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Deciphering the Interconnectedness of Spot and Future Prices in the Indian Derivatives Market with Special Emphasis on Banknifty

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Abstract

Aim: The growth of the Indian stock market is significantly influenced by the derivatives market in India. This research study investigated the relationship between Bank Nifty Spot and futures prices through a thorough examination.

Data and Statistical Tools: The secondary data was analyzed using statistical techniques such as Granger Causality, Correlation, Co-integration, and ECM.

Result: The analysis's main conclusion was the correlation test's substantial positive result between Bank Nifty spot and futures prices. There is evidence of a long-term equilibrium link when Bank Nifty Spot and futures prices cointegrate. This result suggests that there are common factors influencing spot and futures pricing, and that these factors tend to converge over time.

Implication: Understanding this relationship can help traders and investors make better trading and investing decisions by illuminating the long-term patterns of these prices. Overall, the findings of the Granger causality test suggest that the future market has a stronger influence on the spot market than the other way around.

Keywords: *Bank Nifty Spot, Bank Nifty Futures, Correlation, Co-integration, Granger Causality, ECM.*

1. Introduction

Understanding the pricing behaviour of future and spot markets, as well as the influence of one market on the other, is crucial. It helps in assessing market efficiency, arbitrage opportunities, market volatility, and the effectiveness of hedging strategies. This research paper aims to analyse the relationship between the Bank Nifty Index and Bank Nifty futures through correlation, cointegration, and causality analysis. By investigating these aspects, we aim to gain insights into the dynamics and interplay between the Bank Nifty Index and Bank Nifty futures.

Bank Nifty is a widely recognized and influential stock index in the Indian financial market that was introduced on September 15, 2003. It specifically focuses on tracking the performance of the banking sector, making it a valuable indicator of the overall health and trends within this industry. The index consists of a basket of 12 banking stocks that are listed on the National Stock Exchange of India (NSE).

As a sectoral index, Bank Nifty offers insights into the collective performance of the banking sector in India. It serves as a representative benchmark, allowing market participants to assess the dynamics, profitability, and overall market sentiment surrounding this vital sector of the Indian economy. By monitoring Bank Nifty, investors and analysts gain a comprehensive understanding of the trends, strengths, and challenges within the banking industry. Bank Nifty futures and options trading were introduced on June 13th, 2005, providing market participants with additional tools to engage in trading and risk management activities. Bank Nifty futures contracts offer a platform for market participants to speculate on the future price movements of the Bank Nifty index. These standardized contracts with predefined features provide consistency and ease of trading. With their unique characteristics and ability to serve various purposes, Bank Nifty futures contracts have become an essential tool for investors, traders, and institutions in the Indian financial market.

2. Literature Review

Numerous studies have been done to find the relationship between the spot and futures market. Y Zhang, L Liu (2018) showed there exists a relationship between spot and futures market in natural gas. RP Pradhan et al. (2021) identified there is a lead-lag relationship between spot and futures in the Indian commodity market. HB Ameur, Z Ftiti, and W Louhichi (2022) confirmed the futures market's dominant contribution to price discovery in the commodities market. Pani, U, Gherghina, S. C., Mata, M. N., Ferrão, J. A., & Mata, P. N. (2022) showed that the spot market leads the futures market in price discovery for copper and zinc. However, the futures market leads the spot market in price discovery for silver, aluminum, and lead. T Jiang, S Bao, L Li - Physica A (2019) observed there exists a causal relationship between SSE 50 Index markets: The index futures, 50ETF spot, and options markets. N Mandal, R Das (2022) did a study on Bank Nifty and found out price discovery happens in the spot

market. Wats & Mishra (2009), and Pati & Rajib (2011) reportedly agreed that price discovery happens in the CNX-Nifty futures market and it leads the spot market in information transmission. Whereas, Bose (2007), and Gupta, & Singh (2009) are reported to have found that although price discovery happens in both futures and spot markets, as far as the information transmission is considered the futures market leads the spot market of CNX-Nifty. V Jain, R Dahigude, and DR Divekar (2020) establish a long-run relationship between spot, futures, and options. Jolly Sushma, and Dr. Vivek S. Kushwaha (2019) found there is a cointegrating relationship between both spot and future prices. MA Khan et al. (2022) found that the disequilibrium between the spot and futures market is restored by the spot market. S Gupta, S Bhardwaj (2020) predicted the existence of a long-run association between the spot and future prices of the spices taken for the study. Singh, N. P., & Sharma, S. (2018) conclude that the cointegration and causality relationship among Sensex, gold, crude oil, and USD are dynamic. Alemany, N. et al. (2020) found that the more arbitrage opportunities, the greater the leading role of the futures market and the more pronounced the impact of unexpected shocks on prices. Roy, P. S., & Chakraborty, T. (2020) explained that the spot and future markets contribute to price discovery and neither of the markets displays considerably higher information efficiency compared to the other. Raju, G. A. (2020) based on studies done in the energy sector emphasized that for India's economy, the Futures Market appears to play a more efficient role in price discovery than the Spot Market. Sharma, D. et al. (2022) explained that there exist fluctuations, volatility, and lead-lag relationship between the spot and the future which will help investors and policymakers to make well-formed decisions. PK, S. K., & MA, S. (2022) reconfirm the influence of spot prices of gold on its futures price in the Indian commodities market, which is unidirectional from spot to the futures price.

2.1 Objectives of Study

1. To determine the correlation between Bank Nifty spot and Bank Nifty futures prices.
2. To determine the presence of cointegration between Bank Nifty spot and Bank Nifty futures prices.
3. To determine the cause-and-effect relationship between Bank Nifty spot and Bank Nifty futures prices through Granger causality analysis.

3. Research Methodology

3.1 Hypothesis of the Study

H_{01}: There exists no correlation between Bank Nifty spot and Bank Nifty futures.

H_{02}: There is no cointegration between the selected time series of Bank Nifty spot and Bank Nifty futures.

H_{03}: There is no impact of Bank Nifty Spot on the Bank Nifty Future prices.

3.2 Sample Size and Data

The daily closing prices of Bank Nifty spot and futures were collected for 12 years, starting from 4th January 2010 to 30th December 2022. The data was collected from the historical data section of the National Stock Exchange website. Subsequently, the collected data underwent a thorough cleaning process to eliminate any missing values. After the data-cleaning process, a total of 3,224 daily closing prices were available for analysis.

3.3 Statistical Tools

Correlation analysis, cointegration, Granger causality, and error correction models collectively offer a comprehensive toolkit for understanding the interconnectedness of spot and future prices in the Indian derivative market, with a specific focus on Bank Nifty.

To conduct the Granger causality test, we follow several key steps. First, we select the relevant variables for analysis, focusing on the spot and future prices of Bank Nifty. It is important to ensure that the data used is stationary, meaning it exhibits no long-term trends or systematic patterns.

Next, we determine the appropriate lag length to capture the temporal relationship between the variables. Lag length selection is critical as it influences the accuracy of the test. Commonly used criteria such as the Akaike Information Criterion (AIC) or the Schwarz Bayesian Criterion (SBC) help us determine the optimal lag length.

We then construct the test equation, typically in the form of an autoregressive model, using the selected variables and lag length. The test equation considers the past values of the variables and the coefficients associated with them. For example, the test equation for the relationship between spot and future prices can be represented as:

$$\Delta Spot\_Price(t) = \alpha + \sum(\beta * \Delta Spot\_Price(t-i)) + \sum(\gamma * \Delta Future\_Price(t-i)) + \varepsilon(t) \qquad \textit{Equation 1...}$$

$$\Delta Future\_Price(t) = \delta + \sum(\theta * \Delta Spot\_Price(t-i)) + \sum(\varphi * \Delta Future\_Price(t-i)) + \varepsilon(t) \qquad \textit{Equation 2...}$$

Here, $\Delta Spot\_Price(t)$ and $\Delta Future\_Price(t)$ represent the first differences of spot and future prices at time t, respectively. The coefficients β, γ, θ, and φ capture the lagged effects, and α, δ represent the intercept terms. $\varepsilon(t)$ denotes the error term.

The theory behind ECMs is rooted in the concept of cointegration, which suggests that spot and futures prices are linked by a long-term equilibrium relationship. The ECM framework allows us to model the disequilibrium or deviations from this equilibrium relationship. The key idea is that any divergence from equilibrium in the short term will be corrected in subsequent periods, leading to a converging behaviour.

The general form of an ECM is represented by the following equation:

$$\Delta Yt = \alpha + \beta_1 \Delta Y\_(t-1) + \beta_2 \Delta X\_(t-1) + \gamma(ECM\_(t-1)) + \varepsilon\_t \qquad \textit{Equation 3....}$$

In this equation, ΔYt represents the change in the dependent variable (e.g., spot price) at time t, ΔX_(t-1) represents the change in the independent variable (e.g., future price) at time t-1, ECM_(t-1) represents the error correction term at time t-1, and ε_t is the error term.

The error correction term, ECM_(t-1), captures the adjustment mechanism and measures the speed of convergence to equilibrium. It is calculated as the difference between the actual value of the dependent variable at time t-1 and its predicted value based on the long-term equilibrium relationship.

4. Statistical Results

4.1 Augmented Dickey-Fuller Test for Stationarity Analysis

Table 1: ADF test result

	at level (p-value)	at first difference (p-value)
Bank Nifty Spot	0.9572	0.0000*
Bank Nifty Futures	0.9654	0.0000*

*Source: Computed on the basics of data collected from nseindia.com using EViews, *5% level of significance*

Table 1, ADF test results suggested that both Bank Nifty Spot and Bank Nifty Futures are non-stationary at level but stationary at first difference. This suggests that the data does not possess unit roots or trends, making it suitable for time series analysis and modelling.

4.2 Karl Pearsons Correlation Analysis

Table 2: Correlation test results of Bank Nifty spot and Bank Nifty futures closing price

Bank Nifty Spot and Bank Nifty Futures

Correlation Probability	Spot Price	Future Price
Spot Price	1.0000 …….	
Future Price	0.9928 0.0000	1.0000 ……..

Source: Computed on the basics of data collected from nseindia.com

The calculated correlation coefficient between spot price and future price is presented as 0.992876. This value indicates a strong positive correlation between the two variables. A correlation coefficient close to 1 suggests that the variables move closely together, exhibiting a tendency to increase or decrease simultaneously. Given these results, we can conclude that the null hypothesis (H01) is rejected.

4.3 Johansens Cointegration Analysis

Table 3: Johansen Cointegration test results

Cointegration Between	Lag length selected	Cointegration test using	No. of cointegrating equations	Eigen Value	Trace Statistic	Critical value at 5%	Probability
Nifty Bank daily spot closing price and daily future closing price	1 to 2	Trace test	None	0.359840	2368.877	12.32090	0.000
			At most 1	0.251466	932.6370	4.129906	0.000
		Max-Eigen Value test	None	0.359840	1436.240	11.22480	0.000
			At most 1	0.251466	932.6370	4.1229906	0.000

Source: Computed on the basics of data sourced from nseindia.com

The results reveal an eigenvalue of 0.359840 corresponding to the hypothesis of no cointegration. The trace statistic is reported as 2368.877, which exceeds the critical value of 12.32090 at the 0.05 significance level. Additionally, the associated probability is reported as 0.000, indicating strong evidence against the null hypothesis.

As a result, the null hypothesis of no cointegration is rejected, and the alternative hypothesis of cointegration (H_{12}) is accepted. The test suggests the presence of two cointegrating equations at the 0.05 significance level. These findings indicate that Bank Nifty spot and futures exhibit a long-term relationship, suggesting that they move together in equilibrium over time.

4.6 Granger Causality Analysis

Table 4: Granger Causality test results

Null Hypothesis	**Observations**	**F-Statistic**	**Prob.**
Spot does not Granger cause Future	3222	0.01889	0.8907
Future does not Granger cause spot	3222	4.90178	0.0269

Source: Computed on the basics of data collected from nseindia.com

The first null hypothesis, "SPOT does not Granger cause FUTURE," plays a critical role in examining whether changes in the spot price hold substantial predictive power over future price movements. Essentially, it investigates the extent to which the spot price influences or predicts the future price. The obtained F-statistic of

0.01889 is relatively low, indicating a lack of strong evidence in support of the alternative hypothesis that changes in the spot price significantly Granger causes the future price. Consequently, based on these results, we fail to reject the null hypothesis, which indicates that changes in the spot price do not possess significant predictive power over the future price.

In contrast, the second null hypothesis, "FUTURE does not Granger cause SPOT," explores the impact of changes in the future price on spot price movements. The test results reveal an F-statistic of 4.90178 and a corresponding probability value of 0.0269, which provide evidence supporting the alternative hypothesis that changes in the future price significantly Granger cause the spot price.

4.7 Error Correction Model Analysis

Table 5: ECM test results

Dependent Variable: D(Future_Price) Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-0.014566	0.645841	-0.022553	0.9820
D(Spot_Price)	1.006449	0.001464	687.5389	0.0000
ECT(-1)	-1.305374	0.016871	-77.37274	0.0000

Source: Computed based on data collected from nseindia.com

The coefficient estimate for the Error Correction Term (ECT) captures the speed of adjustment between the first-differenced future price and the long-term equilibrium established by the cointegration relationship. In the model, the ECT is lagged by one period (ECT(-1)), indicating the adjustment from the previous period. The coefficient estimate for ECT(-1) is -1.305374, with a standard error of 0.016871. The t-statistic of -77.37274 and the associated p-value of 0.0000 indicate a highly significant coefficient. This suggests a strong and statistically significant speed of adjustment.

5. Conclusion

In this research study, a comprehensive analysis was conducted to explore the interconnectedness of Bank Nifty spot and futures prices. The purpose was to gain a deeper understanding of the relationship between these variables and provide valuable insights for traders, investors, and researchers.

One of the key findings from the analysis was the strong positive relationship revealed by the correlation test between Bank Nifty spot and futures prices. Understanding and recognizing this strong correlation between Bank Nifty Spot and futures prices can be beneficial for traders, investors, and researchers. For example, if a trader holds a spot position, they can offset potential risks by taking a corresponding futures position or vice versa.

The presence of cointegration between Bank Nifty Spot and futures prices indicates a long-term equilibrium relationship. This finding implies that spot and futures prices are influenced by common factors and tend to converge over time. Recognizing this relationship is valuable for traders and investors as it provides insights into the long-term dynamics of these prices and can guide trading and investment strategies. Overall, the findings of the Granger causality test suggest that the future market has a stronger influence on the spot market than the other way around.

The analysis of the error correction model (ECM) provides important insights into the behaviour of Bank Nifty spot and futures prices, particularly regarding their adjustment process towards the long-term equilibrium. This understanding of the adjustment dynamics can guide trading strategies and improve profitability. Similarly, for investors, recognizing the efficient adjustment process can inform their decision-making regarding portfolio management and asset allocation. Understanding how quickly the market corrects deviations can provide insights into the optimal timing for buying or selling positions, allowing investors to take advantage of mispriced assets. Moreover, the speed of adjustment in the Bank Nifty market reflects the underlying forces of supply and demand and the market's ability to efficiently incorporate new information. By recognizing this characteristic, traders and investors can have a more accurate understanding of price movements and trends, aiding in risk management and decision-making.

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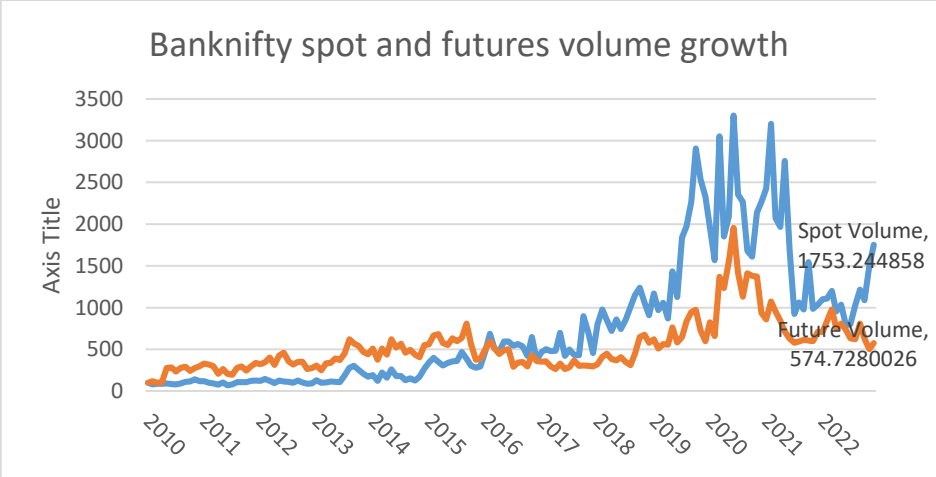
Figure

Figure 1: Bank Nifty Spot and Bank Nifty Futures volume growth



Source: nseindia.com

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