Lead-Lag Relationship between the Spot and Futures in the Indian Equity Market - An Empirical Examination

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Abstract

Derivatives as financial instruments are used to either mitigate risk or assume risk with the expectation of commensurate reward. The research is undertaken to examine the lead-lag relationship between the spot and futures in the equity market. The cointegration tests revealed that there is a long-run relationship between the spot and futures prices, allowing investors to employ various diversification strategies to gain profit with minimal risk. The direction of causality is also examined and showed a unidirectional relationship among the variables. In the case of the Nifty 50 index, it has been determined that the futures market outperforms the spot market thus the traders can predict the spot price movements with the help of the futures market information and earn profit at low risk. In the case of the Bank Nifty index, the Spot market leads the futures market.

Key Words: Equity Market,Futures, Index, Lead-Lag Relationships, Nifty, Spot

Introduction:

The capital market of India has witnessed remarkable transformations and changes in structure over the last two decades as a result of prevailing reforms in the financial sector. The major objectives of these reforms were increasing market efficiency, improving transparency, identifying the unfair trade practices, and making the Indian capital market have an international standard. One of the notable steps taken as part of the reforming process is the introduction of derivative instruments in the major Indian stock exchanges- NSE and BSE with an overview of providing tools to investors to manage risk and which also helps to increase the informational efficiency of the market. Since 1865, with the introduction of the first commodity futures in the Chicago board of trade, many emerging economies had started to introduce derivative instruments into the market. The capital markets in India have started to experience the trading of derivative products with the introduction of index futures on June 9, 2000, on the Bombay Stock Exchange, and on June 12, 2000, on National Stock Exchange. index options were

introduced after one year to expedite the investors in risk management. They also introduced stock options and futures on underlying stocks in July 2001 and Nov. 2001 respectively. Derivatives were introduced in India with an aim of curbing the increasing volatility of prices of the assets in the financial markets not only was the aim but also to introduce refined tools for risk management which tends to higher returns by reducing transaction costs and risks as compared to the individual financial assets. Though the derivative trading has efficiently altered the stock price movements in the Indian spot market, whether the derivative instruments have fulfilled the purpose as claimed by the Indian regulators is yet to be proved.

In today's financial literature, the derivative markets have been receiving greater attention for the price discovery process. According to the efficient market hypothesis, any new information would be immediately reflected in the market prices in a perfectly efficient financial market. It was seen that any important information would be mirrored instantly in the spot and futures market prices. This means that there was no scope for the arbitrage opportunities and no possibility for the lead-lag relationship between the spot market and futures market. However, the futures market started reacting faster to the information available in the market historically which makes the futures market play an important role in price discovery. The lead-lag relationship between two markets has been observed due to different market frictions such as transaction cost differences and infrastructure settings of the financial markets etc. It was observed that one market reflects any new information faster than the other market which tends to help the traders to earn the arbitrage profit. It also enables the investors to forecast future prices in the spot market using this past information.

In today's globalized economy, India has become one of the fastest-growing economies in the world and also performing great in the derivative market. It is expected to show an increasing growth pattern in the Indian Derivative markets in the coming years. One of the main aims of this study is to determine the efficiency of the Indian derivative market by exploring more opportunities in these markets. This study is based on the exchange-traded derivatives - futures. Futures has been selected for this study due to their properties such as (a) less cost because of the factor that only margin money is required to maintain (b) its hedging effectiveness and (c) because of their fewer complexities. This study tries to identify the lead-lag relationship between the spot and future price concerning the Nifty 50 index and Bank nifty index by employing the data from 2005 to 2021 and also identifying whether it provides any productive information which helps to forecast the movements or trends of spot or futures markets.

Literature Review:

PyungKun Chu et al. (2022) examined the predictability of Brent crude oil. The study used the best-performing model for the analysis which helps to impose very little structure on the relationship between spot and futures prices. They identified that the simple no-change forecast works better than forecasts based on futures prices over short-term horizons that are less than one year and futures-based forecasts perform better than the no-change forecast across long-term horizons that is for a period of one to five years.

SuranjanaJoarder and Diganta Mukherjee (2021) conducted a study on the lead-lag relationship between future and spot prices based on a case of oil and oilseeds contracts traded on the Indian Exchange. They analyzed the role played by the futures market in the price discovery process through this study. To test whether the futures or spot market in India plays a dominant role in information dissemination, they used regression analysis considering the lagged futures and spot price volatility as explanatory variables. They considered the major oil and oilseed contracts traded on National Commodity and Derivatives Exchange such as soybean, refined soy oil, soymeal, mustard seed, castor seed, cottonseed oilcake, etc. They used the daily closing price of the futures contract and the daily spot price of the commodities for the period from 2005 to 2014 for the study. The stationarity between spot and futures price series was tested using Augmented Dickey-Fuller (ADF) test. As the uses of many of the oilseeds are related, they tried to analyze the interlinkages among the market for different commodities. The results clearly showed that information on relevant futures market volatilities helps significantly to assess the volatility in the spot markets. This linkage can be leveraged to manage the spot market risks better.

Nuria Alemany et al. (2020) used switching models to investigate the lead-lag relation between spot and future stock indexes in terms of intraday data and regime. The impact of changes in arbitrage opportunities on the price discovery process between the DAX30 index and the DAX30 index future over a short time was investigated in this study. This study used high-frequency observations on a five-minute interval basis of transaction prices from DAX30 for both the stock index and index futures. The findings reveal nonlinearities in the cointegrating vector as well as the limitations of depending on linear assumptions. The presence of arbitrage opportunities modifies the structure of the lead-lag dynamics, implying that the more arbitrage opportunities, the larger the futures market's leading role and the more intense the impact of unanticipated shocks on prices.

Samak N, Hosni R, and M Kamal (2020) investigated the direction of the relationship between food spots and future prices concerning global food commodities. The time-series data source of futures prices was obtained from the historical end-of-day dataset of the Chicago Mercantile Exchange Group (CME Data Mine) and the time-series data source of spot prices was obtained from the World Bank International Commodity Prices database. The initial descriptive analysis was conducted on commodities such as wheat, corn, and soybeans for the period from 2010 to 2018. The study suggested that the cointegration and error correction model is preferable since it provides a more formal framework for examining the short-run dynamics and testing for the equilibrium relationship among economic variables. Special attention to alternative instruments, such as the implementation of a global virtual reserve, should be highlighted to minimize speculative attacks and avoid excessive spikes in prices in spot and futures markets. This implies the importance of adopting the possible protectionist measures by developing countries to hedge against the negative reflections of global food price volatility.

Rudra P. Pradhan, John H. Hall, and Elda du Toit (2020) examine the relationship between spot and futures prices of different commodities and indices in the Indian commodity market for the period from 2009 to 2020. The data was obtained from the Bloomberg database. The results indicate that the futures and spot prices of all the selected commodities and indices are non-stationary at level data, but that the variables are all stationary at 1% when tested at first difference. The findings also show that the spot and futures prices of these commodities have a long-run equilibrium relationship. The causality study demonstrates unidirectional causality in the long run for aluminium and copper from spot to futures prices, as well as bidirectional and unidirectional causality in the short run for aluminium, copper, gold, and silver between the two prices.

Gouri Prava Samal and Anil Kumar Swain (2019) analyzed the dynamic relationship between spot and futures prices of turmeric with evidence from NCDEX (National Commodity and Derivatives Exchange Ltd.). The study was undertaken considering the importance of turmeric in the Indian Economy. The study evidences the following (a)the futures markets dominate spot markets for turmeric in India (b) F statistics indicate a strong flow of information from the futures markets to spot markets than the reverse and (c) the unidirectional causal relationships exhibited by the futures and spot prices implied that the futures markets of turmeric help to discover prices in the spot markets.

BurcuKapar and Jose Olmo (2018) conducted a study to analyze the Bitcoin price discovery process. The data was collected on futures and spot prices for the period from December 2017 to May 2018 and computed Hasbrouck's information share and Gonzalo and Granger's common factor component to determine how much each market contributes to the price discovery process. For Bitcoin spot price, they used the Coindesk Bitcoin USD Price Index, a simple average of global Bitcoin/USD exchange prices. It was expressed as the midpoint of the bid/ask spread across several global exchanges meeting certain minimum criteria about minimum trade size, trading volume, and others. For Bitcoin Future Price, the study used Chicago Mercantile Exchange & Chicago Board of Trade (CME) contracts. Both measures used in the study suggested that the Bitcoin futures market dominates the price discovery process. The result also shows that both prices are driven by a common factor that was given by a weighted combination of the

futures and spot market and observed that deviations from the equilibrium condition equating the futures and spot log-price have predictive ability for the return on the Bitcoin spot price but not on the futures price.

Xin Jin (2017) in a study entitled "does the futures price help forecast the spot price?" proposed a futures-based unobserved components model for the commodity spot price which proves to have superior forecasting ability. The researcher used crude oil market data for the study from 1986 onwards. The commodity spot price was divided into long-term and short-term components, while the futures price was divided into expected future spot price and risk premium. Under this model, information from the whole futures curve could be utilized to improve the forecasting accuracy of the spot price. Applying this model to oil market data, it was found that the model forecasts outperform in multiple dimensions the benchmark of the literature optimal forecast (the random walk) as well as simple futures prices forecasts. The model forecasts overall have smaller error variation over the 20-year sample period and are also more possible to have a smaller absolute error when compared to the benchmark forecasts period by period.

Viviana Fernandez (2016) conducted a study to show that the researcher Gulley and Tilton's findings can be rationalized by the theory of storage as periods of contango and backwardation can be singled out by the sign of the interest-adjusted basis. The study considered two tests to assess the degree of association between spot and futures markets, depending on the sign of the interest-adjusted basis. One test was utilized to gauge the difference in correlation between spot and futures returns when the interest-adjusted basis was positive or negative. The second test was the Granger causality test which accommodates the existence of cointegration between spot and futures prices and this test was utilized to assess whether feedback effects between spot and futures prices are stronger when the interest-adjusted basis was positive. The estimated results for the six base metals of the London Metal Exchange show that a stronger association between futures and spot returns during periods of high stocks (i.e., positive interest-adjusted basis) holds only contemporaneously.

Research Methods:

The time-series data used for the study is extracted from the official website of the National Stock Exchange (NSE-www.nse.com). The daily closing price of Nifty 50 and Bank Nifty indices in the spot market is taken as the spot price and the next month's closing price of future contracts of both the indices are taken in case of a futures market for the period from 2005 to 2021.The study has chosen the index futures data for the analysis since the Nifty 50 has been recognized as a well-diversified index consisting of 50 liquid stock indexes.

Hypothesis:

H0: There is no significant lead-lag relationship between spot and futures prices

Results and Discussions:

All the variables undergo a descriptive statistic to determine whether the data is statistically significant and the values of mean, median, standard deviation, skewness, kurtosis, and Jarque-Bera statisticsare measured. In order to study the time series data, it is required to conduct a test for stationarity to check whetherthe value of the variable doesn't change with time, which is done with help of unit root tests such as the Augmented Dickey-fuller (ADF) test and the Philips-Perron (PP) test. In order to test the cointegration between the variables, to identify the cointegration lag relationship,Autoregressive Distributed Lag (ARDL) technique and Johansen cointegration test are used. However, the Granger Causality test is used to identify the causal relationshipbetween the variables, in order to check whether there exists a functional relationship between the variables. These analyses are done with the help of EViews 9.

The basic descriptive statistics for all the variables of the data are represented in the below tables.

Table 1 Descriptive Statistics – Nifty 50 Spot and Futures price

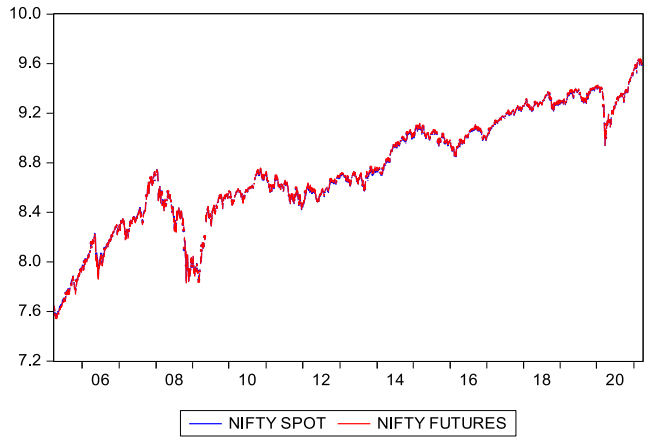
Measures	Spot price	Futures price
Mean	6928.616	6928.616
Median	6001.550	5960.900
Maximum	15376.65	15314.70
Minimum	1877.950	1902.500
Standard deviation	2999.079	2976.396
Skewness	0.470663	0.480748
Kurtosis	2.362204	2.368435
Jarque-Bera	213.8095	218.8489
Probability	0.0000	0.0000

Source: Author analysis

The mean value of Nifty 50 futures price is 6928.616 with a maximum of 15314.70 and minimum of 1902.500 respectively while the mean value of spot price is 6928.616 with a maximum of 15376.65 and minimum of 1877.950. The standard deviation of spot prices is 2999.079 and futures prices is 2976.396 which are larger values indicatinga high variation from the data of mean values. The positive values of skewness mean that the data are skewed to the right. The kurtosis value of both the statistics is less than the standard value which indicates that it is a platykurtic distribution. Since, the Jarque-Berashows a significant value andare high in the case of spot and futures price with a probabilityindicates that the errors are not normally distributed.

The positive value of skewness is not attractive for a statistical test since it may mislead the results. Therefore, to overcome this problem, the data transformation tool is used for this analysis to make the skewed data closer to the normal distribution. The most popular transformation tool for positively skewed distribution is log transformation which implies the calculations of natural logarithm for each data set to reduce the skewness. All the variables are converted into their natural logarithm for the application of statistical tools for the analysis of this study.

Graph 1 - Daily Nifty 50 spot and futures returns (2005-2021)



Graph 1 represents the daily spot and futures returns in the natural logarithm form of the Nifty 50 index from 2005 to 2021. It is clear from the graph that there is a minor fluctuation in the price movements from 2005 to 2021. There is an upward trend shown at the beginning which was followed by a major downward trend due to the recession in the market. After the recession period, it showed an upward movement in the spot and futures prices with minor fluctuations.

Table 2 Descriptive Statistics – Bank Nifty Spot and Futures Prices

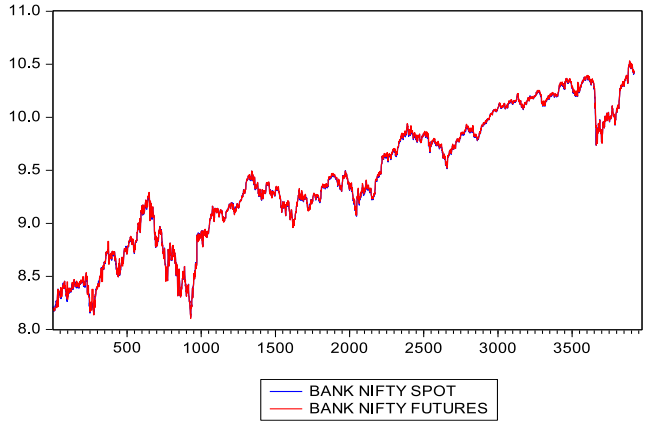
Measures	Spot prices	Futures prices
Mean	14635.30	14706.24
Median	11614.38	11699.83
Maximum	37306.25	37486.60
Minimum	3339.700	3304.200
Standard deviation	8314.604	8361.873
Skewness	0.602901	0.599628
Kurtosis	2.238782	2.235389
Jarque-Bera	331.9543	330.2293
Probability	0.000000	0.000000

Source: Author analysis

The mean value of Nifty 50 futures price is 14706.24 with a maximum of 37486.60 and minimum of 3304.200 respectively while the mean value of spot price is 14635.30 with a maximum of 37306.25 and minimum of 3339.700 . The positive value of skewness means that the data are skewed to the right. The standard deviation of spot prices is 8314.604 and futures prices is 8361.873 which are larger values indicating a high variation from the data of mean values. The kurtosis value of both the statistics is less thanthe standard value, which indicates that it is a platykurtic distribution. Since, the Jarque-Bera values are high in case of both indices with a probability 0 indicates that the errors are not normally distributed.

The positive value of skewness is not attractive for a statistical test since it may mislead the results. Therefore, to overcome this problem, the data transformation tool is used for this analysis to make the skewed data closer to the normal distribution. The most popular transformation tool for positively skewed distribution is log transformation which implies the calculations of natural logarithm for each data set to reduce the skewness. All the variables are converted into their natural logarithm for the application of statistical tools for the analysis of this study.

Graph 2 Daily Bank Nifty spot and futures returns (2005-2021)



Graph 2 represents the daily spot and futures returns in the natural logarithm form of the Bank Nifty index from 2005 to 2021. It is clear from the graph that there is a major fluctuation in the price movements. The downward trend in the market is due to the recession in the year 2008. After that, it showed an upward trend in the direction of movement in the spot and futures prices with minor up and down fluctuations.

Unit Root Test

To determine the stationarity of the time series data, the unit root test like the Augmented Dickey-Fuller test and Phillips-Perron test is conducted.

ADF is estimated using the following equation :

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \epsilon_t$$

Where $\alpha = \rho - 1$

Evaluation is based on the test statistic :

$$t_\alpha = \hat{\alpha}/(se(\hat{\alpha}))$$

where $\hat{\alpha}$ is the estimate of α and $se(\hat{\alpha})$ is the coefficient standard error.

PP Test is estimated based on the statistic :

$$\tilde{t}_\alpha = t_\alpha\left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0-\gamma_0)(se(\hat{\alpha}))}{2f_0^{1/2}s}$$

where $\hat{\alpha}$ is the estimate and t_α the t ratio of α $se(\hat{\alpha})$ is the coefficient standard error and s is the standard error of the test regression.

The hypothesis for the test is:

H0: There is a presence of unit root i.e., time series is non-stationary.

H1: There is no presence of unit root i.e., time series is stationary.

Table 3 - ADF statistics

	Level I(0)	First difference I(1)	Critical value at significance level of 1%
Nifty Spot	-3.4571	-60.6792	-3.9604
Nifty Futures	-3.5580	-62.5474	-3.9604
Bank Nifty Spot	-3.6933	-56.3626	-3.9604
Bank Nifty Futures	-3.9604	-60.3998	-3.9604

Source: Author analysis

Decision criterion: If the value of calculated test statistics is greater than the critical value, then reject the null hypothesis that the time series is non stationary and accept the alternative hypothesis.

Table 3 represents the test statistics values of the time series data of the spot and future prices of both the Nifty 50 and Bank Nifty indices through ADF test. It is clear from the table that the test statistic values obtained at level data are less that the critical value at significance level 1%. So, we accept the null hypothesis that there is unit root. However, in case of first difference data, the test statistics values obtained are greater than the critical values which means that the null hypothesis cannot be accepted.

Table 4 - PP statistics

	Level I(0)	First difference I(1)	Critical value at a significance level of 1%
Nifty 50 Spot	-3.5746	-60.6523	-3.9604
Nifty 50 Futures	-1.5864	-62.5515	-3.9604
Bank Nifty Spot	-3.6155	-56.1661	-3.9604
Bank Nifty Futures	-3.6967	-60.3859	-3.9604

Source: Author analysis

Decision criterion: If the value of calculated test statistics isgreater than the critical value, then reject the null hypothesis that the time series is non-stationary and accept the alternative hypothesis.

Table 4 represents the test statistics values of the time series data of the spot and futures prices of both the Nifty 50 and Bank Nifty indices through PP test. It is clear from the table that the test statistic values obtained at level data are less than the critical value at significance level 1%. So, we accept the null hypothesis that there is unit root. It indicates

that mean, variance and covariance of the spot and futures returns of Nifty 50 and Bank Nifty indices do vary with the change in time. However, in case of first difference data, the test statistics values obtained are greater than the critical values which means that the null hypothesis cannot be accepted. It indicates that the mean, variance and covariance of the spot and futures returns of Nifty 50 and Bank Nifty do not vary over time i.e., they are at constant position.

Thus, the results from ADF test and PP test shows that the future and spot prices of both indices are non-stationary at level I(0) and stationary at first difference I(1).

Cointegration Test

In order to determine the long-run relationship between the variables, a cointegration test is conducted. ARDL technique is the most suitable to check the cointegration since all the variables are found to be between the bounds I(0) and I(1) on the basis of the unit root tests.

- ARDL (Autoregressive Distributed Lag) Test

The general form of the ARDL test is

$$y_t = \sum_{i=1}^{j} a_i y_{t-i} + \sum_{j=0}^{k} b_j x_{t-j} + e_t$$

· Johansen cointegration test

It is of two forms: Trace statistics and Maximum eigenvalue

Trace statistics can be estimated using the test statistic

$$LR_{tr}(r|k) = -T \sum_{i=r+1}^{k} \log(1-\lambda_i)$$

where λ_i is the i-the largest eigenvalue

Maximum eigenvalue can be estimated using the test statistic

$$LR_{max}(r|r+1) = -T\log(1-\lambda_{r+1}) = LR_{tr}(r|k) - LR_{tr}(r+1|k)$$

For r=0,1…..,k-1.

The hypothesis for this test is:

H0: There is no cointegration between two variables i.e., there is no long-run relationship exist between futures and spot returns

AUTOREGRESSIVE DISTRIBUTED LAG TEST

Table 5 - ARDL bound test

	Optimal Lag length	F statistics	Diagnostic tests		Critical values at 1%, 5% & 10%	
			χ2 (A)	χ2 (B)	I(0) lower bound	I(1) upper bound
Nifty 50	4,4	887.465	88.519	5.775*	6.84/4.94/4.04	7.84/5.73/4.78
Bank Nifty	4,4	816.825	109.914	24.247	6.84/4.94/4.04	7.84/5.73/4.78

Source: Author analysis

Note: χ2 (A) indicates the value of the heteroscedasticity ARCH test and χ2 (B) indicates the value of Breusch–Godfrey serial correlation LM test.

*Denotes that significance at 5% and 10% significance levels.

Decision criterion: If the estimated value of F-statistics exceeds the upper critical bound value, then the null hypothesis gets rejected.

Table 5 represents the result of the ARDL bound test. As shown in the table, all the test values exceed the upper critical bound, hence the null hypothesis of there is no cointegration cannot be accepted which means that there is a long-run relationship between the variables.Thus, the results show that the spot and future returns of both Nifty 50 and Bank Nifty indices are cointegrated.

Johansen Cointegration Test

For strengthening the result obtained using the ARDL test, the Johansen Cointegration test is also used.

Table 6 - Results of Johansen Cointegration test

	Hypothesized no. of cointegrating vectors	Trace statistics	Maximum eigenvalue	No. of cointegrating vectors
Nifty 50 spot and futures	None (k)	1892.970	1167.670	2
	At most 1 (k	725.300	725.300	
Bank Nifty spot and futures	None (k)	1937.866	1196.577	2
	At most 1 (k	741.289	741.289	

Source: Author analysis

Table 7 Critical Values for The Johansen Cointegration Test

	Critical values at 0.05 significance level	
	Trace statistics	**Maximum eigen value**
None	15.4947	14.2646
At most 1	3.8415	3.8415

Source: Author analysis

Decision criterion: If the trace statistics and maximum eigenvalue are greater than their respective critical values, then the null hypothesis will not be accepted.

Table 7 shows the result of the Johansen cointegration test. It is evident from the table that in none of the variables and at most 1, the value of trace statistics and maximum eigenvalue is greater than their respective critical values, so the null hypothesis cannot be accepted which indicates that there is cointegration between the variables.

Thus, the results show that the spot and futures returns of both Nifty 50 and Bank Nifty indices are cointegrated. As a result, spot and futures prices with differing times to expiration are cointegrated, and there is a long-term link between the prices, allowing investors to use this knowledge as a diversification strategy to gain an extra return with minimal risk. It also indicates that the spread stays around the mean values. The cointegration between the spot and futures prices allows the traders to create strategies for hedging and speculation in both markets which provides larger opportunities to the players of the market.

Granger Causality Test

Granger causality test is used to determine the causal relationship between the spot and futures price of the indices. It also helps to identify the price discovery process.

The general form of this test is

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \ldots + \beta_l x_{-l} + \epsilon_t$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \ldots + \beta_l y_{-l} + u_t$$

for all possible series of (x,y) series.

Table 8 - Granger Causality Test Result of Nifty 50 Index

Null hypothesis	F statistics	Probability
Future market does not granger cause spot market	3.8777	0.0208
Spot market does not granger cause future market	0.5257	0.5912

Source: Author analysis

Decision criterion: If the estimated p-value is less than the critical value i.e.,0.05, then the null hypothesis is rejected.

The findings of the granger causality test with regard to the Nifty 50 index are shown in table 8. The estimated p-value is lesser than 0.05 in the case of a null hypothesis future market does not cause a granger spot market. So, the null

hypothesis cannot be accepted which means that any change in future price does affect the spot price. This indicates that the futures market leads the spot market. So, it enables the traders to earn profits by proper observation of these futures prices' information. All the market participants can use this price movement information to make a profit through trading in the spot market by reducing risks.

But in case of the null hypothesis spot market does not granger cause future market, the estimated p-value is greater than the critical value 0.05. Therefore, the null hypothesis cannot be rejected which means that any change in spot market does not cause a change in the future market in the case of the Nifty 50 index.

Table 9 - Granger Causality Test Result of Bank Nifty Index

Null hypothesis	F statistics	Probability
Future market does not granger cause spot market	1.2062	0.2994
Spot market does not granger cause future market	155.304	1.E-65

Source: Author analysis

Decision criterion: If the estimated p-value is less than critical value i.e., 0.05, then the null hypothesis is rejected.

The findings of the granger causality test with regard to the Bank Nifty index are shown in table 9. The estimated p-value is greater than the critical value of 0.05 in the case of a null hypothesis future market does not cause a granger spot market. So, the null hypothesis cannot be rejected which means that any change in future price does not affect the spot price. But in the case of the null hypothesis spot market does not granger cause future market, the estimated p-value is lesser than the critical value of 0.05. Therefore, the null hypothesis cannot be accepted which means that any change in the spot market does cause a change in the future market in the case of the Bank Nifty index. This indicates that futures markets are influenced by the news of spot markets and information flows freely in-between spot and futures markets. Furthermore, spot market prices contain information for predicting futures market prices and play a price discovery role in this study, as spot prices lead to futures prices. Thus, futures market participants can utilize the spot market prices as a strategy for trading to minimize risk and earn profit in the market.

Hence, it is proven that the futures market is determined by the information and news of the spot market which indicates that spot price leads the future prices in the case of the Bank Nifty index. However, in the case of the Nifty index, future price leads the spot prices which enables investors to predict the cash price movements in the spot market and earn profit.

Discussions:

The spot prices of the Nifty 50 index and Bank Nifty are non-stationary at level data and stationary at first difference level data. This indicates that the mean, variance, and covariance of the spot prices of both indices change over time at level data and do not vary over the time at first difference. The futures prices of the Nifty 50 and Bank Nifty index are non-stationary at level data and stationary at first difference level data and this indicates that the mean, variance, and covariance of the futures prices of both indices change over time at level data and do not vary over the time at first difference.

The spot and futures prices of the Nifty 50 index is having a long-run relationship i.e., they are cointegrated. The cointegration of the spot and futures prices leads to a more efficient market which enables the market players to create strategies for hedging and speculation with the help of market information which leads to larger opportunities. The spot and futures prices of the Bank Nifty index is having a long-run relationship i.e., they are cointegrated. The cointegration of the spot and futures prices leads to a more efficient market which enables the market players to create strategies for hedging and speculation with the help of market information which leads to larger opportunities. This also enables the investors to use different diversification tools to minimize the risk and earn more profit.

The futures market prices lead to the spot market prices in the case of the Nifty 50 index. There is only a one-way causal relationship. This shows that spot traders can use this information of futures price movement to predict spot prices and earn profit at low risk. The spot market prices lead the futures market prices in the case of Bank Nifty. There is only a one-way causal relationship. It indicates that futures markets are influenced by the news of spot markets and information flows freely in-between spot and futures markets. Further, spot market prices contain information that can be used to forecast future prices and play a price discovery role since spot prices lead to futures prices in this study regarding the Bank Nifty index. Thus, futures market participants can utilize the spot market prices as a strategy for trading to minimize risk and earn profit in the market. Also, it allows for maximizing the investors' portfolio with high returns.

Conclusion:

The study establishes the lead-lag relationship among the spot and futures prices in the case of both indices-Nifty 50 and Bank Nifty and helps to identify the price discovery process, which may help the investors develop new strategies to manage risk and earn profit through the determination of lead-lag relation. Also, it enables the arbitrageurs to plan accordingly so that they can take suitable policies to stabilize the stock market. This study also indicates that the information can be used efficiently to forecast the future direction of movements since there is a long-run relationship and causal relationship between the prices. This enables investors to have the opportunity to generate more profit in a variety of economic environments.

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