The Efficacy of the Black–Scholes Option Pricing Model in Valuing Nifty 50 Single Stock Options: Is There a Difference Between Shariah-Compliant and Non-Compliant Constituent Stocks?

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Abstract

This study investigates the pricing efficacy of single-stock options on India's NIFTY 50 index by applying the Black–Scholes Option Pricing Model (BSOPM) to both call and put options from December 18, 2024–January 30, 2025. Theoretical prices were estimated using standard inputs (spot, strike, volatility, time to maturity, and a 5.98 % risk-free rate), and mispricing was defined as the difference between market prices and theoretical prices. Paired t-tests and Welch's tests compared overall mispricing and segmental differences between Shariah-compliant and conventional stocks. The findings revealed widespread mispricing: 46.9% of call options and 57.14% of put options exhibit significant underpricing relative to theoretical values. However, contrary to expectations that Shariah-compliant stocks might display different pricing behaviour due to structural characteristics like lower leverage and volatility, no statistically significant difference in mispricing was observed between Shariah-compliant and conventional options. These results suggest that broader market factors—such as liquidity, risk aversion, and regulatory dynamics—play a more dominant role in influencing pricing inefficiencies than the Shariah compliance of the underlying stocks. These insights can guide hedging strategies for institutional investors and inform regulatory oversight in emerging derivatives markets.

Keywords: *Option pricing, Black–Scholes Model, Mispricing. Shariah-compliant stocks, Market inefficiencies*

1. Introduction

Although the Black–Scholes option-pricing model (BSOPM) serves as a basis for global derivatives markets with respect to its closed-form valuation and analytical simplicity, its application to India's structurally changed and increasingly retail-based derivatives market is lesser studied, especially when comparing Shariah-compliant and conventional single-stock options. Studies of NIFTY index and single-stock options point to significant BSOPM mispricing in that in-the-money contracts are under-priced, and out-of-the-money contracts are over-priced due to BSOPM's assumptions of constant volatility, frictionless trading, and continuous hedging (Tripathi & Gupta, 2010; Srivastava & Shastri, 2018). However, no research has explored whether the Shariah

screening process that creates a subset that possesses lower leverage and different volatility features has an impact on BSOPM valuation performance on the single-stock options.

India's exchange-traded derivatives ecosystem re-emerged in mid-2000 under Securities and Exchange Board of India (SEBI) oversight, with index futures debuting in June and single-stock options following quickly (Sharma & Arora, 2015). Since then, derivatives volumes have outstripped those of the cash equity market, reflecting fast-evolving investor sophistication and growing demand for tailored hedging instruments. Notably, retail investors now account for 41 percent of India's overall derivatives trading volumes—up from just 2 percent in 2018—underscoring the segment's retail-driven dynamics (Dugal, 2024).

At the heart of India's equity-derivatives trading is the NIFTY 50 index—a free-float, market-capitalization-weighted basket of the fifty most liquid stocks. NSE Indices Limited launched the NIFTY 50 Shariah Index, whose constituents are drawn from the parent NIFTY 50 but must pass Shariah-compliance filters. These filters are overseen by Taqwaa Advisory & Shariah Investment Solutions (TASIS), which applies a two-stage screening: (1) a business-activity screen excluding firms in non-permissible industries (interest-based finance, alcohol, gambling, etc.); and (2) a financial-ratio screen capping interest-bearing debt, interest income, and cash-and-receivables exposures to ensure alignment with Islamic-finance principles (Natarajan & Dharani, 2012). This process yields a Shariah-compliant subset whose sectoral mix, leverage profile, and realized volatility differ meaningfully from the full NIFTY 50 universe.

Despite these structural and behavioural differences, three critical questions remain unanswered for NIFTY 50 single-stock options. First, how closely do BSOPM theoretical prices align with observed market premiums for calls and puts over a targeted 30-trading-day window (December 18, 2024–January 30, 2025) We select this period to capture both year-end rebalancing dynamics and January's post-holiday trading surge while avoiding major Security and Exchange Board of India (SEBI) policy shifts. Second, do pricing deviations differ systematically between call and put contracts, reflecting asymmetries in hedging demand or embedded risk premia? Third, does Shariah compliance itself—beyond its influence on volatility and leverage—produce statistically distinct mispricing compared to non-compliant constituents.

To answer these questions, we (i) compute BSOPM theoretical values using spot prices, strikes, time to maturity, a prevailing risk-free rate, and historical volatility (30-day rolling standard deviation); (ii) define mispricing as the difference between observed option premiums and BSOPM estimates; and (iii) employ paired t-tests and Welch's tests — to examine mean deviations, call–put asymmetries, and cross-group differences.

By empirically quantifying BSOPM's valuation errors and isolating the effect of Shariah screening, our study makes three contributions. First, it provides one of the first rigorous, short-window tests of BSOPM efficacy in India's single-stock options market. Second, it uncovers whether call–put mispricing asymmetries persist when calibrated with market-consistent inputs. Third, it delivers the inaugural comparison of BSOPM mispricing between Shariah-compliant and non-compliant NIFTY 50 stocks—offering novel insights for both conventional and Islamic-finance practitioners. These results will guide institutional hedgers on model calibration and inform regulators as India's derivatives landscape continues to evolve.

2. Literature Review

The Black–Scholes model, despite criticisms in emerging markets for its assumptions of frictionless trading, continuous hedging, and log-normal returns, continues to serve as the benchmark for option valuation. In this study, its use is particularly justified because it provides a standardized baseline against which deviations can be measured. By comparing mispricing patterns across Shariah-compliant stock options and non-Shariah compliant stock options using the same pricing framework, we are able to isolate whether compliance screening introduces systematic differences in option valuation. However, empirical studies consistently highlight mispricing, particularly in emerging markets such as India, where high retail participation and episodic volatility shocks challenge the model's core assumptions. This literature review critically examines BSOPM's performance in Indian derivatives markets, focusing on single-stock options, and the underexplored impact of Shariah compliance on pricing efficiency.

The BSOPM, introduced by Black and Scholes (1973), provides a closed-form solution for pricing European-style options by linking market prices to five key inputs: spot price, strike price, time to maturity, risk-free rate, and volatility. While widely adopted, empirical research has sought to refine its assumptions. Merton (1976) introduced a jump–diffusion model, recognizing that discrete price movements better capture market shocks. Corrado and Su (1996) incorporated skewness and kurtosis adjustments to account for observed

fat-tailed distributions, while Hull and White (1987) developed stochastic volatility models to address BSOPM's assumption of constant variance. These refinements, while theoretically robust, reveal that pricing discrepancies persist due to liquidity constraints and investor behaviour.

Empirical studies on NIFTY index options document systematic mispricing. Tripathi and Gupta (2010) observed that in-the-money (ITM) calls are consistently underpriced, whereas out-of-the-money (OTM) contracts are overpriced, attributed to India's pronounced volatility smile. Singh et al. (2011) compared BSOPM valuations with those from a Heston–Nandi GARCH model, demonstrating that while GARCH frameworks improve accuracy, significant pricing errors remain. These biases are exacerbated by retail-driven demand dynamics, liquidity constraints, and regulatory inefficiencies, necessitating further scrutiny of single-stock options.

Empirical analyses of Indian single-stock options reinforce these findings. Kumar and Agrawal (2017) confirmed that BSOPM systematically underprices high-volatility stocks, failing to adjust for idiosyncratic risk. Srivastava and Shastri (2018) demonstrated that mispricing magnitudes increase with extreme moneyness, particularly for deep ITM and OTM contracts. Sharma (2018) highlighted that short-tenor options (maturities <30 days) exhibit greater discrepancies, underscoring BSOPM's limitations in handling short-term market dynamics. However, sector-specific stability plays a role in dampening pricing errors. Panduranga (2013) found that cement-sector options showed more modest mispricing, while Narayanamoorthy and Sehgal (2007) linked pricing efficiency to historical volatility patterns, demonstrating that implied volatility often underestimates actual risk.

Volatility estimation critically influences theoretical valuations. Nagendran and Venkateswar (2014) and Nandan and Agrawal (2016) showed that implied volatility improves pricing accuracy, yet historical volatility remains widely used due to data consistency and its independence from market calibration. This study adopts 30-day historical volatility, recognizing its comparability with prior Indian BSOPM studies (Tripathi and Gupta, 2010; Srivastava and Shastri, 2018) while acknowledging potential robustness concerns.

Indian Shariah-screened equities exhibit lower and more predictable volatility, raising questions about their impact on option pricing. Natarajan and Dharani (2012) reported that while mean returns of Shariah-compliant stocks were similar to conventional equities, volatility was significantly lower, suggesting a distinct risk profile. Dharani et al. (2015) applied ARCH–GARCH models to Shariah-compliant stocks, confirming stable conditional variances relative to non-screened firms. Given BSOPM's sensitivity to volatility inputs, Shariah-compliant stocks should theoretically exhibit less mispricing, yet empirical validation remains scarce. The evidence is clear: BSOPM mispricing in India is widespread, influenced by violated assumptions of constant volatility, liquidity constraints, and retail-driven demand patterns. While sectoral stability and alternative pricing models offer partial corrections, mispricing remains persistent. The role of Shariah compliance in single-stock option valuation, despite theoretical predictions of lower volatility-driven biases, remains underexplored. By directly testing BSOPM-derived theoretical prices against observed market premiums, this study aims to address this critical research gap, providing insights for asset managers, traders, and regulators in both conventional and Islamic finance.

3. Research Methodology

This section presents a step-by-step account of the procedures used to evaluate option-pricing efficiency for NIFTY 50 single-stock options over the 30-trading-day window from 18 December 2024 to 30 January 2025. Although the index comprises 50 constituents, the analysis is restricted to 49 stocks: Shriram Finance was excluded because it executed a stock split on 10 January which is the observation period and reliable split-adjusted data were not available. The exclusion prevents mis-measurement of underlying prices and strike adjustments that would otherwise bias both Black–Scholes parameter estimates and subsequent efficiency tests. All remaining stages—data acquisition and cleaning, volatility and risk-free-rate estimation, theoretical pricing via the BSOPM, and statistical evaluation of pricing deviations—are detailed below to ensure transparency and reproducibility.

3.1 Data Collection

The sample for this study comprises forty-nine constituent stocks of the NIFTY 50 index, one having been excluded due to a recent corporate action that rendered its option series incomplete. Of these, eighteen have been classified as Shariah-compliant according to the National Stock Exchange's (NSE) screening criteria and

thirty-one as non-compliant. Daily closing equity prices were obtained for each of the forty-nine stocks over the thirty-trading-day period from 18 December 2024 to 30 January 2025 using the Python yahoo finance library; these price series were then exported in CSV format for analysis. For the same sample window, the full option chain for each underlying was retrieved directly from the NSE website. An option chain—in this context—is defined as the complete set of exchange-traded call and put contracts on a given underlying for every available strike and expiration, accompanied by each contract's end-of-day premium, open interest, and trading volume. A constant annualized risk-free rate of 5.98 percent (0.0598 in decimal form), corresponding to the prevailing 90-day Treasury bill bid rate published by the Reserve Bank of India, was applied uniformly in all theoretical valuations. The procedure for calculating historical volatility is detailed in Section 8.3. Collectively, these equity, derivatives, and risk-free rate inputs form a comprehensive and reliable foundation for calibrating and evaluating the Black–Scholes Option Pricing Model.

3.2 Data Cleaning and Exclusion Criteria

Once acquired, the raw equity series were adjusted in Excel for corporate actions. Adjustment factors for dividends, bonus issues, and splits were applied and documented in a dedicated worksheet. Sriram Finance, which underwent a 1: 5 shares split on 10 January 2025 without a reliable adjusted price history, was therefore excluded, yielding a final sample of forty-nine stocks. Option-chain data were subjected to a completeness screen: any strike price missing one or more premium quotes across the thirty-day period was removed. This ensured that all subsequent computations relied on consistently observed option contracts.

3.3 Strike Price Identification

Strike-selection was informed by robust evidence that BSOPM mispricing in India escalates as options move away from the at-the-money level. Tripathi and Gupta (2010) show that in-the-money call options on the NIFTY index are persistently underpriced, while out-of-the-money contracts are consistently overpriced—patterns attributable to a pronounced volatility smile at moneyness extremes. Srivastava and Shastri (2018) further demonstrate that relative pricing discrepancies increase monotonically with the distance from the at the money (ATM) strike, peaking for deep ITM and deep OTM strikes. In light of these findings, and to focus our analysis on the strike region where hedging demand is highest and theoretical-market comparability is strongest, we adopt a proximity-based approach to ATM identification.

Concretely, we compute each stock's thirty-day average closing price over the 18 December 2024–30 January 2025 window in Excel. An option contract whose strike exactly equals this average—and which possessed uninterrupted daily data—was designated as the ATM strike (applicable to Coal India, HCL Technologies, IndusInd Bank, Maruti Suzuki, Nestlé India, and Power Grid Corporation of India). For the remaining stocks, we selected the nearest available strike within ± 1 percent of the average; only Hero MotoCorp and Tata Steel required expansion of the tolerance to ± 2 percent to secure a consistently traded series. This hierarchical, literature-motivated method ensures that our selected strikes lie closest to true ATM levels—precisely where BSOPM's assumptions are most pertinent—while guaranteeing uniform data coverage across the entire sample.

Table 1 – Strike Prices.

	Company Name	Avg near ATM Strike Price (₹)	CE	PE	± 1 range		CE	PE	±2 (for illiquid options)		CE	PE	Selected Strike Price (₹)
1	Adani Enterprises	2410	x	x	2386	2434	✓	✓	2362	2458			2400
2	Adani Ports	1152	x	x	1140	1164	✓	✓	1129	1175			1140
3	Apollo Hospitals **[S]**	7040	x	x	6970	7110	✓	✓	6899	7181			7000
4	Asian Paints **[S]**	2276	x	x	2253	2299	✓	✓	2230	2322			2280
5	Axis Bank	1035	x	x	1025	1045	✓	✓	1014	1056			1030
6	Bajaj Auto	8691	x	x	8605	8778	✓	✓	8518	8865			8700

7	Bajaj Finserv	1670	x	x	1653	1687	✓	✓	1637	1703			1680
8	Bajaj Finance	7230	x	x	7158	7302	✓	✓	7085	7375			7200
9	BEL	279	x	x	276	282	✓	✓	273	285			280
10	Bharti Airtel	1607	x	x	1591	1623	✓	✓	1575	1639			1600
11	BPCL [S]	274	x	x	271	277	✓	✓	269	279			275
12	Britannia Industries [S]	4879	x	x	4830	4928	✓	✓	4781	4976			4850
13	Cipla [S]	1470	x	x	1455	1484	✓	✓	1440	1499			1480
14	Coal India [S]	375	✓	✓	372	379			368	383			375
15	Dr. Reddy's Laboratories [S]	1318	x	x	1305	1331	✓	✓	1292	1344			1320
16	Eicher Motors	5024	x	x	4974	5074	✓	✓	4924	5125			5000
17	Grasim Industries	2437	x	x	2412	2461	✓	✓	2388	2486			2440
18	HCL Tech [S]	1860	✓	✓	1841	1878			1823	1897			1860
19	HDFC Bank	1708	x	x	1690	1725	✓	✓	1673	1742			1710
20	HDFC Life Insurance Company	619	x	x	613	626	✓	✓	607	632			620
21	Hero MotoCorp [S]	4055	x	x	4014	4095	x	x	3974	4136	✓	✓	4000
22	Hindalco Industries	601	x	x	595	607	✓	✓	589	613			600
23	Hindustan Unilever [S]	2368	x	x	2344	2392	✓	✓	2321	2415			2360
24	ICICI Bank	1257	x	x	1244	1270	✓	✓	1232	1282			1260
25	IndusInd Bank	960	✓	✓	950	970			941	979			960
26	Infosys	1899	x	x	1880	1918	✓	✓	1861	1937			1900
27	ITC	446	x	x	442	450	✓	✓	437	455			445
28	JSW Steel	914	x	x	905	923	✓	✓	896	932			910
29	Kotak Mahindra Bank	1810	x	x	1792	1828	✓	✓	1774	1846			1800
30	Larsen & Toubro	3562	x	x	3526	3598	✓	✓	3491	3633			3550
31	Mahindra & Mahindra	2984	x	x	2954	3014	✓	✓	2924	3044			3000
32	Maruti Suzuki India	11600	✓	✓	11484	11716			11368	11832			11600
33	Nestle India [S]	2180	✓	✓	2158	2201			2136	2223			2180
34	NTPC	324	x	x	321	327	✓	✓	317	330			325
35	ONGC [S]	248	x	x	246	250	✓	✓	243	253			250
36	Power Grid Corporation of India	300	✓	✓	297	303			294	306			300
37	Reliance Industries	1243	x	x	1231	1255	✓	✓	1218	1268			1240
38	SBI Life Insurance Company	1443	x	x	1429	1457	✓	✓	1414	1472			1440
39	State Bank of India	775	x	x	767	783	✓	✓	760	791			770
40	Sun Pharmaceutical Industries [S]	1799	x	x	1781	1817	✓	✓	1763	1835			1800

41	Tata Consumer Products [S]	945	x	x	935	954	✓	✓	926	963			940
42	Tata Motors	754	x	x	746	761	✓	✓	739	769			750
43	Tata Steel	133	x	x	132	134	x	x	130	136	✓	✓	130
44	TCS [S]	4136	x	x	4094	4177	✓	✓	4053	4218			4150
45	Tech Mahindra [S]	1688	x	x	1671	1704	✓	✓	1654	1721			1700
46	Titan	3369	x	x	3335	3403	✓	✓	3302	3436			3350
47	Trent [S]	6449	x	x	6384	6513	✓	✓	6320	6578			6400
48	UltraTech Cement [S]	11210	x	x	11098	11322	✓	✓	10986	11435			11200
49	Wipro	297	x	x	294	299	✓	✓	291	302			295

Source: Author's computation using NSE data

This table displays the strike prices for call (CE) and put (PE) options associated with the NIFTY 50 constituent stocks, along with designated ranges for liquid and illiquid options. It serves as a reference for determining the optimal strike price for options trading based on liquidity considerations. Stocks marked with '[S]' indicate Shariah-compliant equities.

3.4 Parameter Estimation for Black–Scholes Inputs

The Black–Scholes formula requires five inputs: the spot price (S), the strike price (K), time to expiry (t), the risk-free rate (r), and volatility (σ) each of which was estimated as follows.

Option-chain selection was governed by liquidity considerations: only the 30 January 2025 expiration series traded continuously at the pre-selected at-the-money strikes; all other expiries either failed to trade on certain days or exhibited inadequate volume. Accordingly, daily call and put premiums, open interest, and trading volumes for the 30 January 2025 contracts were retrieved from the National Stock Exchange website over the valuation window (18 December 2024–30 January 2025).

Spot prices were taken from the cleaned series of daily closing equity prices. Strike prices were held constant at the pre-selected at-the-money levels shown in Table 8.1. Time to expiry was expressed as the ratio of remaining trading days in the valuation window (18 December 2024–30 January 2025) to the conventional 252-day trading year. A uniform annualized risk-free rate of 5.98 percent (r = 0.0598) was applied across all observations.

Historical volatility was estimated over a separate thirty-trading-day period immediately preceding this window (1 November 2024 to 17 December 2024). Within the estimation period, daily closing prices were used to compute thirty logarithmic returns in Excel, $\ln(S_t/S_{t-1})$, where S_t denotes the closing price on day t. then calculating their standard deviation using Excel's STDEV.P function. This daily figure was annualized by multiplying by square root of 252 producing the annualized volatility input (σ_{annual}) for the Black–Scholes model. The annualized volatility values for all forty-nine constituent stocks, including both Shariah-compliant (denoted as '[S]') and non-Shariah-compliant equities, are presented in Table 2.

Table 2 Annualized Volatility Estimates for Constituent Stocks.

Stock Name	Volatility
Adani Enterprises	0.8598
Adani Ports	0.5679
Apollo Hospitals [S]	0.3041
Asian Paints [S]	0.2981
Axis Bank	0.1863
Bajaj Auto	0.2450
Bajaj Finserv	0.1946
Bajaj Finance	0.2209
BEL	0.2867
Bharti Airtel	0.2680
BPCL [S]	0.2526
Britannia Industries [S]	0.3221

Cipla **[S]**	0.2025
Coal India **[S]**	0.1959
Dr. Reddy's Laboratories **[S]**	0.2065
Eicher Motors	0.2759
Grasim Industries	0.2558
HCL Technologies **[S]**	0.1986
HDFC Bank	0.1962
HDFC Life Insurance Company	0.2071
Hero MotoCorp **[S]**	0.2564
Hindalco Industries	0.3596
Hindustan Unilever **[S]**	0.2132
ICICI Bank	0.1577
IndusInd Bank	0.1871
Infosys	0.2459
ITC	0.1719
JSW Steel	0.2682
Kotak Mahindra Bank	0.1581
Larsen & Toubro	0.2316
Mahindra & Mahindra	0.2702
Maruti Suzuki India	0.1678
Nestle India **[S]**	0.1677
NTPC	0.2545
ONGC **[S]**	0.2375
Power Grid Corporation of India	0.2533
Reliance Industries	0.2249
SBI Life Insurance Company	0.2330
State Bank of India	0.2579
Sun Pharmaceutical Industries **[S]**	0.1848
Tata Consumer Products **[S]**	0.2497
Tata Motors	0.2267
Tata Steel	0.2335
TCS **[S]**	0.2441
Tech Mahindra **[S]**	0.2328
Titan	0.2368
Trent **[S]**	0.3184
UltraTech Cement **[S]**	0.2548
Wipro	0.2165

Source: Author's computation using NSE data

3.5 Theoretical Option-Price Computation

With inputs in place, theoretical call and put prices were calculated using the Black–Scholes framework in Excel. The intermediate terms were evaluated via Excel's natural-log and arithmetic functions.

$$d1 = \frac{\ln S/K + \left(r + \sigma^2/2\right)t}{\sigma\sqrt{t}}$$

$$d2 = d1 - \sigma\sqrt{t}$$

Subsequently, call prices (CE) were obtained using

$$C = S \cdot N(d1) - Ke - rt \cdot N(d2)$$

$$P = Ke - rt.N(d2) - S.N(d1)$$

These formulas were applied uniformly across all forty-nine stocks and thirty trading days, yielding a total of 2,998 option-price observations.

3.6 Empirical Measurements and Statistical Tests

Following the computation of Black–Scholes theoretical prices for all 2,998 option observations, the dataset was divided by underlying stock and option type, yielding thirty paired observations for calls and thirty for puts per security. Paired-sample t-tests were then performed in Excel to compare each series of market premiums against its corresponding model prices. For each of the forty-nine stocks, paired-sample t-tests were conducted separately on the deviations of call and put prices. For each test, Excel produced the sample means market price and mean theoretical price, together with the t-statistic and associated p-value. Instances in which the p-value fell below the 0.05 threshold were interpreted as evidence of statistically significant discrepancies between the market prices and the theoretical prices as calculated by BSOPM. To quantify these deviations, the percentage mispricing was calculated as;

$$\text{Mispricing}(\%) = (\text{Market Price} - \text{Theoretical Price} / \text{Theoretical Price}) \times 100$$

The resulting t-statistics, p-values and percentage mispricing were recorded in tabular form, providing a clear, stock-by-stock measure of both the significance and magnitude of systematic mispricing under the Black–Scholes framework. To ensure these results were free from spreadsheet-related errors, all paired-sample t-tests were independently replicated in Python. The Python outputs matched the Excel results exactly, confirming the reliability of our inferential statistics.

All statistical tests were evaluated at the conventional 5% significance level, such that $p < 0.05$ was taken as grounds to reject the null hypothesis of equality between market and theoretical prices. This threshold reflects common practice in empirical finance research, providing robustness while avoiding over-interpretation of marginal results.

Having established the overall significance of mispricing at the stock level, we next examined whether Shariah-compliant Nifty 50 constituents display distinct option-pricing mispricing compared to their non-compliant counterparts, we computed, for each of the 49 equities and for both call (CE) and put (PE) series, the average mispricing Δ = (Market – BSOPM). This resulted in 98 observations, each marked with a binary "Compliance" indicator (Yes = Shariah-compliant, No = non-compliant). We then compared the distribution of average mispricing Δ across the two groups employing an independent-samples t-test with Welch's correction, suitable for uneven variances and sample sizes. The null hypothesis (H_{02}) posited that the mean average mispricing Δ for Shariah-compliant options is equivalent to the mean.

3.7 Concluding remarks in methodology

This chapter has comprehensively outlined the empirical framework, encompassing data collection, cleaning, strike identification, parameter estimation, and theoretical pricing under the Black–Scholes model, followed by inferential procedures using paired-sample t-tests. Each step was documented to ensure reproducibility and to directly address the study's hypotheses concerning overall mispricing and the potential influence of Shariah compliance. Having established this methodological foundation, the analysis now turns to the presentation and interpretation of the empirical findings.

4. Results

This section presents an in-depth interpretation of the empirical findings for Objective 2, which measures the average difference (Δ = Market Price – BSOPM price) for call and put options on all 49 Nifty 50 stocks, testing whether these deviations differ significantly. The results reveal three clear clusters of behavior for calls and put: (1) statistically significant overvaluation, (2) statistically insignificant deviation, and (3) statistically significant undervaluation.

4.1 Call Options: Overvaluation, Indeterminate, and Undervaluation

The findings of the study reveal significant deviations in call-option pricing for selected stocks relative to the theoretical pricings provided by the Black-Scholes Option Pricing Model (BSOPM). Notably, seven stocks as shown in Table 3, exhibited statistically significant overvaluation ($\Delta > 0$, $p < 0.05$), wherein market prices consistently exceeded theoretical prices. Out of the seven stocks, Coal India is the only shariah compliant stocks, that exhibit statistically significant call option overvaluation.

The evaluation of call option pricing among banking stocks within the NIFTY50 Index reveals notable mispricing dynamics. Specifically, out of the six banking stocks constituting the index, the call options of four exhibited overvaluation, where the market price (Mp) exceeded the theoretical price (Tp). This discrepancy underscores potential inefficiencies in option pricing models. Moreover, among the seven stocks analyzed, Coal India, a Shariah-compliant stock, demonstrated statistically significant call option overvaluation, suggesting that compliance with Islamic financial principles does not insulate a stock from prevailing market inefficiencies. The extent of percentage mispricing varied substantially across the sample, ranging from a relatively modest 2% for Tata Steel to a pronounced 32% for Axis Bank. Such disparities indicate that market participants may be attributing varying degrees of premium over Black-Scholes Option Pricing Model (BSOPM)-derived valuations.

Table 3 Stocks with Statistically Significant Call-Option Overvaluation (Mp > Tp).

Stock	Mean Market Price (₹)	Mean Theoretical Price (₹)	% Mispricing	p value
AXISBANK	52.095	39.563	31.68%	0.003
COALINDIA [S]	16.572	13.454	23.17%	0.034
ICICIBANK	33.007	29.634	11.38%	< 0.001
INDUSINDBK	30.567	24.256	26.02%	< 0.001
KOTAKBANK	53.025	49.875	6.32%	0.006
TATAMOTORS	28.410	25.933	9.55%	< 0.001
TATASTEEL	6.480	6.351	2.03%	0.004

(Source: Author's computation using NSE data)

In contrast, nineteen stocks demonstrated no statistically significant deviation from theoretical prices (Δ not significant at $p < 0.05$), indicating a close alignment between observed market premiums and BSOPM prices. Among the five Fast-Moving Consumer Goods (FMCG) stocks that are part of the NIFTY50 Index, four—ITC, Hindustan Unilever (HUL), Nestle India, and Britannia—demonstrate statistical significance. Additionally, eight Shariah-compliant stocks, identified in Table 4 by [S], do not exhibit statistical significance. This trend highlights the distinct pricing behavior and market characteristics of these stock categories, potentially influenced by factors such as liquidity, investor sentiment, and sector-specific dynamics.

Table 4 Stocks with Statistically no Significant deviation for Call Option Pricing.

Stock	Mean Market Price (₹)	Mean Theoretical Price (₹)	% Mispricing	p value
BAJAJ-AUTO	263.13	274.49	-4.14%	0.170
BAJAJFINSV	41.22	42.45	-2.90%	0.135
BEL	11.91	12.17	-2.17%	0.514
BPCL[S]	14.04	13.31	5.47%	0.112
BRITANNIA [S]	124.11	117.69	5.45%	0.154
CIPLA [S]	37.18	36.96	0.61%	0.818
DRREDDY [S]	43.87	43.56	0.71%	0.830
GRASIM	84.44	81.20	4.00%	0.746
HDFCBANK	51.85	51.91	-0.11%	0.975
HDFCLIFE	15.35	16.73	-8.25%	0.053
HINDUNILVR [S]	61.23	66.27	-7.62%	0.399

ITC	16.54	18.12	-8.70%	0.185
JSWSTEEL	33.56	32.24	4.07%	0.569
MARUTI	292.61	311.04	-5.93%	0.064
NESTLEIND [S]	52.17	54.74	-4.69%	0.460
NTPC	13.78	11.87	16.02%	0.274
TRENT [S]	418.98	431.26	-2.85%	0.207
ULTRACEMCO [S]	373.82	402.94	-7.23%	0.110
WIPRO	14.03	13.16	6.67%	0.064

(Source: Author's computation using NSE data)

Furthermore, analysis indicates that the remaining 23 stocks exhibit significant undervaluation ($\Delta < 0$, p < 0.05), with market prices below their theoretical prices. Within the Information Technology sector of the NIFTY50 Index, which comprises five stocks, four—HCL Tech, Infosys, TCS, and Tech Mahindra—demonstrate statistically significant call option undervaluation. Additionally, nine Shariah-compliant stocks, listed in Table 5 by [S], show differences between their market and theoretical prices, indicating that their call options are undervalued. This suggests possible market inefficiencies, which may be influenced by sector trends and investor behavior. Further research is needed to understand the reasons behind this undervaluation.

Table 5 Stocks with Statistically Significant Call-Option Undervaluation (Mp < Tp).

Stock	Mean Market Price (₹)	Mean Theoretical Price (₹)	% Mispricing	p value
ADANIENT	107.942	256.537	-57.92%	8E-14
ADANIPORTS	57.332	87.320	-34.34%	5E-12
APOLLOHOSP [S]	242.291	325.559	-25.58%	2E-10
ASIANPAINT [S]	53.063	82.391	-35.60%	4E-13
BAJFINANCE	210.312	222.307	-5.40%	0.0146
BHARTIARTL	38.562	55.985	-31.12%	5E-13
EICHERMOT	136.607	184.070	-25.79%	1E-12
HCLTECH [S]	58.015	67.806	-14.44%	9E-05
HEROMOTOCO [S]	219.693	232.080	-5.34%	0.0033
HINDALCO	18.895	27.962	-32.43%	3E-13
INFY	56.273	62.957	-10.62%	0.0002
LT	106.052	120.999	-12.35%	1E-06
M&M	89.542	104.040	-13.94%	2E-06
ONGC [S]	9.462	10.222	-7.44%	3E-06
POWERGRID	10.923	12.481	-12.48%	8E-09
RELIANCE	30.413	37.209	-18.26%	3E-11
SBILIFE	39.983	46.130	-13.32%	2E-07
SBIN	26.730	31.255	-14.48%	6E-10
SUNPHARMA [S]	47.597	53.557	-11.13%	6E-08
TATACONSUM [S]	25.650	31.597	-18.82%	1E-08
TCS [S]	84.117	127.320	-33.93%	3E-10
TECHM [S]	42.997	46.458	-7.45%	0.0295
TITAN	91.260	110.510	-17.42%	5E-08

(Source: Author's computation using NSE data)

4.2 Put Options: Overvaluation, Indeterminate, and Undervaluation

The findings of the study reveal significant deviations in the put-option pricing for selected stocks relative to the theoretical pricings provided by the Black-Scholes Option Pricing Model (BSOPM). Notably, thirteen stocks exhibited statistically significant overvaluation ($\Delta > 0$, p < 0.05), wherein market prices consistently exceeded theoretical prices, indicating that traders pay an extra premium for bearish protection.

The percentage mispricing across these stocks varies between 6.23% (Cipla) and 41.62% (IndusInd Bank), indicating substantial deviations from theoretical valuations. Among these twelve stocks, six—Axis Bank, Coal India, ICICI Bank, IndusInd Bank, Kotak Mahindra Bank, Tata Motors, and Tata Steel—exhibited call option overvaluation, where market prices exceeded theoretical estimates.

Among the six banking stocks in the NIFTY50 Index, four show overvalued put options (Mp > Tp), reflecting the same trend as their call options. This points to persistent pricing inefficiencies in the banking sector. Additionally, six Shariah-compliant stocks, listed in Table 6 by [S], exhibit statistically significant put option overvaluation, reinforcing the presence of pricing anomalies. These trends call for further analysis of market sentiment, liquidity, and structural influences on option pricing.

Table 6 Stocks with Statistically Significant Put-Option Overvaluation (Mp > Tp).

Stock	Mean Market Price	Mean Theoretical Price	% Mispricing	p value
AXIS BANK	27.042	24.629	9.8%	0.0019
BPCL [S]	7.478	6.417	16.55%	0.0037
BRITANNIA [S]	93.662	74.480	25.75%	7E-10
CIPLA [S]	41.835	39.383	6.23%	0.007
COALINDIA [S]	6.542	5.068	29.08%	8E-07
DRREDDY [S]	40.498	37.166	8.97%	0.0026
HCLTECH [S]	51.783	46.099	12.33%	9E-06
ICICIBANK	27.832	23.818	16.85%	3E-09
INDUSINDBK	26.510	18.719	41.62%	1E-09
KOTAKBANK	38.815	34.207	13.47%	0.0004
TATAMOTORS	19.282	16.496	16.89%	1E-04
TATASTEEL	2.377	2.216	7.25%	0.0002
WIPRO	6.947	4.912	41.43%	3E-08

(Source: Author's computation using NSE data)

Eight stocks show non-significant differences, meaning the market and BSOPM prices are statistically indistinguishable. Among the eight stocks analyzed, six—Bajaj Auto, Bajaj Finserv, HDFC Life, ITC Ltd, Maruti Suzuki Ltd, and Nestlé India—demonstrate pricing efficiency, with no significant deviation in their call option prices as well. Similarly, Bajaj Auto, Bajaj Finance, and Bajaj Finserv, the only Bajaj Group companies in the NIFTY50 Index, show no statistically significant differences in their put option prices. This consistency may be attributed to shared financial strategies, market positioning, and institutional stability within the Bajaj Group. Additionally, two Shariah-compliant stocks, listed in Table 7 by [S], also display no statistically significant deviation, reinforcing broader trends in option pricing.

Table 7 Stocks with Statistically no Significant deviation for Put Option Pricing.

Stock	Mean Market Price	Mean Theoretical Price	% Mispricing	p value
BAJAJ-AUTO	232.232	231.7367	0.21%	0.9456
BAJAJFINSV	42.745	47.3004	-9.63%	0.0871
BAJFINANCE	179.570	191.7235	-6.34%	0.1939
HDFCLIFE	13.692	13.1671	3.98%	0.5028
ITC	5.955	6.2278	-4.38%	0.0573
MARUTI	292.783	273.1105	7.20%	0.1924
NESTLEIND [S]	30.595	31.0095	-1.34%	0.6887
TECHM [S]	48.463	45.3360	6.90%	0.0809

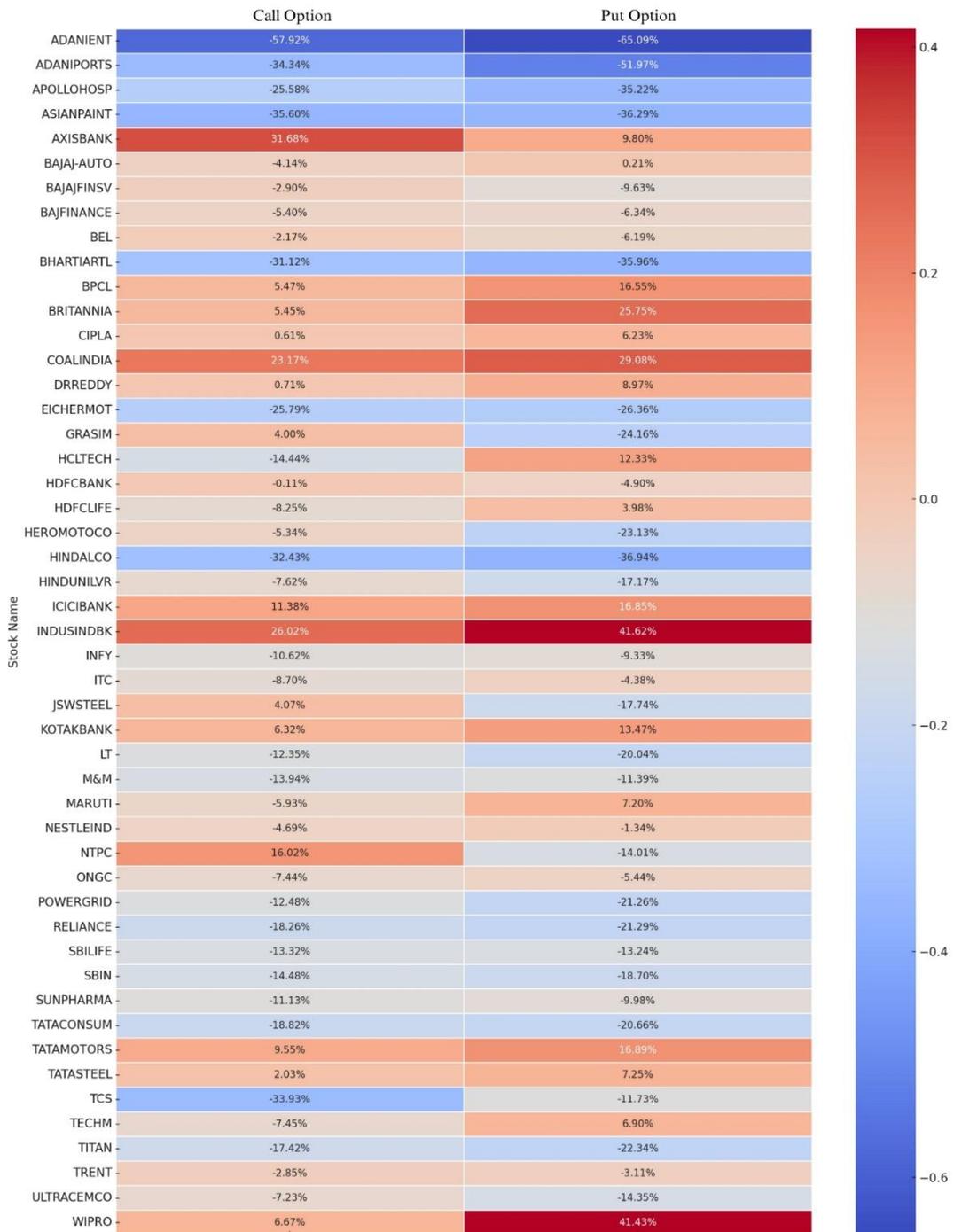(Source: Author's computation using NSE data)

The remaining twenty-eight put series—comprising the bulk of the sample—display significant undervaluation of the market prices ($p < 0.05$). Additionally, ten Shariah-compliant stocks, listed in Table 8 by [S], also display statistically significant put option undervaluation.

Table 8 - Stocks with Statistically Significant Put-Option Undervaluation (Mp < Tp).

Stock	Mean Market Price	Mean Theoretical Price	% Mispricing	p value
ADANIENT	78.530	224.9522	-65%	1.2E-13
ADANIPORTS	30.895	64.3233	-52%	1.6E-12
APOLLOHOSP [S]	138.895	214.4109	-35%	7.3E-11
ASIANPAINT [S]	45.260	71.0385	-36%	3.9E-15
BEL	8.368	8.9201	-6%	7.6E-03
BHARTIARTL	25.838	40.3503	-36%	8.1E-11
EICHERMOT	108.717	147.6274	-26%	7.5E-10
GRASIM	51.952	68.5013	-24%	2.2E-08
HDFCBANK	39.510	41.5453	-5%	1.7E-02
HEROMOTOCO [S]	37.075	48.2284	-23%	8.4E-10
HINDALCO	14.183	22.4933	-37%	1.6E-12
HINDUNILVR [S]	40.308	48.6655	-17%	1.1E-04
INFY	45.748	50.4561	-9%	2.7E-03
JSWSTEEL	19.223	23.3689	-18%	1.1E-05
LT	63.732	79.7060	-20%	7.7E-08
M&M	90.270	101.8773	-11%	1.8E-05
NTPC	7.048	8.1964	-14%	1.7E-05
ONGC [S]	5.760	6.0916	-5%	1.1E-02
POWERGRID	5.567	7.0697	-21%	1.7E-09
RELIANCE	21.743	27.6263	-21%	3.6E-09
SBILIFE	29.980	34.5552	-13%	9.9E-03
SBIN	15.418	18.9651	-19%	4.8E-06
SUNPHARMA [S]	29.540	32.8152	-10%	9.2E-06
TATACONSUM [S]	19.862	25.0332	-21%	2.8E-05
TCS [S]	94.005	106.4999	-12%	7.6E-05
TITAN	57.158	73.5969	-22%	7.2E-09
TRENT [S]	287.110	296.3195	-3%	1.1E-02
ULTRACEMCO [S]	274.973	321.0246	-14%	6.7E-05

(Source: Author's computation using NSE data)

Figure 1 Heatmap of % Mispricing

Heatmap of %Mispricing

(Source: Author's computation using NSE data)

This heatmap illustrates the percentage mispricing of call (CE) and put (PE) options across the NIFTY50 constituent stocks. Each row represents a stock, with columns denoting call and put options. Positive values (red) indicate overvaluation, while negative values (blue) signal undervaluation.

4.3 Impact of Volatility on Option Mispricing: Empirical Analysis

The analysis reveals a strong negative correlation between volatility and option mispricing for both call and put options (-0.619 and -0.624, respectively). This finding indicates that increased stock volatility corresponds to reduced deviations from theoretical values derived from the Black-Scholes Option Pricing Model (BSOPM). More volatile stocks exhibit market prices that align more closely with BSOPM predictions, suggesting that the market effectively incorporates risk into pricing. In contrast, lower-volatility stocks demonstrate greater mispricing, particularly significant cases of overvaluation or undervaluation. These results underscore volatility as a critical factor in explaining deviations from theoretical option pricing and advocate for incorporating volatility adjustments in future mispricing models to enhance predictive accuracy.

Figure 2 Volatility vs % Mispricing
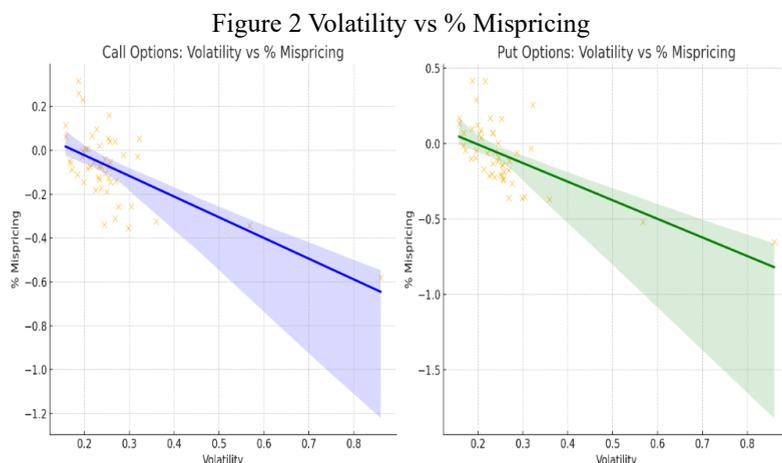
(Source: Author's computation using NSE data)

4.4 Shariah Compliant vs Non shariah compliant

The comparative analysis of mispricing between Shariah-compliant and non-compliant NIFTY 50 options reveals that the two groups are indistinguishable in terms of average deviation from Black–Scholes theoretical values. The Welch t-test produced a test statistic of –0.1205 and a two-tailed p-value of 0.9044, indicating that the observed mean difference of approximately 1.92% (–6.09% for Shariah-compliant versus – -8% for non-compliant series) is not statistically significant at $p = 0.05$. Although the non-shariah compliant subset exhibits both a larger cross-sectional variance (768.62 versus 461.71) and a larger sample size, Welch's formulation adjusts for these disparities in dispersion and degrees of freedom (df $\approx$ 88).

Collectively, the statistical and empirical evidence suggests that Shariah stock-screening criteria— primarily the removal of highly leveraged or interest-based companies do not result in a significant shift in the market pricing of individual stock options, thus the Null Hypothesis (H_{02}) is not rejected.

Among the 62 observations on non–Shariah-compliant stocks, 72.6% observations (45 observations) exhibit mispricing that is significant at the 5 percent level, while the remaining 27.4% observations (17 observations) fail to reject the hypothesis of zero deviation. Likewise, in the sample of 36 Shariah-compliant stocks, 72.2% observations (26 observations) are significant, with 27.8 % observations (10 observations) deemed insignificant.

Focusing first on call options in the non–Shariah compliant group, 20 of the 31 call observations (64.5%) display statistically significant mispricing. Within this subset, 30% (6 options) are overvalued, indicating market prices in excess of theoretical values, whereas 70% (14 options) are undervalued. The remaining 35.5% call observations (11 options) do not exhibit significant deviation.

Among the 36 observations on put options of non-Shariah-compliant group, higher share—25 out of 31 observations (80.6%)—is statistically significant. Of these, 28% are overvalued (7 options) are overvalued and 72% (18 options) are undervalued, leaving 19.4% (6 options) without significant mispricing.

In contrast, Shariah-compliant call options exhibit fewer significant departures: only 55.6% are significant, and within this group a striking 90% (9 calls) are undervalued, with a solitary case of overvaluation (10%). The 8 remaining calls (44.4%) do not depart significantly from theoretical values. This pronounced skew toward underpricing among Shariah calls may stem from the lower leverage ratios inherent to screened firms, which tend to dampen idiosyncratic volatility and yield market prices that systematically fall below Black–Scholes estimates.

Finally, Shariah-compliant put options display the highest significance rate of all subsamples: 88.9% are significant, and within this group 37.5% are overvalued (6 puts) and 62.5% undervalued (10 puts) observations; the remaining 11.1% (2 puts) are insignificant.

5. Discussion

Contrary to the prevailing evidence in the literature—where option markets are typically found to exhibit systematic overvaluation relative to Black–Scholes benchmarks—this study documents a different pattern: across the Nifty 50 universe, about 52 percent of options (both call and put) display statistically significant undervaluation, 27.5 percent show no significant difference, and the remaining 20.4 percent exhibit overvaluation. This divergence highlights that pricing dynamics in India's derivatives market do not necessarily replicate those of developed economies, and that local structural and regulatory factors can generate distinct outcomes.

The observed persistent overvaluation of at-the-money (ATM) call options suggests that volatility clustering and liquidity constraints—factors not captured by the Black–Scholes assumptions of constant volatility and frictionless markets—play a significant role in pricing deviations (Hull and White, 1987). For Shariah-compliant stock options, the similarity in mispricing patterns indicates that screening criteria alone do not materially alter the violation of Black–Scholes assumptions; instead, market microstructure effects dominate. Thus, the Black–Scholes model serves not only as the pricing benchmark but also as the analytical bridge in comparing Shariah-compliant stock options and non-Shariah compliant stock options, since deviations from its assumptions manifest similarly across both categories.

Several contemporaneous market forces help explain why theoretical values systematically exceed observed premiums on both calls and puts during our sample period. First, by selecting strikes very close to at-the-money levels, this study concentrated on contracts where theoretical sensitivities peak and small input errors translate into large price gaps; prior studies that report market overvaluation typically examine a broader range of moneyness, including deep in- and out-of-the-money options, where BSOPM biases differ. In this case, ATM contracts during turbulent conditions may have compounded sensitivities, driving theoretical values above depressed market quotes.

Second, foreign institutional investors (FIIs) pulled back sharply at year-end 2024: in December alone, FIIs offloaded US$2.33 billion (₹19,848 crore) of Indian equities (EconomicTimes.com, 2025) despite a modest net monthly inflow overall, and over the quarter they withdrew a net US $11.9 billion, sapping option-market liquidity and reducing demand on both sides of the book. The undervaluation of market prices observed in our analysis during the December–January window aligns with the institutional rebalancing dynamics documented by Harvey et al. (2025). Their study demonstrates that mandate-driven portfolio rebalancing—particularly at calendar endpoints like year-end—induces predictable equity sell-offs, depressing returns by approximately 17 basis points daily, with reversals occurring within two weeks. This transient selling pressure directly impacts option pricing. Third, global risk aversion—fanned by repeated threats of U.S. tariffs—drove Asian markets into a protracted risk-off stance, weakening both leverage-based call buying and speculative put hedging; Reuters notes that "amid global instability spurred by U.S. tariff policies," investors sold US $4 billion in Indian stocks in April 2025 alone.

An important factor contributing to the observed mispricing during the study period may be the significant decline in trading volumes following regulatory changes. In November 2024, the Securities and Exchange Board of India (SEBI) mandated that exchanges offer only one weekly expiry per index, leading the National Stock Exchange to discontinue multiple weekly option contracts, retaining only the Nifty 50 for weekly

expiries. This regulatory action resulted in a substantial decrease in derivatives trading activity, with average daily turnover for index options declining by over 37 percent in December 2024 compared to the previous month. Reduced trading volumes likely led to lower market liquidity, wider bid-ask spreads, and less efficient price discovery, thereby exacerbating deviations between theoretical and observed option prices.

Finally, during this same interval, the SEBI instituted regulatory changes—raising margins, altering contract specifications, and increasing transaction costs—to curb speculative derivatives trading. These measures further disincentivized participation in Futures and Options segments, narrowing bid-ask spreads and mechanically lowering observed premiums relative to the frictionless-market assumption of BSOPM. As a result, retail participation in Futures and Options fell by 18 percent month-on-month in December 2024, and daily index-options volumes plunged by 70 percent into early 2025, further draining liquidity and skewing market quotes.

In addition, an auxiliary comparison of the historical volatility inputs—computed over the thirty-day estimation window preceding the valuation period—revealed that Shariah-compliant stocks exhibited marginally lower annualized volatility and variance than non-Shariah stocks; however, this difference did not reach statistical significance and therefore did not materially influence the observed pattern of option undervaluation.

Overall, the predominance of market undervaluation in the research findings reflects the intersection of ATM strike focus, year-end and post-pandemic market troughs, regulatory tightening by SEBI, and geopolitical headwinds—factors that collectively suppressed option premiums below their Black–Scholes benchmarks. These findings highlight that mispricing is less a function of Shariah compliance and more a reflection of structural frictions in India's derivatives market, while also illustrating that emerging market dynamics can diverge sharply from the overvaluation bias as reported in the developed markets.

6.   Conclusion

This study highlights that option pricing inefficiencies in India during late 2024 and early 2025 cannot be fully explained by theoretical model limitations alone, but must be understood within the context of market microstructure, regulatory interventions, and institutional flows.

For market participants, these findings suggest that option mispricing is strongly event-driven and sensitive to regulatory cycles. Portfolio managers and traders should integrate such distortions into their derivative pricing and hedging strategies, especially around institutional rebalancing periods and policy shifts.

For Islamic finance, while conventional options remain impermissible, monitoring mispricing dynamics offers valuable insight into market volatility, enabling Shariah-compliant portfolio managers to design risk-mitigation tools aligned with Islamic principles. As Bacha (1999) argues, the outright rejection of derivatives overlooks their potential role in improving risk-sharing and liquidity when carefully structured to comply with Shariah. Thus, the insights from observed mispricing can inform the development of Shariah-compliant instruments that capture the risk-hedging benefits of derivatives without violating Shariah constraints.

For regulators, the results underscore the need to balance prudential measures with liquidity preservation. Abrupt specification changes, margin hikes, and cost increases can unintentionally impair price discovery and reduce market efficiency. By contrast, well-sequenced and transparent reforms can support both stability and efficient pricing.

This study remains limited to at-the-money 30-day single stock futures of NIFTY 50 constituents during a short interval coinciding with exceptional volatility. Broader samples across different maturities, strikes, and international comparisons would provide further clarity.

In summary, this paper contributes by documenting a systematic undervaluation bias in Indian options, offering empirical insights into how theoretical models interact with real-world frictions in both conventional and Shariah-relevant contexts, while also opening space for policy debate on the constructive use of derivatives in Islamic finance.

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