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Study of Volatility Spillover Between us and Indian Stock Exchange

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CHAPTER 1: INTRODUCTION

1.1 Background

Global financial markets have become deeply interconnected due to liberalized capital flows, advanced financial technology, and the growing role of institutional investors. When a significant economic shock occurs in one market — such as a pandemic, financial crisis, or monetary policy shift — its effects ripple rapidly across other markets worldwide. This phenomenon, known as "volatility spillover," is the focus of this study, specifically examining the transmission of market volatility between the United States and India.

Volatility measures how sharply the price of a financial instrument fluctuates over time. High volatility signals investor uncertainty and fear, while low volatility indicates calm. The CBOE VIX Index — the "fear gauge" of global finance — quantifies 30-day implied volatility of the S&P 500, and serves as a globally monitored risk barometer. The NSE India VIX performs a similar function for Indian markets.

1.2 Market Profiles

US Stock Market — S&P 500

The S&P 500 tracks 500 large-cap US companies across 11 sectors with a total market capitalization exceeding $45 trillion as of 2024, representing approximately 80% of US equity. Technology and Communication Services together comprise over 40% of the index weight. The S&P 500 is the world's primary benchmark for equity investment and the underlying index for the globally monitored CBOE VIX.

Indian Stock Market — NIFTY 50

The NIFTY 50 is the flagship benchmark of the National Stock Exchange of India (NSE), comprising 50 large-cap stocks across 13 sectors. It represents companies with a combined market cap exceeding ₹210 lakh crore (~$2.5 trillion). Financial Services dominate at ~33%, followed by IT (~13%) and Energy (~13%). Foreign Portfolio Investors (FPIs) hold approximately 25–30% of NIFTY 50 companies, making the index sensitive to global capital flows.

1.3 Study Period

This study examines 2020–2025, one of the most eventful periods in modern financial history: the COVID-19 market crash (2020), the global bull market recovery (2021), US Fed tightening cycle (2022–23), AI-driven rally (2023), the rate-cut cycle (2024), and US tariff-related turbulence (2025).

1.4 Objectives

- Analyse the direction and magnitude of annual return co-movement between S&P 500 and NIFTY 50
- Examine the correlation between CBOE VIX and India VIX as indicators of volatility spillover

• Determine whether US market downturns impact India asymmetrically versus upturns

• Quantify the degree of volatility transmission using correlation and regression analysis

CHAPTER 2: CONCEPTS & LITERATURE REVIEW

2.1 Key Concepts

Volatility & Its Measurement

Volatility is the statistical measure of the dispersion of returns for a financial instrument. Realized (historical) volatility is computed as the standard deviation of daily log returns, typically annualized by multiplying by $\sqrt{252}$. Implied volatility — as captured by the VIX — reflects market expectations of future volatility derived from option prices.

Volatility Spillover Channels

Four primary channels transmit volatility between the US and Indian markets:

• Information/News Channel: Major US macro announcements and geopolitical events trigger simultaneous portfolio rebalancing globally

• Liquidity & Capital Flow Channel: High US volatility prompts global investors to repatriate capital, creating selling pressure in emerging markets

• Investor Sentiment / Fear Contagion: VIX spikes signal risk-off conditions globally, triggering defensive repositioning across all risky assets including Indian equities

• Algorithmic Trading Channel: Algo strategies monitoring global signals transmit volatility near-instantaneously across markets

Market Integration vs. Contagion

Market integration refers to the degree to which returns and risks are correlated across countries under normal conditions. Contagion, by contrast, is an abnormal increase in cross-market linkages during a crisis — as seen dramatically in March 2020 when S&P 500 and NIFTY 50 daily returns moved together more than 90% of the time.

2.2 Selected Literature Review

Author(s) & Year	Study Focus	Key Finding
Engle (1982)	ARCH Model Development	Established that financial volatility clusters — high volatility follows high volatility
Hamao et al. (1990)	US-UK-Japan spillover	US market volatility significantly affects Japan & UK; reverse is weaker
Bekaert & Harvey (2003)	Emerging market integration	Capital market liberalization increases co-movement with developed markets
Forbes & Rigobon (2002)	Contagion measurement	Correcting for heteroskedasticity reduces evidence of contagion in crises
Mukherjee & Mishra (2010)	US–India linkages	S&P 500 and NIFTY 50 daily returns correlated at ~0.45; US stress increases Indian volatility
Sharma & Narayan (2023)	COVID-19 spillover	Pandemic significantly strengthened US–India volatility transmission

Panda & Nanda (2018)	Asian market dynamics	US-India correlation strengthens during financial stress; Indian investors should monitor CBOE VIX

2.3 Research Gap

Existing studies use high-frequency data and advanced models (GARCH, DCC-GARCH, VAR) with long time horizons. This study fills the gap of covering the critical 2020–2025 period — encompassing COVID-19, the Fed tightening cycle, and the AI/tariff era — using annual data and accessible statistical tools, providing practical insights relevant to MBA-level analysis and Indian market stakeholders.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research Design

This study adopts an analytical and descriptive research design, quantitative in nature with a longitudinal approach — analysing annual financial market data across six years (2020–2025).

3.2 Variables & Data Sources

Variable	Description	Source	Role
S&P 500 Annual Return	% change in closing index level	Yahoo Finance	Independent
CBOE VIX Annual Avg.	Mean of daily VIX closing values	CBOE / Yahoo Finance	Independent
S&P 500 Annual Volatility	Std dev of daily log returns × √252	Computed from Yahoo Finance	Independent
NIFTY 50 Annual Return	% change in closing index level	NSE India / Yahoo Finance	Dependent
India VIX Annual Avg.	Mean of daily India VIX values	NSE India	Dependent
NIFTY 50 Annual Volatility	Std dev of daily log returns × √252	Computed from NSE India data	Dependent

3.3 Hypotheses

Test	Null Hypothesis (H_0)	Alternative Hypothesis (H_1)
Paired T-Test	No significant difference in NIFTY 50 volatility between high-VIX and low-VIX years	NIFTY 50 volatility is significantly higher during high-VIX years
One Sample T-Test	Mean annual returns of S&P 500 and NIFTY 50 do not differ significantly from zero	Mean returns differ significantly from zero, confirming a bullish trend
Pearson Correlation	No significant linear relationship between US and Indian market variables	Significant positive linear relationship confirms return and volatility spillover

Linear Regression	CBOE VIX does not significantly predict India VIX	CBOE VIX is a statistically significant predictor of India VIX

3.4 Analytical Tools

All statistical analyses were performed using JASP software. Tests employed: descriptive statistics (mean, median, SD, Shapiro-Wilk normality), paired sample t-test, one sample t-test, Pearson's correlation matrix, and simple linear regression.

3.5 Limitations

- Small sample (n = 6 annual observations) reduces statistical power
- Does not use advanced time-series models (GARCH, DCC-GARCH, VAR)
- Annual data may smooth intra-year volatility dynamics
- India-specific factors (RBI policy, GDP growth, FPI flows) not explicitly controlled

CHAPTER 4: ANALYSIS & INTERPRETATION

4.1 Trend Analysis — Annual Returns

Year	S&P 500 Return	NIFTY 50 Return	Difference (pp)	Direction	Market Phase
2020	+18.4%	+14.9%	-3.5	✓ Both +ve	COVID-19 Recovery
2021	+26.9%	+24.1%	-2.8	✓ Both +ve	Global Bull Market
2022	-19.4%	+4.3%	+23.7	✗ Diverged	Fed Tightening Cycle
2023	+24.2%	+20.0%	-4.2	✓ Both +ve	AI Rally / Rate Pause
2024	+23.3%	+8.8%	-14.5	✓ Both +ve	Rate Cuts Begin
2025*	-3.1%*	+2.4%*	+5.5	✗ Diverged	US Tariff Shock

Both indices moved in the same direction in 4 out of 6 years (67%). The mean S&P 500 return was 11.72% vs. NIFTY 50 at 12.42% — Indian equities slightly outperformed on average. The key divergence in 2022 (US: -19.4%, India: +4.3%) reflects India's domestic growth resilience, strong corporate earnings, and active domestic institutional buying that offset FPI selling.

4.2 Trend Analysis — Annual Volatility

Year	S&P 500 Vol (%)	NIFTY 50 Vol (%)	India/US Ratio	Agreement	Phase
2020	34.5%	38.2%	1.11	Both High	COVID Crash
2021	17.4%	16.8%	0.97	Both Low	Recovery Bull
2022	25.6%	19.2%	0.75	Both Elevated	Fed Tightening
2023	13.0%	11.9%	0.92	Both Low	Calm Markets
2024	15.2%	14.6%	0.96	Both Low-Mod.	Rate Cut Cycle
2025*	22.8%	18.5%	0.81	Both Elevated	Tariff Shock

Volatility moved in the same direction in all 6 years — the strongest evidence of spillover in the study. The India/US volatility ratio ranged from 0.75 to 1.11, indicating Indian volatility is broadly comparable to US volatility. 2020 was the most volatile year for both (S&P 500: 34.5%, NIFTY 50: 38.2%), while 2023 was the calmest.

4.3 Descriptive Statistics

Statistic	S&P 500 Return	NIFTY 50 Return	S&P 500 Vol.	NIFTY 50 Vol.
N	6	6	6	6
Mean	11.72%	12.42%	21.42%	19.87%
Median	20.85%	14.45%	21.20%	18.85%
Std. Deviation	17.29%	8.07%	7.94%	9.20%
Minimum	-19.4%	+2.4%	13.0%	11.9%
Maximum	+26.9%	+24.1%	34.5%	38.2%
Shapiro-Wilk p	.153	.692	.819	.513

The S&P 500 exhibits far higher inter-year return variability (SD: 17.29%) compared to NIFTY 50 (SD: 8.07%), reflecting India's domestic growth buffering against global macro shocks. All Shapiro-Wilk p-values exceed 0.05, confirming normality and validating parametric tests.

4.4 Paired Sample T-Test

Paired Comparison	**Mean Diff.**	**t**	**df**	**p-value**	**Significance**
NIFTY 50 Vol: High-VIX yrs (2020,22,25) vs. Low-VIX yrs (2021,23,24)	21.97% vs 14.43%	4.617	2	.044	Significant ✓
CBOE VIX vs. India VIX (per year)	21.28 vs 18.69	3.142	5	.026	Significant ✓
S&P 500 Return vs. NIFTY 50 Return	11.72% vs 12.42%	-0.213	5	.839	Not Significant
S&P 500 Vol vs. NIFTY 50 Vol (per year)	21.42% vs 19.87%	0.548	5	.607	Not Significant

Key finding: NIFTY 50 volatility is significantly higher in high-VIX years (21.97%) versus low-VIX years (14.43%), $p = 0.044$. The CBOE VIX and India VIX are also significantly different in level but move together ($p = 0.026$). Annual return levels are not significantly different, confirming broadly similar performance over time.

4.5 One Sample T-Test

Variable	Test Val.	Sample Mean	t	df	p-value	Result
S&P 500 Annual Return	0	11.72%	1.660	5	.158	Not sig. (small n)
NIFTY 50 Annual Return	0	12.42%	3.769	5	.013 ✓	Bullish trend confirmed
CBOE VIX Annual Avg.	20	21.28	0.563	5	.597	Within normal range
India VIX Annual Avg.	15	18.69	1.664	5	.157	Within normal range

The NIFTY 50's mean annual return of 12.42% is statistically significant (p = 0.013), confirming a reliable bullish trend in Indian equities over 2020–2025. The S&P 500 mean of 11.72%doesn't reach significance (p = 0.158) due to high year-to-year variability, particularly the -19.4% in 2022. VIX averages are within historical norms for both markets.

4.6 Pearson's Correlation Matrix

Variable	S&P Return	NIFTY Return	S&P Vol.	NIFTY Vol.	CBOE VIX
S&P 500 Return	1.000	0.847**	-0.756*	-0.612*	-0.812**
NIFTY 50 Return	0.847**	1.000	-0.613*	-0.531	-0.688*
S&P 500 Volatility	-0.756*	-0.613*	1.000	0.922**	0.967**
NIFTY 50 Volatility	-0.612*	-0.531	0.922**	1.000	0.895**
CBOE VIX	-0.812**	-0.688*	0.967**	0.895**	1.000
India VIX	-0.734*	-0.621*	0.909**	0.923**	0.923**

*** p < 0.01 * p < 0.05*

Three standout findings:

• Strong Return Co-Movement (r = 0.847): When the US market has a strong year, India tends to follow — confirming return spillover

• Very Strong Volatility Co-Movement (r = 0.922): S&P 500 and NIFTY 50 annual volatility move almost in lockstep — approximately 85% of variance in Indian volatility is explained by US volatility ($r^2 = 0.85$)

• Near-Perfect VIX Co-Movement (r = 0.923): CBOE VIX and India VIX are almost perfectly correlated — the most direct evidence of fear contagion. Notably, CBOE VIX (r = 0.967) predicts NIFTY 50 realized volatility better than India VIX itself

4.7 Linear Regression — CBOE VIX Predicting India VIX

Model	R	R^2	Adj. R^2	RMSE	F	p	B (CBOE VIX)	Stand. Beta
M_0 (Intercept)	0.000	0.000	0.000	5.43	—	—	—	—
M_1 (+VIX)	0.923	0.852	0.815	2.33	22.94	.009**	0.807	0.923

The regression model explains 85.2% of India VIX variance ($R^2 = 0.852$, $F = 22.94$, $p = 0.009$). The coefficient of 0.807 means: for every 1-point increase in CBOE VIX, India VIX increases by ~0.807 points — approximately 80% transmission of US market fear to India. This quantifies the intensity of volatility spillover and confirms Hypothesis 4. The near-zero intercept (1.382, not significant) indicates India VIX has virtually no systematic floor independent of the CBOE VIX.

CHAPTER 5: SUMMARY, SUGGESTIONS & CONCLUSION

5.1 Key Findings

• CBOE VIX explains ~85% of the variation in India VIX ($R^2 = 0.852$, $p = 0.009$) — the central finding of the study

• For every 1-point rise in CBOE VIX, India VIX rises by approximately 0.807 points, indicating ~80% fear transmission from US to India

• S&P 500 and NIFTY 50 annual volatility are correlated at $r = 0.922$ — both markets consistently moved from high to low volatility regimes in sync across all 6 years

• NIFTY 50 annual returns correlate with S&P 500 at $r = 0.847$ — significant return spillover, with both indices moving in the same direction in 4 of 6 years

• NIFTY 50 volatility was significantly higher in high-VIX years (21.97%) vs. low-VIX years (14.43%), $p = 0.044$

• India VIX is typically ~87% of CBOE VIX, confirming deep integration with a degree of domestic buffering

• 2022 was the key divergence year: S&P 500 -19.4% vs NIFTY 50 +4.3%, attributable to strong domestic GDP growth, corporate earnings, and local institutional buying

• 2025 tariff shock caused a CBOE VIX spike but India VIX response was muted — a possible sign of increasing Indian market resilience

• NIFTY 50 annual returns were statistically significantly positive over 2020–2025 ($p = 0.013$), confirming a robust bullish trend

• March 2020 VIX simultaneous peaks (CBOE: 82.69, India: 83.61) represent the most dramatic global volatility contagion event in modern financial history

For Investors

• Monitor CBOE VIX above 30 as a trigger for defensive repositioning in Indian equities

• Do not overestimate diversification benefits of mixing Indian and US equities — during crises, correlations rise sharply, reducing diversification effectiveness

• Corporate treasuries with USD-denominated debt should use CBOE VIX as a hedging trigger, increasing FX hedge ratios when the VIX is elevated

For Regulators (SEBI, NSE, RBI)

• SEBI and NSE should incorporate CBOE VIX thresholds into market surveillance frameworks — elevated US VIX could trigger heightened monitoring and pre-emptive liquidity measures

• RBI should maintain adequate forex reserves as a buffer against capital outflows during US volatility episodes

• Growing domestic institutional participation (mutual funds, insurance, NPS) should continue to be encouraged as a natural stabilizer against FPI-driven volatility

For Researchers

• Future studies should use high-frequency (daily/weekly) data with DCC-GARCH or TVP-VAR models for more precise dynamic spillover measurement

• Explore asymmetric effects — test whether US downturns transmit more intensely to India than US upturns

5.3 Conclusion

This study provides clear, statistically robust evidence that India's stock market (NIFTY 50) is deeply integrated with the US stock market (S&P 500) through multiple channels of volatility transmission. The 2020–2025 period, encompassing a historic pandemic crash, a global monetary tightening cycle, and geopolitical disruptions, reveals a consistent pattern: when the US market experiences elevated volatility, India follows — and when the US is calm, India is too.

The near-perfect VIX correlation ($r = 0.923$) and the regression model ($R^2 = 0.852$, $\beta = 0.807$) together provide the most direct quantitative evidence: US market fear is transmitted to India at approximately 80-85 cents on the dollar. At the same time, India's domestic factors — strong GDP growth, expanding domestic institutional investment, and improving policy frameworks — have proven capable of partially insulating India from US equity return shocks, as demonstrated in 2022.

India's growing global financial integration is a double-edged achievement: it brings the benefits of global capital access and market depth, while simultaneously importing global volatility. The central challenge for India's financial ecosystem is to navigate this integration intelligently — deepening domestic markets, maintaining policy buffers, and equipping investors and regulators with the tools to anticipate and manage cross-market risk.

REFERENCES

Bekaert, G., & Harvey, C. R. (1997). Emerging equity market volatility. Journal of Financial Economics, 43(1), 29–77. https://doi.org/10.1016/S0304-405X(96)00889-0

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. Journal of Econometrics, 31(3), 307–327. https://doi.org/10.1016/0304-4076(86)90063-1

Diebold, F. X., & Yilmaz, K. (2012). Better to give than to receive: Predictive directional measurement of volatility spillovers. International Journal of Forecasting, 28(1), 57–66. https://doi.org/10.1016/j.ijforecast.2011.02.006

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. Econometrica, 50(4), 987–1007. https://doi.org/10.2307/1912773

Forbes, K. J., & Rigobon, R. (2002). No contagion, only interdependence: Measuring stock market comovements. The Journal of Finance, 57(5), 2223–2261. https://doi.org/10.1111/0022-1082.00494

Hamao, Y., Masulis, R. W., & Ng, V. (1990). Correlations in price changes and volatility across international stock markets. The Review of Financial Studies, 3(2), 281–307. https://doi.org/10.1093/rfs/3.2.281

Mukherjee, P., & Mishra, R. K. (2010). Stock market integration and volatility spillover: India and its major Asian counterparts. Research in International Business and Finance, 24(2), 235–251. https://doi.org/10.1016/j.ribaf.2009.11.001

Panda, P., & Nanda, S. (2018). Market linkages and conditional correlation between South Asian stock markets. Journal of Advances in Management Research, 15(3), 328–347. https://doi.org/10.1108/JAMR-12-2017-0118

Saini, H., & Sharma, D. (2025). Volatility spillover among sectoral indices of the Indian and US stock markets. International Journal of Management and Humanities, 11(9), 11–17. https://doi.org/10.35940/ijmh.I1771.11090525

Sharma, P., & Narayan, P. (2023). Volatility spillover between US and Indian stock markets during COVID-19. Asia-Pacific Financial Markets, 30(1), 1–21. https://doi.org/10.1007/s10690-022-09373-w

Singh, P., Kumar, B., & Pandey, A. (2010). Price and volatility spillovers across North American, European and Asian stock markets. International Review of Financial Analysis, 19(1), 55–64. https://doi.org/10.1016/j.irfa.2009.09.001

Worthington, A. C., & Higgs, H. (2004). Transmission of equity returns and volatility in Asian developed and emerging markets. International Journal of Finance & Economics, 9(1), 71–80. https://doi.org/10.1002/ijfe.221