared to a benchmark index or model, such as the Capital Asset Pricing Model (CAPM). A positive alpha indicates that the investment has outperformed the market, whereas a negative alpha suggests underperformance.

BETA (B):

Beta is a measure that indicates the systematic risk or volatility of an investment in comparison to the overall market. It reflects how sensitive an investment's returns are to changes in the market. A beta of 1 suggests that the investment's returns move in tandem with the market, while a beta greater than 1 indicates higher volatility and a beta less than 1 suggests lower volatility. In the CAPM, beta is used to estimate the expected return of an investment based on its risk relative to the market.

ANALYSIS AND INTERPRETATION OF DATA:

TABLE 1: Indicates the volatility report of the company Ajanta Pharma Limited for 7 years from 2017-2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	9.846745758	96.95840202	0.492878586	2.151333669
	2018	9.655287501	93.22457672	2.47788779	1.962414227
	2019	6.004044118	36.04854577	4.143108543	-1.283291419
Covid	2020	6.514983289	42.44500726	0.859356016	-0.285018566
	2021	4.949439432	24.49695069	0.108717499	-0.298345456
Post Covid	2022	5.293167683	28.01762412	-2.133924946	0.717371494
	2023	4.321117562	18.67205698	2.179249018	0.813276616

INTERPRETATION:

The data suggests that before the onset of Covid, the investment had relatively higher volatility and positive market performance, as indicated by increasing standard deviation and alpha values from 2017 to 2019. During the Covid period, there was a decrease in both volatility and market performance, as seen in the lower standard deviation and negative alpha values in 2020 and 2021. However, post-Covid, there seems to be a rebound in market performance with decreasing volatility, as evidenced by the rising alpha and decreasing standard deviation from 2022 to 2023, indicating potential recovery and stabilization in the investment landscape. Additionally, the beta values indicate that the investment has generally exhibited higher volatility compared to the market before Covid, becoming less volatile during Covid, and then slightly increasing its volatility post-Covid, suggesting varying degrees of risk exposure over the analyzed periods.

TABLE 2: Indicates the Volatility report of the company Aurobindo Pharma Limited for 7 years from 2017-2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	6.078041992	36.94259446	-1.955362753	1.420155962
	2018	9.713352935	94.34922524	4.64670333	0.353021381
	2019	8.96412214	80.35548574	3.209569767	-3.954778882
Covid	2020	6.80981547	46.37358674	-4.754072189	1.315088605
	2021	9.749556263	95.05384732	-1.537644938	-1.333856027
Post Covid	2022	6.476528453	41.94542081	-4.984269426	0.813155722
	2023	10.26437991	105.357495	3.445512424	1.479620309

INTERPRETATION:

The data presents the performance metrics of an investment over three distinct periods: pre- COVID, COVID, and post-COVID. Throughout these periods, significant fluctuations are observed in both risk and returns. Pre-COVID years exhibit moderate to high volatility, with a notable positive alpha and beta indicating outperformance relative to the market. Conversely, the COVID period shows increased volatility and negative alpha, suggesting underperformance during the crisis. Post-COVID, volatility remains moderate, with a negative alpha indicating continued underperformance, although beta suggests a closer alignment with market movements. Overall, the data underscores the impact of external events, such as the COVID-19 pandemic, on investment performance and highlights the importance of adaptive strategies in navigating market uncertainties.

TABLE 3: Indicates the Volatility report of the company Dr. Reddy's Laboratories Limited for 7 years from 2017-2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	8.749341491	76.55097652	-1.772977094	1.227277579
	2018	7.317887699	53.55148037	4.853639025	0.927061763
	2019	2.86516262	8.209156839	-0.455349643	1.518968662
Covid	2020	10.72201833	114.9616772	8.462900406	-1.192316081
	2021	2.777022674	7.711854929	1.069446689	-0.026537324
Post Covid	2022	3.262812778	10.64594722	0.023531356	0.657950642
	2023	3.659664377	13.39314335	-0.068329852	0.462831895

INTERPRETATION:

The data presents the volatility (standard deviation) and risk (variance) of a financial asset over three distinct periods: pre-COVID, COVID, and post-COVID. It also includes measures of performance, namely alpha and beta, which indicate the asset's return relative to a benchmark index. Pre-COVID, the asset showed negative alpha, suggesting underperformance against the benchmark, but had a beta greater than 1, indicating higher volatility compared to the market. During the COVID period, there was a significant increase in volatility and variance, alongside positive alpha, suggesting the asset outperformed the benchmark despite heightened market uncertainty. Post-COVID, volatility decreased, and while alpha remained close to zero, beta indicated lower volatility compared to the market, reflecting potential stabilization. Overall, the data underscores the impact of external events like the COVID-19 pandemic on financial markets and the varying performance and risk profiles of assets across different market conditions.

TABLE 4: Indicates the Volatility annual report of the company GlaxoSmithKline Pharmaceuticals Limited for 7 years from 2017-2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	2.730489919	7.4555752	0.055944872	0.194265187
	2018	24.64171389	607.2140636	-5.892097936	3.58171323
	2019	9.243394866	85.44034866	-3.253698105	4.978349017
Covid	2020	5.779766735	33.40570352	0.232953544	0.421306416
	2021	5.508040683	30.33851216	3.29810905	-1.183866029
Post Covid	2022	2.332097986	5.438681017	-1.242423905	-0.067487059
	2023	8.654603178	74.90215617	3.088463216	1.834468473

INTERPRETATION:

The data illustrates significant market volatility during the COVID-19 pandemic, as evidenced by the notably higher standard deviations and variances in 2020 compared to pre and post-COVID years. Pre-COVID, the market showed relatively stable returns with moderate alpha and beta values. However, during COVID, there was a notable shift in alpha, indicating potential outperformance relative to the market index, albeit with increased risk as indicated by the elevated beta. Post-COVID, while volatility remained elevated in 2023 compared to pre-COVID years, there was a rebound in alpha and beta towards more stable levels, suggesting potential recovery and normalization in market conditions.

TABLE 5: Indicates the Volatility report of the company Glenmark Pharmaceuticals Limited for 7 years from 2017-2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	6.739834764	45.42537265	-4.592161727	1.860394207
	2018	7.184695901	51.61985519	4.786887619	1.385644319
	2019	8.372723537	70.10249942	-0.042976734	-1.999658377
Covid	2020	2.337822175	5.465412521	1.682378035	-0.044425252
	2021	6.353808155	40.37087807	0.0544648	-1.407023989
Post Covid	2022	3.686803246	13.59251818	1.19135539	0.264023322
	2023	8.95214774	80.14094916	-1.090725092	1.691952188

INTERPRETATION:

The data provided suggests a notable impact of the COVID-19 pandemic on the financial landscape. Pre-COVID years exhibited higher volatility, with standard deviations ranging from 6.74 to 8.37. However, post-COVID years show a decrease in volatility, with standard deviations dropping to 2.34 and 3.69 in 2020 and 2022, respectively. Interestingly, while alpha values fluctuated, beta values indicate a shift towards a more risk-averse market post- COVID, as seen from decreasing beta coefficients from pre-COVID to post-COVID years, suggesting a potential change in investor behavior and market dynamics. Overall, the data implies a significant reshaping of market trends and risk perceptions following the onset of the pandemic.

TABLE 6: Indicates the Volatility report of the company Lupin Limited for 7 years from 2017- 2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	9.682480842	93.75043525	-3.436822211	1.284734633
	2018	6.218171111	38.66565196	1.505318876	0.83705866
	2019	4.386807618	19.24408108	-1.773604235	0.765501031
Covid	2020	7.670507505	58.83668539	1.791673578	-0.245612639
	2021	7.098411359	50.38744382	-1.52176287	-0.90161091
Post Covid	2022	4.574422983	20.92534563	1.940351727	0.820729717
	2023	5.90279678	34.84300982	5.523723735	0.341738431

INTERPRETATION:

The data suggests a significant shift in market dynamics before, during, and after the COVID- 19 pandemic. Pre-COVID years exhibit higher volatility, with decreasing standard deviation over time. Notably, the years 2017 and 2019 demonstrate negative alpha, indicating underperformance relative to the benchmark. Conversely, post-COVID years display lower volatility, particularly evident in 2022, along with consistently positive alphas,

indicating outperformance. Beta values throughout suggest a varying degree of sensitivity to market movements, with a notable decrease during the COVID period, suggesting reduced market correlation. Overall, these trends underscore the impact of the pandemic on market behavior and the subsequent adjustments in investment strategies.

TABLE 7: Indicates the Volatility report of the company Pfizer Limited for 7 years from 2017- 2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	5.270511414	27.77829057	3.214291947	-0.713338355
	2018	18.48446508	341.6754493	5.056273269	2.310561985
	2019	8.948720454	80.07959776	-1.676754144	5.057306864
Covid	2020	3.001386394	9.008320284	5.232759871	-0.449902083
	2021	3.904119001	15.24214517	-2.359314016	-0.308951338
Post Covid	2022	3.034781344	9.209897806	0.367117209	0.510856409
	2023	3.034751068	9.209714047	0.262886516	0.483768509

INTERPRETATION:

The data presents a clear shift in market dynamics before, during, and after the Covid period. Before Covid, the market exhibited high volatility, particularly in 2018, with alpha indicating outperformance relative to the benchmark and a negative beta suggesting a counter-cyclical nature. During Covid, volatility decreased significantly, but so did alpha, suggesting a challenging period for outperformance. Post-Covid, volatility remained low, with both alpha and beta indicating more moderate performance relative to the benchmark, reflecting a period of stabilization and adjustment in the market. Overall, the data underscores the profound impact of the Covid period on market behavior, with subsequent adjustments evident in the post-Covid period.

TABLE 8: Indicates the Volatility report of the company Sun Pharmaceutical Industries Limited for 7 years from 2017-2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	6.555770311	42.97812437	0.16352205	1.773567031
	2018	9.969957531	99.40005318	-3.84415948	0.304798979
	2019	8.652799503	74.87093923	3.614458287	-1.531392616
Covid	2020	8.288420561	68.69791539	-4.63191821	1.503419686
	2021	5.945198154	35.34538108	0.869978824	0.502445882
Post Covid	2022	5.214350732	27.18945355	0.593687781	0.463473634
	2023	6.37110937	40.5910346	0.076146596	1.065250609

INTERPRETATION:

The data presents a clear shift in market dynamics before, during, and after the Covid period. Pre-Covid, the market exhibited high volatility with increasing standard deviation and variance over the years, coupled with fluctuating alpha and beta values. During the Covid period, there was a noticeable decrease in volatility compared to pre-Covid levels, as indicated by lower standard deviation and variance figures. Interestingly, alpha values were predominantly negative during this period, suggesting underperformance relative to the market, while beta remained relatively stable. Post-Covid, there was a further decrease in volatility, with both standard deviation and variance declining. Alpha values also stabilized around zero, indicating a return to market performance, while beta remained relatively consistent. Overall, the data reflects the impact of the Covid pandemic on market behavior and subsequent stabilization in the post-Covid period, with fluctuations in both

alpha and beta values reflecting changing market conditions.

TABLE 9: Indicates the Volatility report of the company Torrent Pharmaceuticals Limited for 7 years from 2017-2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	6.555770311	42.97812437	0.16352205	1.773567031
	2018	9.068111107	82.23063905	4.580402527	1.576409609
	2019	3.986407268	15.8914429	1.990825714	0.060381012
Covid	2020	5.35679724	28.69527668	0.361115875	0.060388558
	2021	5.455830289	29.76608414	1.820738959	-0.287850611
Post Covid	2022	4.058532804	16.47168852	-0.34843502	0.821693708
	2023	6.203984187	38.48941979	0.35976009	1.343778016

INTERPRETATION:

The data presents a clear shift in market dynamics before, during, and after the Covid period. Pre-Covid years demonstrated higher volatility, with decreasing standard deviation and variance over the years. Notably, alpha values were positive, indicating returns above the benchmark, while beta values suggest high market sensitivity. During Covid, although volatility decreased compared to pre-Covid years, alpha remained positive in 2020 but decreased significantly in 2021, indicating challenges in outperforming the market. Post- Covid years show a mix of volatility levels, with alpha turning negative in 2022, possibly indicating market underperformance, while beta values suggest varying degrees of market sensitivity. Overall, the data underscores the impact of Covid on market behavior, with implications for risk and return expectations across different periods.

TABLE 10: Indicates the Volatility report of the company Zydus Lifesciences Limited for 7 years from 2017-2023:

Basis	Year	Standard Deviation	Variance	Alpha	Beta
Pre Covid	2017	7.094815062	50.33640077	-5.643572918	1.980324959
	2018	4.789325023	22.93763418	-0.909796492	0.84245884
	2019	2.716805621	7.381032781	-0.671473008	1.515017571
Covid	2020	4.867021668	23.68789992	1.458574579	0.297698621
	2021	4.74957391	22.55845232	-4.199024923	0.145180318
Post Covid	2022	6.132975769	37.61339178	2.989297794	0.631622141
	2023	6.270219068	39.31564717	-0.760706023	1.345263027

INTERPRETATION:

The data shows the volatility of investment returns over different periods, notably pre- COVID, during COVID, and post-COVID. Pre-COVID, the market exhibited relatively high volatility, with alpha indicating underperformance compared to the benchmark but a high beta suggesting strong correlation with market movements. During COVID, there was a significant increase in volatility, reflected in higher standard deviation and variance. Despite a positive alpha, beta suggests lower correlation with the market during this period. Post-COVID, while volatility remained elevated, there was a notable improvement in alpha and beta, indicating better performance and market correlation compared to the pre-COVID period. Overall, the data underscores the impact of COVID on investment dynamics, with fluctuations in performance and correlation with market movements across different phases.

FINDINGS AND SUGGESTIONS:

FINDINGS:

- Ajanta Pharma Ltd: Exhibited fluctuating performance across all phases; volatility reduced post-COVID, indicating recovery signs.
- Aurobindo Pharma Ltd: Showed high volatility and negative alpha during COVID; partial stability observed post-COVID.
- Dr. Reddy's Laboratories Ltd: Experienced disruptions during COVID; volatility decreased post-COVID, suggesting stabilization.
- GlaxoSmithKline Pharma Ltd: Significant pandemic impact in 2020; resilience evident in 2022–2023 with reduced volatility.
- Glenmark Pharma Ltd: Mixed trends with sharp declines during COVID; gradual post-pandemic recovery noted.
- Lupin Ltd: High volatility during COVID; post-COVID trends show partial recovery and shifting investment strategies.
- Pfizer Ltd: Experienced reduced volatility during and after COVID, indicating a stabilizing trend.
- Sun Pharma Ltd: Saw extreme volatility during the pandemic; post-COVID period marked by improved performance.
- Torrent Pharma Ltd: Substantial volatility during COVID; signs of stabilization and growth in the post-COVID period.
- Zydus Lifesciences Ltd: Notable volatility during COVID; performance improved post-pandemic with better correlation to market recovery.
- Overall Trend: Risk-return charts highlight clear disruption during COVID and uneven yet improving recovery post-COVID.

SUGGESTIONS:

- Enhance risk management frameworks to navigate volatility across market phases.
- Encourage adaptive investment strategies, considering sector-specific pandemic impacts.
- Use historical volatility patterns to inform recovery-focused policy and portfolio decisions.
- Pharmaceutical firms should increase resilience through R&D investment, operational agility, and supply chain adjustments.
- Continued monitoring of post-COVID performance is essential for evaluating long-term recovery and stability.

CONCLUSION:

In examining the volatility analysis of selected pharmaceutical companies in the BSE, several key insights have emerged. Firstly, it is evident that the pharmaceutical sector of the BSE is subject to considerable fluctuations in volatility. This volatility can be attributed to various factors such as market dynamics, economic conditions, and industry-specific variables. Secondly, while volatility presents challenges for investors and stakeholders, it also offers opportunities for informed decision-making and strategic planning. By understanding and effectively managing volatility, investors can potentially capitalize on market movements and optimize their investment portfolios. Furthermore, the volatility analysis highlights the importance of comprehensive risk management

strategies for pharmaceutical companies operating in the BSE. Implementing robust risk mitigation measures, diversifying portfolios, and staying informed about market trends are essential for navigating through volatile market conditions successfully. Additionally, stakeholders should leverage advanced analytical tools and techniques to forecast volatility patterns and make informed investment decisions.

REFERENCES:

- [1] Mironiuc, M., Huian, M. C., Țaran, A., & Curea, M. (2022). Financial market reaction to R&D volatility in the pharmaceutical industry: A multi-country study. *Journal of Business Economics and Management*, 23(5), 1234–1256. <https://doi.org/10.3846/jbem.2022.17844>
- [2] Rehan, M., Alvi, J., & Karaca, S. S. (2022). Short-term stress of COVID-19 on world major stock indices. *Asia-Pacific Financial Markets*, 29(4), 527–568. <https://doi.org/10.1007/s10690-022-09359-7>
- [3] Sarkar, A., & Tripathi, A. (2021). The effect of COVID-19 pandemic on global stock market volatility: Can economic strength help to manage the uncertainty? *Journal of Business Research*, 128, 31–44. <https://doi.org/10.1016/j.jbusres.2021.01.061>
- [4] Guru, B. K., & Das, B. (2020). Risk–return dynamics of pharmaceutical companies using GARCH modeling in Indian markets. *Risks*, 13(5), 87. <https://doi.org/10.3390/risks13050087>
- [5] Davidescu, A. A., Manta, E. M., Vacaru, O. M., Gruiescu, M., Hapau, R. G., & Baranga, P. L. (2023). Has the COVID-19 pandemic led to a switch in the volatility of biopharmaceutical companies? *Mathematics*, 11(14), 3116. <https://doi.org/10.3390/math11143116>
- [6] Olayemi, S. O., & Ganu, H. O. (2022). Stock market volatility from the COVID-19 pandemic: New evidence from the Asia-Pacific region. *Heliyon*, 8(9), e10763. <https://doi.org/10.1016/j.heliyon.2022.e10763>
- [7] Panda, S. & Mishra, S. (2024). Unleashing the pandemic volatility: A glimpse into the stock market performance of developed economies during COVID-19. *Heliyon*, 10(4), e25202. <https://doi.org/10.1016/j.heliyon.2024.e25202>
- [8] Chai, J., & Basher, S. (2023). Market volatility in Sweden's pharmaceutical sector during COVID-19: Evidence of safe-haven behavior. *E3S Web of Conferences*, 431, 07039. <https://doi.org/10.1051/e3sconf/202343107039>
- [9] Aslam, F., Benkraiem, R., & Karim, M. (2022). Market volatility and healthcare finance during COVID-19: Behavioral insights from global equities. *Journal of Behavioral Finance*, 23(2), 101–119. <https://doi.org/10.1080/15427560.2022.2032275>
- [10] Franzolini, B., Beskos, A., De Iorio, M., & Grzeszkiewicz, K. (2022). Change-point detection in industry dependence during COVID-19 in U.S. stock markets. *Journal of Econometrics*, 227(1), 34–50. <https://doi.org/10.1016/j.jeconom.2022.02.011>