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Price Discovery and Market Efficiency in India's Financial Futures Market within the Derivatives Landscape: An Empirical Analysis

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Abstract

This study offers a robust, long-term analysis of price discovery and the persisting lead-lag relationship between India's equity futures and spot markets. Utilising monthly data from April 2005 to December 2022, it filters transient noise typically associated with high-frequency data. Information Share and Common Factor Weight methodologies within the Vector Error Correction (VEC) framework consistently reveal the dominance of futures markets in the price discovery process. The insights remain consistent across three distinct periods spanning the global financial crisis and the COVID-19 pandemic. The volatility dynamics and asymmetry effects in the Indian equity futures and spot markets using the Vector Error Correction - Exponential General Autoregressive Conditional Heteroskedastic (VEC-EGARCH) approach uncover notable asymmetry effects, signifying a strong market sensitivity to negative news. This highlights the necessity for comprehensive risk management strategies and stringent regulatory supervision, especially in light of the significant growth and systemic risks in the Indian derivatives market.

Keywords: Derivatives Landscape, Equity Futures, India, Price Discovery, Spot Markets
JEL Classification: C32, G1, G13, G14

1. Introduction

Derivatives perform several essential economic functions, including price discovery, risk management, and liquidity provision. Their nature allows for a faster response to new information, owing to reduced transaction costs and the lack of restrictions on short sales. The expectation is that they contribute to reducing volatility in the spot market, thereby enhancing financial and economic stability[1-3].

Price discovery, a fundamental role of derivatives, is the process in which market participants determine a fair price for an asset, based on the information available to them. Within organised derivatives markets, participants balance current valuations against future expectations, leading to a consensus price. This price, reflecting the asset's perceived worth and potential future direction, essentially makes transparent the market's collective outlook. Thus, price discovery serves as the market's method for determining an asset's current and future value.

However, the effects of derivatives on the price discovery process of underlying assets and the stability of asset markets continue to be a subject of ongoing debate and research[4-6]. The rapid expansion of India's equity derivative markets, and the potential implications of this growth on the underlying market, have stimulated a few research questions.

In line with this, the core objectives of this paper are twofold. Firstly, to study the price discovery role of India's equity futures market and measure the extent to which it influences the price discovery in the underlying spot market. Secondly, to investigate the market efficiency of

India's futures market by analysing how accurately and promptly the market incorporates available information into prices.

Furthermore, acknowledging the complex relationships and volatility dynamics that exist between futures and spot markets, this paper also seeks to explore these dynamics within India's equity futures market. Applying the Exponential General Autoregressive Conditional Heteroskedastic (EGARCH) model, this research captures time-varying volatility and non-linear relationships, thus providing a comprehensive understanding of the volatility dynamics in these markets.

Through this thorough analysis, the paper aims to enrich the extant literature by providing a nuanced understanding of price discovery, market efficiency, and volatility dynamics in India's financial futures market. The implications of this work extend to policymakers, market participants, and researchers, equipping them to make informed decisions, devise effective regulatory frameworks, and enhance the overall resilience and stability of the financial market infrastructure.

The remaining sections of this paper are as follows: Section 2 traces the establishment, growth, and challenges of the derivatives market in India. The literature review in Section 3 explores the economic role of derivatives, specifically focusing on price discovery and market efficiency. Theoretical and empirical frameworks are discussed in Section 4, followed by the econometric methodology in Section 5. The results of the analysis are presented in Section 6. Finally, Section 7 concludes the paper by summarising the key findings and implications derived from the study.

2. Growth and Complexity of India's Derivatives Market: An Overview

Financial derivatives, gaining global momentum in the 1970s, made their significant footprint in India by the late 1990s. The Securities and Exchange Board of India (SEBI) played a crucial role in this journey, forming committees under the leadership of Dr. L. C. Gupta in 1996 and Prof. J. R. Verma in 1998. Tasked with establishing a regulatory framework and risk containment measures, these committees laid the groundwork for derivatives trading in India. Amendments in the Securities Contract Regulation Act (SCRA) in 1999 recognised 'derivatives' as 'securities,' providing a robust regulatory architecture for derivatives trading. The journey that began with the launch of index futures contracts in June 2000 now encompasses Index Futures, Index Options, Stock Futures, and Stock Options. India's derivatives market has been significantly shaped by the roles of the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE). Advanced trading technologies adopted by these exchanges, coupled with the Indian Clearing Corporation Limited's (ICCL) central counterparty clearing services, are supposed to enhance market efficiency and risk management. The International Financial Services Centre (IFSC) and the International Exchange (India INX) are recent milestones, attracting global investors and enabling trade in global derivatives. These developments form the backdrop to this research, studying price discovery and market efficiency in India's derivatives market.

India's derivatives market has seen an exponential rise, with NSE turnover increasing from ₹ 24 billion in 2000-01 to ₹ 38,223 trillion by 2022-23 (NSE data), and the number of investors in the equity futures and options segment growing by over 500 percent in FY22 compared to FY19 (SEBI (2023)). The market's growth extends beyond turnover, with diverse and complex financial instruments enhancing risk understanding and management. These developments have helped to position the NSE as the globally leading derivatives exchange in terms of contracts traded and the third-largest in the equity segment based on the number of trades as of 2022.

SEBI (2022) report indicates that equity derivatives dominate the market share (96.8 percent of notional turnover), followed distantly by currency derivatives (1.5 percent) and cash equity (1.0 percent). Consequently, India's derivatives market, driven by the NSE, has shown impressive growth, diversity, and innovation, altering India's financial landscape and fortifying its global standing.

The growth in the ratio of equity derivatives to equity cash turnover from 2010-11 to 2021-22, highlighted in Table 1 (Figure 1), might indicate the maturing Indian market defined by increased hedging, speculation, and liquidity. While the substantial Compound Annual Growth Rate (CAGR) of equity derivatives turnover (46.5 percent) compared to the cash market (18.6 percent) from FY 2012-13 to FY 2021-22 signifies market sophistication, it also introduces increased systemic risk due to possible significant losses if market dynamics turn adverse.

Table 1. Evolution of Turnover Volumes in Equity Cash and Equity Derivative Segments in the Indian Derivatives Market (2010-2022)

FY	Turnover in Equity cash segment (₹ Billion)	Turnover in Equity Derivatives segment (Notional) (₹ Billion)	Ratio: Turnover in Equity Derivatives / Equity cash
2010-11	46824.37	292483.75	6.25
2011-12	34783.91	321582.08	9.25
2012-13	32570.87	387045.72	11.88
2013-14	33413.38	475755.71	14.24
2014-15	51845	759692.9	14.65
2015-16	49772.78	693008.43	13.92
2016-17	60544.22	943772.41	15.59
2017-18	83179.87	1649881.22	19.84
2018-19	87246.25	2376029.55	27.23
2019-20	96597.35	3447951.6	35.69
2020-21	164430.09	6786782.77	41.27
2021-22	179045.26	17613114.62	98.37

Source: Author's compilation from NSE and BSE data

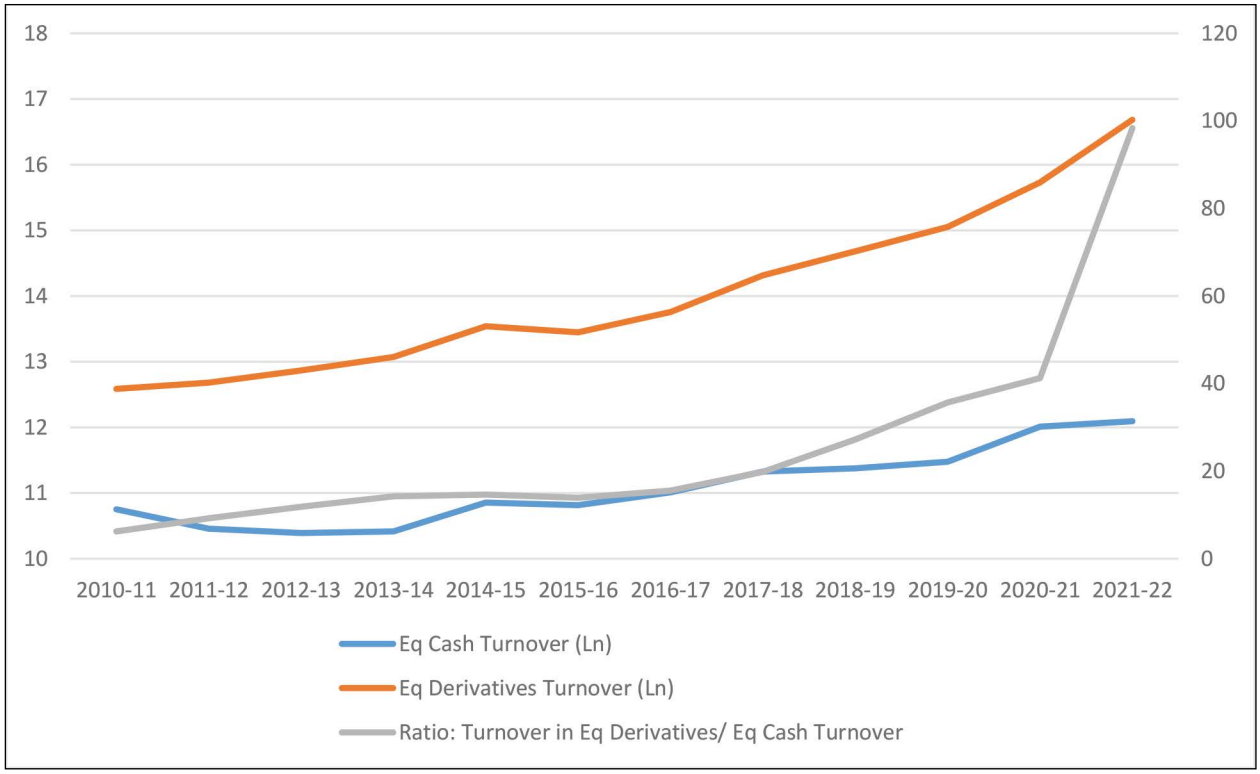

Figure 1. Trend in Turnover Volumes in Equity Cash and Equity Derivative Segments in the Indian Derivatives Market (2010-2022).

Factors driving this growth range from increasing index levels and stock prices, policy changes such as Securities Transaction Tax (STT) reduction[7], to the Covid-19 pandemic catalysing digitisation and easier access to derivative trading. However, the rapid growth is accompanied by notable challenges, namely concentration

in products (Index Options leading with 77.14 percent of total derivative trading), exchanges (NSE accounting for over 95 percent of equity derivative trading), and investor categories (proprietary traders dominating with 45-55 percent of turnover).

Within this context, this study narrows its focus to critical elements pertinent to India's equity futures market. It seeks to examine the interaction and lead-lag connection between futures and spot pricing and to determine the extent to which each influences the price discovery process. A significant aspect of this study is to assess the implications of these dynamics on overall market efficiency and stability.

3. Literature Review

In the world of financial markets, derivatives occupy a crucial position as they have the potential to enhance the efficiency of underlying markets while simultaneously posing risks due to speculative positions. Understanding the theoretical considerations surrounding derivatives is of paramount importance. Noteworthy contributions by McClintock (1996), Stulz (2004), and Lien and Zhang (2008) have shed light on the influence of equity derivatives on the stability or instability of financial markets and the overall economy[1-3].

Carter (1999)[4] provides a comprehensive overview of futures markets, highlighting their role in determining inter-temporal prices and facilitating decentralized decision-making while considering risk. Arora and Kumar (2012)[8] examine the practical implications of derivatives, specifically focusing on the MCX. Their findings suggest that the futures market possesses higher information efficiency compared to the spot market, serving as a valuable source of information for investors and policymakers, thereby enhancing market regulation and decision-making processes.

Following the global financial crisis, Prabha *et al.* (2014)[5] investigate the role of derivatives in post-crisis recovery and economic growth. Their study reveals that derivatives play a positive and influential role in minimising cash-flow volatility and promoting business investment, contributing to economic resilience and growth during the recovery phase.

Recent research[6] continues to explore the economic role of derivatives markets across different countries, uncovering varied effects influenced by diverse factors. These findings highlight the complex relationship between derivatives markets and economic growth, offering guidance to policymakers and market participants for making informed decisions.

3.1 Price Discovery and Market Efficiency

Price discovery and market efficiency are fundamental aspects of financial markets that have garnered significant attention in the literature. Several investigations have analysed the connection between futures markets and the efficiency of price discovery, illuminating the function of futures contracts in risk management and the assimilation of new information.

For instance, Bose (2007)[9] highlights the crucial role played by the Indian Stock Index Futures market in assimilating information and contributing to spot price movements. Debasish (2009)[10] conducted an analysis of the lead-lag relationships between the NSE Nifty index and its derivatives contracts, revealing that derivative contracts lead the underlying cash market. Karmakar (2009)[11] demonstrates that Nifty futures lead the cash market in terms of price discovery and informational efficiency.

Furthermore, studies[12,13] explore the agricultural commodities market in India, indicating bidirectional Granger lead relationships between spot and futures markets, confirming long-run equilibrium relationships and identifying transmission mechanisms. Choudhary and Bajaj (2013)[14] emphasise the importance of both futures and spot markets in price discovery for the Nifty index and individual securities in India. Aggarwal *et al.* (2014)[15] examine the Information Share (IS) metric to assess the role of commodity derivatives in India's price discovery and hedging effectiveness. Analysing the daily closing prices of agricultural and non-agricultural commodities in both futures and spot markets from 2003 to 2014, the study concludes that futures prices relatively efficiently discover information but are less effective in managing risk.

In a research conducted by Mishra *et al.* (2017)[16], the effect of increased derivatives trading on India's price discovery process is evaluated. The analysis focuses on the single-stock-options market, comparing option prices with corresponding futures and spot prices. Employing cointegration procedures and Granger causality tests on Nifty Futures, Nifty options, and F&O data from Dec'01 to Dec'12, the study finds that the spot market's dominance has increased, while the futures market's dominance over the options market has significantly declined due

to increased STT (Securities Transaction Tax). Aggarwal and Thomas (2018)[17] explore the price discovery process between single stock futures (SSFs) and corresponding spot prices and reveal an IS of 55 percent for SSFs during news arrivals, increasing to 61 percent for negative news due to restrictions on short-sale on the spot market.

Recent literature in the area of price discovery and market efficiency in various financial markets provides key insights. He *et al.* (2020)[18] analyse high-frequency data from the CSI 300 Index futures and underlying index from 2010-18. Using Johansen's multivariate cointegration framework, VECM price adjustments, and ECM correction analysis, they find that the futures market initially had a greater sensitivity to new information and exerted a dominant influence on the price discovery process, but this effect weakened over time due to decreased liquidity.

Gupta and Dalal (2021)[19] study the impact of futures prices on market efficiency and price discovery in select heavyweight stocks named HRITHIK stocks, using both VAR and VECM tests. They observe that futures prices had a causal effect on spot prices and that futures market was dominant in the long run. Nadig and Viswanathan (2022)[20] apply forecast models, Holt-Winters framework, and ARIMA analysis on pepper's spot and future prices data from the Spice Board of India. They find bidirectional causality between the spot and futures markets but argue that future price prediction for the spot market remains challenging.

Shao and Hua (2022)[21] investigate the Shanghai Crude Oil Futures' price discovery contribution and suggest that despite the long-run equilibrium relationship between crude oil futures and spot prices, the Shanghai Crude Oil Futures contribute only about 50 percent to price discovery.

3.2 Volatility Dynamics

This study now embarks on a discussion of volatility dynamics, an important aspect of financial markets. The complexities of India's equity futures and spot markets may be observed by drawing insights from various studies. Roy and Roy (2017)[22] find notable financial contagion with the stock market within the Indian commodity sector. Rastogi and Athaley (2019)[23] highlight volatility disintegration between spot, futures, and options markets within the same Indian context.

In a comparative stance, Hou *et al.* (2019)[24] and Zhou *et al.* (2021)[25] discern notable volatility spillovers in China's markets. Hou *et al.* (2019) observe a time-varying volatility spillover between fuel oil and stock index futures markets, while Zhou *et al.* (2021) note bidirectional spillovers between stock index futures and spot prices influenced by news releases.

Khan *et al.* (2022)[26] explore the intraday dynamics of India's Nifty 50 futures and spot markets, and they find two-way volatility spillovers with futures having a greater impact. They use the Baba, Engle, Kraft, and Kroner (BEKK) – Generalized Autoregressive Conditional Heteroskedasticity (GARCH) also known as BEK-GARCH model, Granger causality tests, common factor weights, and Hasbrouck's IS to support their findings. Qin *et al.* (2023)[27] illustrate the smooth transition error correction behaviour in Nikkei 225 futures price discovery along with the EGARCH approach, suggesting non-linear dynamics, while Garg *et al.* (2023)[28] underscore the spot market's dominance in Indian agricultural commodity price discovery and employ bivariate GARCH models. Chen and Tongurai (2023)[29] evaluate the impact of the US-China trade conflict on the flow of information between China's futures and spot markets. They found the dispute significantly increased futures-spot correlations in most markets, excluding gold, the safe haven asset.

The literature reviewed in this study highlights the crucial function of futures contracts in processing information effectively, a fundamental aspect of efficient markets. The studies also point out the complex relationship and volatility patterns between futures and spot markets. This research aims to understand market efficiency, the process of price discovery, and volatility aspects within India's equity futures market.

While several studies have examined price discovery and volatility in the commodity and currency derivatives markets in India, there appears a gap in the study of these aspects in the Indian financial derivatives market, especially the equity futures market. Considering the significant role of the equity futures market in India's financial system, it becomes essential to study its volatility dynamics for effective risk management, informed policy-making, and promoting market stability.

This research targets the Nifty 50 index futures and its corresponding spot index, as they are significant representatives of the financial futures market in India. To emphasise long-term relationships and minimise short-term volatility noise, this paper uses monthly data,

particularly the end-of-month closing values, from April 2005 to December 2022. These values reflect the cumulative market information and sentiment at a particular point in time in a month, thereby ensuring study accuracy.

Given the above, this paper seeks to address these research gaps by undertaking the following:

- Investigate the price discovery role and market efficiency of India's equity futures market and measure the extent to which it influences the price discovery in the underlying spot market.
- Explore the volatility dynamics and asymmetry effects in the Indian equity futures and spot markets using a VEC-EGARCH model. This model surpasses the limitations of traditional VECM models by capturing time-varying volatility and non-linear relationships, thus offering a more nuanced analysis of volatility dynamics in these markets.

4. Theoretical and Empirical Framework

Theoretical models employed for futures pricing, such as the Expectation Theory (Sharpe *et al.* (1998)[30]) and the Efficient Market Hypothesis (EMH) by Fama (1970)[31], provide insights into the pricing dynamics of futures contracts. According to the Expectation Theory, futures prices reflect the anticipated future price of the underlying asset, assuming rational market participants with access to relevant information. The EMH suggests that financial markets are perfectly informationally efficient, with prices incorporating all available information.

The cost of carry model describes the no-arbitrage condition between spot and futures prices as follows:

$$F_t = S_t \exp((r - d)(T - t)) \quad (1)$$

The futures price, denoted as F_t, corresponds to the spot price represented by S_t. The constant risk-free rate is denoted as 'r', and 'd' stands for the continuous dividend yield on the index. 'T' represents the maturity date of the futures contract, while 't' denotes the current time. The spot and future prices should exhibit a cointegrated relationship, which can be represented as:

$$f_t = \beta_0 + \beta_1 s_t + \varepsilon_t \quad (2)$$

Here, f_t and s_t are the natural log of the futures price and spot price, β_0 and β_1 are the parameters of the model, and ε_t is the residual term encompassing the basis spread between the spot and futures prices. Lastly, the relationship between the residuals and the logarithmic prices is defined as:

$$\varepsilon_t = f_t - s_t \quad (3)$$

In this study, the relationship between Nifty 50 Index Futures representing India's equity derivatives market and the underlying Nifty 50 Index (Spot) is examined to test the validity of these theories in India's financial futures market, contributing to the understanding of its price discovery role and market efficiency.

5. Econometric Methodology

The dataset for this study comprises 213 monthly observations of the closing values for the Nifty 50 near-month Futures and the underlying Nifty 50 Spot index, sourced from the NSE, spanning the period from April 2005 to December 2022. The use of monthly data, as opposed to daily, offers a balance between granularity and the reduction of potential noise or short-term volatility, thus providing a clearer view of the long-term relationships that are the focus of this study. Moreover, closing values may be considered representative market values as they reflect the market information and sentiment at a specific time point. As futures prices predict the spot price one month ahead, averaging them across the month could potentially distort their predictive value.

The first step in examining the price discovery role of futures in India is ensuring the stationarity of time series data, which is crucial for identifying long-term relationships. Following this, the Johansen cointegration test is applied. Upon confirmation of cointegration, this research estimates the price discovery shares of the Nifty futures and spot market. This paper uses Hasbrouck (1995)'s Information Share Approach (IS)[32] and Gonzalo and Granger (1995)'s Common Factor Component Weight (CFW)[33] approach. These methodologies provide a nuanced understanding of the part played by futures and spot markets in determining prices in the Indian financial market setting. This paper also employs the EGARCH approach to provide an understanding of the volatility dynamics in the markets under investigation.

5.1 Tests for Non-Stationarity

The cornerstone of the econometric methodology employed in this study rests upon the concept of data stationarity, which is a fundamental assumption in time series analysis. This study employs two methods, namely the Dickey-Fuller Generalized Least Squares (DF-GLS) test proposed by Elliot, Rothenberg, and Stock (1996)[34] and the KPSS (1992)[35] test, to detect the presence of unit roots. The DF-GLS test demonstrates improved power in the presence of an unknown mean or trend compared to other unit root tests. On the other hand, the KPSS test takes a unique approach by assuming the opposite null hypothesis. By employing these tests, this paper ensures a robust and accurate analysis of the data, forming the foundation for reliable research results and conclusions derived from the econometric methodology.

5.2 Econometric Methodology for Price Discovery Analysis

Two widely used measures in quantifying price discovery are Information Shares (ISs) and Common Factor Weights (CFWs). They assess the contribution of individual markets to the process of price discovery. The IS uses a Vector Error Correction Model (VECM) and measures a market's contribution to the variance of the common factor's innovations. In a two-market situation, an IS value greater than 0.5 for the futures market signifies its dominance in the price discovery process and vice versa. The IS approach, relying on the efficient price implicit in market prices, attributes more variation to the market-dominating price discovery.

Conversely, the CFW represents each market's proportionate contribution to the common factor that influences all of them. Both CFW and IS stem from a common cointegration relationship, offering complementary perspectives on price discovery. The IS accounts for the correlation between market innovations, while the CFW does not.

5.3 The Exponential GARCH (EGARCH) Model

Nelson (1991)[36] proposed the Exponential GARCH (EGARCH) model, which specifies the conditional variance of returns as follows.

$$\log(\sigma_t^2) = \phi + \sum_{i=1}^{q} \eta_i \left|\frac{z_{t-i}}{\sigma_{t-i}}\right| + \sum_{i=1}^{q} \lambda_i \frac{z_{t-i}}{\sigma_{t-i}} + \sum_{j=1}^{p} \theta_j \log(\sigma_{t-j}^2) \quad (4)$$

where:

ϕ = constant term; η = ARCH Effects, λ = Asymmetric effects, θ = GARCH effects

The log of the conditional variance serves as the left-hand side variable implying that the impact of leverage is exponential in nature, not quadratic, and this ensures that forecasts of the conditional variance will always be non-negative. To examine the existence of leverage effects, one can assess the hypothesis that . Asymmetry in the impact occurs when .

This paper employs the VEC-EGARCH modelling approach to offer a more nuanced understanding of the volatility patterns in the markets under investigation. The EGARCH model allows us to account for time-varying volatility, leverage effects, and ARCH and GARCH effects.

6. Results

6.1 Descriptive Analysis

Table 2 provides a summary of the monthly closing values for the Nifty 50 near-month Futures and the underlying Nifty 50 Spot index for the period from April 2005 to December 2022. It shows a typical 'contango' market considering the cost of carry. The distribution of Futures and Spot prices show near-normal kurtosis, while the Basis series exhibits leptokurtosis, indicating outliers. With the Jarque-Bera statistics yielding p-values significantly less

Table 2. Descriptive Statistics

	Futures	Spot	Basis
Mean	7940.180	7926.828	–13.35188
Median	6354.700	6304.000	–6.699900
Maximum	18874.50	18758.35	86.19980
Minimum	1881.850	1902.500	–116.1500
Std. Dev.	4145.699	4133.293	27.42131
Skewness	0.875919	0.878804	–0.175202
Kurtosis	3.004580	3.005179	4.505401
Jarque-Bera (Probability)	27.23698 (0.000001)	27.41676 (0.000001)	21.20252 (0.000025)
Observations	213	213	213

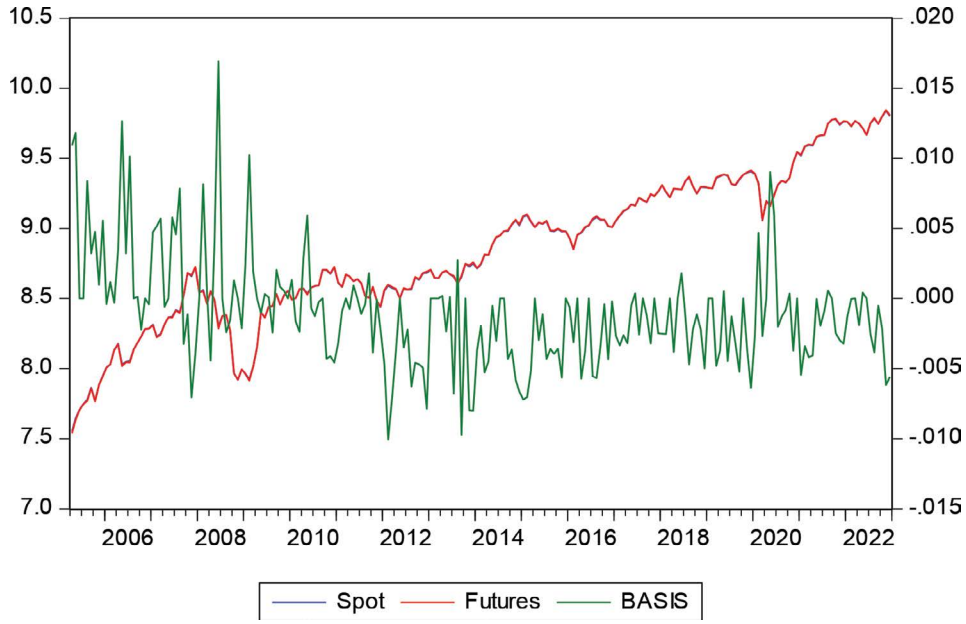

Figure 2. Nifty 50 Futures, the underlying spot and the futures basis (Monthly: Apr 2005 to March 2023).

Table 3. Unit Root Test: April 2005 – December 2022

	DF-GLS t-stats^		KPSS LM-Stats#		Inference
Variable	**Level**	**First difference**	**Level**	**First difference**	
Futures	–2.082641	–4.392730	1.806179	0.077517	I(1)
Spot	–2.074343	–4.290929	1.805601	0.076552	I(1)
Critical values					
1 % level	–3.461200	–3.460800	0.739000	0.739000	
5 % level	–2.927600	–2.928400	0.463000	0.463000	
10 % level	–2.635800	–2.637200	0.347000	0.347000	

^ *with Constant and Linear Trend; # Bandwidth: Newey-West Automatic using Bartlett kernel*

than 0.05, the deviation from a normal distribution across all three series is strongly indicated.

Figure 2 indicates an evident upward trend in futures and spot prices, with a close overlap. Two significant dips correspond with the periods of the Global Financial Crisis of 2008 and the COVID-19 pandemic. The basis, reflecting the cost-of-carry, tends to be above zero, particularly during the first half of the study period. This period also exhibits greater volatility, which may reflect the nascent stage of the Indian Futures market and broad adjustments in market dynamics.

6.2 Stationarity and Cointegration

The unit root results based on both the DF-GLS and KPSS tests for the entire study period suggest that both series are integrated of order one, denoted I(1), meaning that they become stationary after being differenced once (Table 3).

Upon consideration of the VAR lag order selection criteria, a consistent indication towards an optimal lag length of two is observed for the cointegration analysis. The Johansen procedure confirms a long-term relationship between the Nifty Index Futures and the Spot, with both Trace and Maximum Eigenvalue tests affirming a single cointegrating equation. Furthermore, a significant error correction term in the VECM, set at a one-lag length, underscores the sustained equilibrium relationship between the futures and spot markets.

6.3 Price Discovery Estimates

Using the estimated VECM based on the cointegrated Spot and Futures price series, variance decomposition

is conducted to assess the contribution of each market's innovations to the total variance. IS and CFW measures, derived from the VECM, provide decompositions of the price discovery process, with IS considering the variance of innovations and accounting for correlation, while CFW focuses on regression coefficients and the relationship with the common factor without explicit consideration of correlation between innovations.

The estimates suggest that the Futures market consistently contributes more to the price discovery process compared to the Spot market across all three time periods (Table 4). For instance, in the period from Apr 2005 to Dec 2022, the Futures market contributes about 50.4 percent (IS) and 50.8 percent (CFW) to price discovery, compared to 49.6 percent (IS) and 49.2 percent (CFW) for the Spot market. Similar patterns are observed for the other periods.

Across the three distinct periods, including the global financial crisis and the COVID-19 pandemic, the Futures market consistently exhibits a greater contribution to price discovery than the Spot market. This resilience and consistency highlight the robustness of price discovery mechanisms in Indian financial markets. Despite different economic environments and unprecedented disruptions, the relative contributions of the Spot and Futures markets to price discovery remained stable. These findings suggest the enduring nature of the relationship between the two markets, even during periods of significant macroeconomic and external events.

Table 4. Hasbrouck (1995)'s Information Shares (ISs) and Gonzalo and Granger (1995)'s Common Factor Weights (CFWs)

Time Period	ISs		CFWs	
	Spot	Futures	Spot	Futures
Apr 2005 - Dec 2022	0.4960	0.5040	0.4920	0.5080
Jan 2010 - Dec 2022	0.4975	0.5025	0.4950	0.5050
Jan 2010 - Dec 2019	0.4967	0.5033	0.4934	0.5066

6.4 Volatility and Asymmetry Effects

Utilising the EGARCH model, the study examines two distinct series: returns on futures and spot prices and residuals from a VECM of futures and spot cointegrating equation, referred to as VEC-EGARCH. This is to study volatility dynamics under different conditions and draw a more comprehensive picture of the market.

For both the return series and VEC-EGARCH, results reveal significant ARCH and GARCH effects, demonstrating the presence and persistence of volatility shocks in both futures and spot markets (Table 5). The asymmetric effects found are also significant. Negative coefficients for both futures and spot returns suggest that bad news (negative shocks) generates more volatility than good news, indicating a leverage effect. This phenomenon is consistent with numerous financial theories and empirical studies.

Unlike VECM, VEC-EGARCH allows for time-varying volatility, capturing the true complexity and evolving nature of financial markets, where volatility is rarely static. Furthermore, the VEC-EGARCH model helps to capture the non-linear dynamics often observed in financial markets, something that the traditional VECM might miss.

Specifically, for the VEC-EGARCH results, the constant term, ARCH effects, asymmetric effects, and GARCH effects are significant at conventional levels for both futures and spot markets. This indicates the presence and persistence of volatility shocks, further highlighting the complex, non-linear interplay between futures and spot prices in India's equity market.

Table 5. Volatility and Asymmetry Effects, Estimated Co-efficients of the EGARCH Model

Variable	ϕ (Constant)	η (ARCH Effects)	λ (Asymmetry)	θ (GARCH Effects)
Futures Returns	–0.762 (0.001)	0.347 (0.000)	–0.109 (0.005)	0.911 (0.000)
Spot Returns	–5.645 (0.000)	0.770 (0.000)	–0.126 (0.121)	0.106 (0.513)
VEC-EGARCH Futures	–4.156 (0.001)	0.727 (0.000)	–0.142 (0.049)	0.363 (0.078)
VEC-EGARCH Spot	–3.905 (0.001)	0.667 (0.000)	–0.140 (0.035)	0.402 (0.045)

These findings provide insights into India's equity futures and spot markets' dynamics, shedding light on the persistence of volatility shocks, the non-linear interplay between futures and spot prices, and the role of market news. Furthermore, they underline the utility of robust techniques like VEC-EGARCH in capturing the complexity of financial markets.

7. Conclusion and Implications

The consistent results across different economic environments highlight the robust role of the futures market in price discovery, reflecting the maturity and efficiency of Indian financial markets. The greater contribution of the futures market to price discovery suggests active utilisation of futures contracts for hedging and speculation, indicating market maturity and efficiency. Additionally, the futures market leading the spot market in price discovery provides valuable insights for market participants regarding future spot prices.

The results of this study are in line with various studies that found futures markets often lead spot markets in price discovery[14,17,26]. This study uses monthly data of India's benchmark equity futures and spot prices over an extended time period from April 2005 to December 2022. This provides a reliable and long-term analysis compared to studies using high-frequency data for shorter durations. High-frequency data is often subject to noise and microstructure effects. Instead of focusing on transient, minute-to-minute fluctuations, this study places its emphasis on long-term trends. This approach presents a more robust and enduring analysis of price discovery and market efficiency within the Indian financial futures market. This long-term perspective, in addition to capturing a variety of macroeconomic climates and market conditions, thus contributes to a more comprehensive understanding of the mechanisms driving the Indian financial futures market.

Implications of futures trading on spot market stability and the broader economy include:

Price Discovery Role: Futures markets, with their larger contribution to price discovery, can lead to price stabilisation in the spot market. The faster aggregation of information and efficient price adjustments in futures markets are transmitted to the spot market, reducing price volatility.

Market Efficiency: The contribution of futures markets to price discovery reflects a high level of market efficiency in the Indian Equity Futures market. Efficient markets enhance resource allocation and contribute to overall economic stability.

It's important to note that speculative activities dominating futures trading can lead to price distortions and increased volatility in both futures and spot markets, particularly in times of market stress. Therefore, considering the overall market context and balancing hedging and speculative activities in the futures market is crucial.

The paper delves deeper into the dynamics of the Indian equity futures and spot markets by applying the EGARCH model on the returns and VECM residuals of these markets. The findings reveal the presence of significant ARCH and GARCH effects in these markets, confirming the influence of past shocks and volatility on future periods. The presence of asymmetry effects, indicating different market reactions to losses and gains is also observed. These asymmetries underscore the market's sensitivity to negative information, reflecting a propensity for larger swings in market sentiment and price volatility. These findings underscore the importance of comprehensive risk management strategies and effective regulatory oversight.

Further research could specifically focus on the effect of futures trading on spot market volatility and investigate the macroeconomic determinants of financial futures prices in India to provide more detailed insights into this relationship within the Indian financial derivatives market.

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9. Conflict of Interest

The views expressed in this article are of the author and do not necessarily reflect those of the organisation or institution they represent.

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