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An Inter-sectoral Comparison of Hedging Effectiveness with Futures in Indian Equity Market

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Abstract:
Investors are usually risk averse and future market provides effective hedging facility by eliminating price risk. This research is concerned with investigating the Hedge Ratio and Hedging effectiveness of stock index futures and is estimated using the securities which were listed in NSE Nifty 50 Index. Daily closing prices of spot and near month futures of 10 listed companies from different sectors are selected from 50 companies on the basis of Market Capitalisation. Data was collected for a period from 1st January 2010 to 6th November 2019 and include 2424 observations for a single security. Various econometric tools such as ADF test and Johansen co integration test, VECM are used for estimation. Optimal hedge ratios and Hedging effectiveness of the stock futures are estimated using CCC-MGARCH method since it seems to be a better fit for modelling time series data. Results reveal that futures can be termed as an effective hedge and the effectiveness of Hedging for those securities are very high which shows that trading with futures are best way to hedge the price risk.

Keywords: *Hedging, Futures, Spot closing price, CCC- MGARCH, Hedge ratio, Hedging Effectiveness.*

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I. Introduction:

Stock market is a place where regular activities of buying and selling of securities and issuance of shares take place. Stock market is also termed as stock exchanges and it is a place where stock brokers and traders buy or sell their shares. One of the best options that are available for an investor is to build his real worth by investing in stock market and thereby reduce the risk. It is always very important to fabricate an appropriate strategy to make an investment in right place and to hedge risk and thereby yield more return. Here arises the importance of this research. National Stock Exchange of India Limited (NSE) is one of the leading stock exchanges in India, which has its location in Mumbai and was established in 1992. It was the first exchange which provides a fully automated screen based system. Nifty 50 is an Index which is operated by India index services and products which represents the weighted average of 50 company stocks in 13 different sectors. It is termed as the flagship index of India and is one of the world's most actively traded contracts. There are many types of investors in the market such as speculators whose main motive is to make quick profit that arise out of market fluctuations and thereby taking maximum advantage of it, while hedgers mainly try to avoid the price risk that arise out of market fluctuations.

Diversification is a risk management strategy which obliterates unsystematic risk through the creation of portfolio. Since diversification of securities only avoids unsystematic risk it may not be considered as an effective tool to eliminate risk. Therefore in stock market derivative contracts especially futures are used for hedging. Futures are those contractswhere two parties agree to buy or sell a specific stock on a future date at a particular price. The main motive behind hedging includes reducing the risk of uncertainty or reducing the variability from profits. It mainly reduces price risk that mainly results in reduction in the value of security.

Futures market help in providing effective hedging facilities by reducing or eliminating risk that cannot be insured or diversified. Even though there are various hedging strategies, the main objective for all strategies remains the same i.e to reduce risk. Most of the study reveals that hedging effectiveness of future contracts can be best measured using various econometric tools such as OLS and GARCH models This study attempts to determine the hedging effectiveness of certain securities listed on NIFTY 50 by using GARCH models. Out of 50 securities listed, 10 of them were selected from different sectors based on the market capitalization as of 6th November 2019. Spot and future prices of the securities for the last 10 years were selected to measure the hedging effectiveness.

STATEMENT OF PROBLEM:

Movement of futures contract price always depend on the stock price movement and it is seen that spot market can create a price foundation for the futures market. Futures market varies depend on spot price movement and this kind of price fluctuations is reflected in all market segments. This research seeks to identify the effect of futures trading in stock market. Thus the problem under this research is to examine the impact of futures trading on cash price volatility and hedging effectiveness of futures contract in reducing the risk on account of unexpected price fluctuation which is termed as price risk.

II. Literature Review:

Various studies on estimating hedge ratio and hedging effectiveness has been widely investigated. Futures market helps an investor to reduce the price risk that arises out of market fluctuations. Futures are contract between a buyer and a seller to buy or sell a specified quantity of stock or commodity on a future date at predetermined price. Various models are used for estimating hedge ratio and hedging effectiveness.

Jason laws, John Thompson (2005) make a study on Hedging effectiveness of stock index futures with special reference to London stock exchange. Two future indices used were FTSE 100 and FTSE 250. The main aim of the study is to analyse the optimal method to hedge risk and the study reveals that Exponential weighted moving average seems to be superior to other methods. Study also concludes that FTSE 250 provided a better hedge than FTSE 100 index.

Christos Floros and Dimitrious V. Vougas (2006) make a study on Hedging effectiveness in Greek Stock Index Futures market. This study focus on various techniques to estimate variance reduction from constant and time varying hedge ratios. Study reveals that GARCH model provides greater variance reduction.

N. Awang , N.A Azizan, I.Ibrahim and R.M Said(2014) make a study on Hedging Effectiveness Stock index Futures Market: An analysis on Malaysia and Singapore Futures Market. This research investigates the effectiveness of hedging of stock index futures markets in Malaysia and Singapore by using econometric tools such as OLS model, VECM, EGARCH and bivariate GARCH models. The result indicates that the OLS model performs most effectively in both cases followed by EGARCH.

Bard Misund and Frank Asche (2016) make a study on hedging efficiency of Atlantic salmon futures. This study examines the hedging properties of atlantic salmon futures. The result provide evidence that hedging using future contracts listed on fish pool reduces risk and it also reveals that best hedging efficiency is achieved with simple one to one hedge closely followed by bivariate GARCH approach.

Kerkar Puja Paresh, Dr. P. Sri Ram(2017) make a study on Hedge Ratio estimates and Hedging effectiveness. This study focused on NIFTY 50 INDEX futures considering the period from April 2005 to December 2015. The optimal hedge ratio and hedging effectiveness of the stock index futures is determined using various econometric tools such as OLS, Bi-variate VAR model, VECM and GARCH model. It was concluded that GARCH model is found to be superior to other models in finding out Hedging Effectiveness.

Alexandios Koulis, George Kaimakamir, and Christina Beneki(2018) make a study on 'Hedging effectiveness for International Index futures markets'. This paper investigates the effectiveness of hedging of the international index futures market. The result shows that Autoregressive Distributed Lag Co integrationmodel is more efficient than the fixed hedge ratios in terms of minimizing the risk and this superior performance.

III. Data And Methodology:

DATA:

The optimal hedge ratio and hedging effectiveness of the stock index are measured using the daily observation of 10 investment companies which were listed on NSE NIFTY 50. The spot and future prices of these securities were obtained from different investment sites. Though different spot prices are such as opening, low, high, closing etc are available the daily closing price of the securities were selected and in case of futures even though there are different futures prices such as near month, next month and far month are available the near month futures are used for the analysis since it seems to be one of the most actively traded contract. Spot prices of these securities were collected from Yahoo finance whereas future prices of the same were collected from the official site of NSE. In the case of security of Ultratech both the spot and futures were collected from Investing.com. The daily data were collected to a maximum of 10 years (ie period starting from 2010 to2019) which varies differently for all securities according to the data available.

METHODOLOGY:

The spot and futures price of the securities were subjected to logarithmic transformation such as 'logspot' and 'logfutures' and these were used in the study for further estimates. After the transformation these 'log series' are used to identify the trend and to calculate the Unit root which is used to identify the stationarity of the series by using Augmented Dickey- Fuller (ADF) test. The ADF test consists of estimating the following regression:

$\Delta Yt = \beta 1 + \beta 2t + \delta\, y_{t-1} + \Sigma\alpha_i \Delta y_{t-1} + \varepsilon t$

Where εt is a pure white noise error term and

where $\Delta y_{t-1} = (y_{t-1} - y_{t-2})$,

$\Delta y_{t-2} = (y_{t-2} - y_{t-3})$ etc.

After calculating the Optimal lag length of the series co integration of the series are identified by using Johansen Co integration Tests (both Eigen value and Trace Statistic). When it seems that the series are co integrated at level of first difference, VECM (Vector Error Correction Method) is used to identify the Residuals. The parameters of VECM are estimated and the residuals obtained are used to calculate Optimal Hedge Ratio and Hedging Effectiveness.

$$\text{The Optimal Hedge Ratio (H)} = \frac{\sigma sf}{\sigma f}$$

Where,

σ_{sf} = Cov. ($\varepsilon_{st}, \varepsilon_{ft}$)

$\sigma_{s=}$ Variance(ε_{st})

$\sigma_{f=}$ Variance(ε_{ft})

Hedging Effectiveness is calculated as:

$$E = \frac{Var(u) - Var(H)}{Var(u)}$$

Where,

Var (u) = σ_s^2 (i.e, Variance of unhedged portfolio)

Var (H) = $\sigma_s^2 + H^2\sigma_f^2 - 2H\,\sigma_{sf}$ (i.e., variance of hedged portfolio)

H = Hedge Ratio, σ_s and σ_f are the standard deviations of spot and future returns and σ_{sf} is the covariance. The residuals are then tested for ARCH (Autoregressive Conditional Hetroskedasticity) and since ARCH effect is found in the residuals, Dynamic Hedge Ratios are also calculated using constant conditional correlation(CCC) model. Errors from VECM are obtained and these errors are modeled as univariate GARCH. Then covariance is calculated as.

$h_{ss,t} = \omega_s + \alpha_{s,1}\, \varepsilon^2 + \beta_{s,1}\, h_{ss,\,t-1}$

$h_{ff,t} = \omega_f + \alpha_{f,1}\, \varepsilon_{\tau-1}^2 + \beta_{f,1}\, h_{ff,t-1}$

$h_{sf,t} = \rho(h_{ss,t} x h_{ff.t})^{1/2}$

Where, $h_{ss,t}$ is the conditional spot variance at time t, $h_{ff,t}$ isconditional futures variance, $h_{sf,t}$ is covariance and ρ is the constant conditional correlation.

Average Time-Varying Hedge Ratio(H_t) = $\frac{Hf,t}{Hff,t}$

$$\text{Average Time} - \text{Varying Hedging Effectiveness (Et)} = \frac{Var(unhedged\ portfolio) - Var(Hedged\ portfolio)}{Var(unhedged\ portfolio)}$$

GARCH

Majority of the empirical studies expressed that time series of the returns always indicate volatility clustering. The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) can deal with the heteroskedasticity

characteristic of the price series. GARCH (1, 1) model assumes that the conditional heteroskedasticity of the current return on assets is not only related to the residual squares in last periods but also related to the last period conditional heteroskedasticity.

IV. Results And Analysis:

(Insert Chart IV.1)

Chart IV.1 which shows the trend of the price series of all the selected sectors. From the graph it is identified that spot price and futures price tend to move on the same direction.

(Insert Table IV.2)

To make sure that the selected time series data is stationery, we apply Augmented Dickey-Fuller test (ADF). Table IV.2 shows the result of ADF test and it indicates that the series are found to be stationery at 5% level of significance. In case of Bharti airtel(telecom sector), HDFC bank(financial service) and Reliance (energy sector), series are found to be stationery at level while in all other cases series are non-stationery at level and found to be stationery at first difference.Therefore, it is needed to estimate co integration of the series.

The presence of co-integration is confirmed by Johansen co integration test. The trace and max-Eigen value statistic shows the existence of co integration at 5% level of significance. It represents the existence of long run relationship between spot price futures price of the securities. Since the series are co-integrated they are modelled using VECM and residuals are obtained. Residuals that are obtained from the series are shown in Chart no IV.3.

(Insert Chart no IV.3. here)

Static Hedge Ratio and Hedging Effectiveness along with the sectoral classification of the stock futures are shown in the table IV.4.

(Insert table IV.4. here)

It also exhibits that the hedging effectiveness for all the sectors are very high. It is found that effectiveness of hedging for the sector cement and cement products seems to be very high compared to other sectors with 98.3% followed by Pharmaceuticals sector and media and entertainment sector with 98% of hedging effectiveness. While the hedging effectiveness is found least on Metals sector (Coal India ltd.) with 90.1%. Hedge ratio for all the sectors shows the value near to 1 which also represents the high effectiveness of hedging.

Generally time series data of returns may have time varying hetroscedastic volatility structure or it may be referred to ARCH effect which may leads to the inappropriate estimation of Hedge Ratio and Hedging effectiveness. Log series are tested for ARCH effect and it is found that there is a significant ARCH effect in both spot and future price series. This clearly confirms the necessity of MGARCH model for estimating the conditional variance and covariance for calculating time varying Hedge Ratio and Hedging Effectiveness of the sectoral stock futures.

Covariance is calculated as.

$$h_{ss,t} = \omega_s + \alpha_{s,1}\,\varepsilon^{2}_{+}\beta_{s,1}\,h_{ss,\,t-1}$$

$$h_{ff,t} = \omega_f + \alpha_{f,1}\,\varepsilon_{\tau-1}^{2} + \beta_{f,1}\,h_{ff,t-1}$$

$$h_{sf,t} = \rho(h_{ss,t} x h_{ff.t})^{1/2}$$

Where, $h_{ss,t}$ is the conditional spot variance at time t, $h_{ff,t}$ isconditional futures variance, $h_{sf,t}$ is covariance and ρ is the constant conditional correlation.

$$\text{Average Time-Varying Hedge Ratio}(H_t) = \frac{Hf,t}{Hff,t}$$

$$\text{Average Time} - \text{Varying Hedging Effectiveness (Et)} = \frac{Var(unhedged\ portfolio) - Var(Hedged\ portfolio)}{Var(unhedged)}$$

DYNAMIC HEDGE RATIO AND HEDGING EFFECTIVENESS:

Table IV.6 shows the result of average time varying Hedge Ratio and Hedging Effectiveness of selected inter-sectoral stock index futures. Conditional variance and Covariance of the series are estimated through CCC-MGARCH model and thereby estimate Optimal Hedge ratio and Hedging effectiveness.

Dynamic Hedge Ratio:

Time varying Hedge ratio is estimated as the ratio between the covariance of spot and futures price to the variance of futures.

Average Time-Varying Hedge Ratio(H_t) = $\frac{Hf,t}{Hff,t}$

Hedge ratio for all the selected stock futures from different sectors are shown in the table IV.6 and it shows that hedge ratio for all the sectoral stock futures are very high.

Time-varying Hedging Effectiveness:

$$\text{Average time} - \text{varying Hedging Effectiveness (Et)} = \frac{Var(unhedged\ portfolio) - Var(Hedged\ portfolio)}{Var(unhedged\ portfolio)}$$

(Insert Table IV.6 here)

Average Time varying Hedging effectiveness of sectoral stock futures are shown in the table IV.6. In the sample daily data of selected securities from different sectors that are listed in NIFTY 50 Index has been considered from the period ranging from 1st January 2010 to 6th November 2019 and includes 2424 observations for a single security. CCC-MGARCH model was used for estimating the effectiveness of Hedging. It is found that out of the 10 sectors that are selected for the study, Cement and cement products sector (Ultratech cement) have highest hedging efficiency followed by energy sector (Reliance ind.) Pharmaceuticals sector (Sunpharma) and Media and entertainment sector (Zee entertainment ltd.) Results also reveals that the effectiveness of hedging for Metals sector (coal India ltd) is not much efficient compared to other sectors in NIFTY 50 Index.

V. Conclusion:

Financial derivatives play a very important role for the management of risk and its efficient use can reduce the level of risk thereby increasing the rate of return. Since most of the investors are risk averse the depend more on futures trading which provide effective hedging facility by eliminating price risk. The main objective of this study is to examine the optimal hedge ratio and hedging effectiveness of inter-sectoral stock futures that are listed in NIFTY 50 INDEX. This study also aims in estimatingthe sector where hedging with futures is more effective.

Optimal hedge ratio and hedging effectiveness of the sectoral stock futures is estimated using CCC-MGARCH model. For the study the daily closing price of the selected securities from 1st January 2010 to 6th November 2019 were selected. Various econometric tools such as ADF test, Johansen co integration test and VECM is used for the analysis. It is found that the series (spot price and futures price) are co integrated in the long run. This study clearly states that hedging can act as an effective method to reduce the risk that arise out of unexpected price fluctuations and also futures market can play a major role in the price discovery mechanism. 10 year time series data have been selected for the study and the findings points out that the effectiveness of hedging is found to be more than 90 percent and the hedge ratio for all the sectors are found to be near to the value 1.00 which shows a perfect hedge position. Cement and cement products sector provide best hedging option with an effectiveness of 98.3% (table IV.6). Thus from the above study it can be concluded that hedging with sectoral stock index futures turns to be a best option for the investors to offset the risk that arise out of unexpected price variations in the market.

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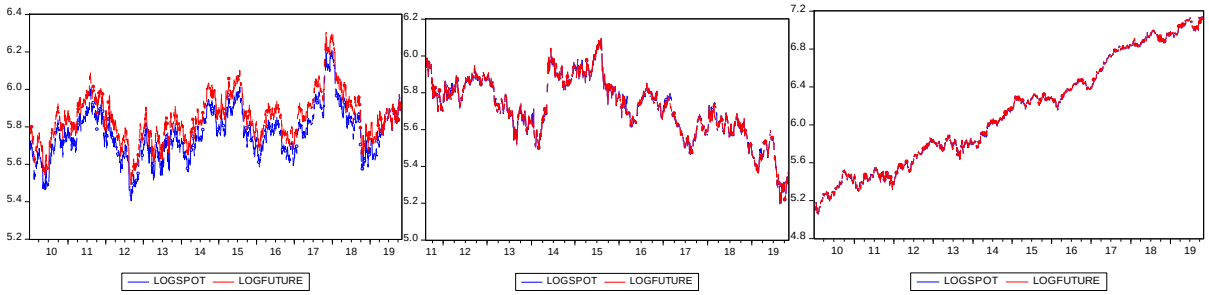
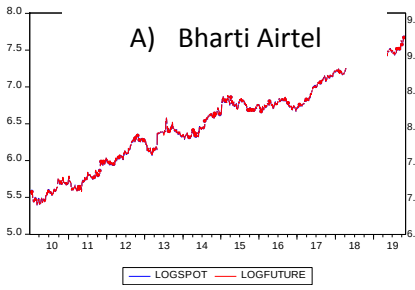
TABLES AND FIGURES

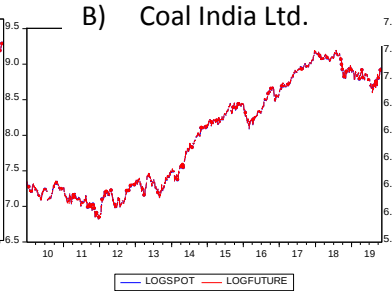
IV.1: CHARTS SHOWING THE TREND OF THE SERIES



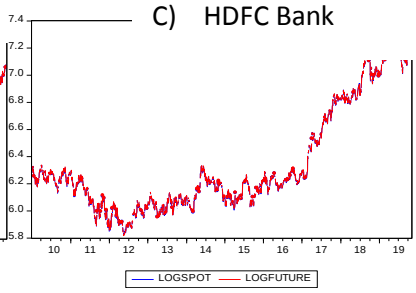
A) Bharti Airtel



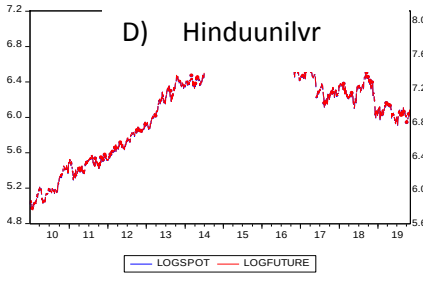
B) Coal India Ltd.



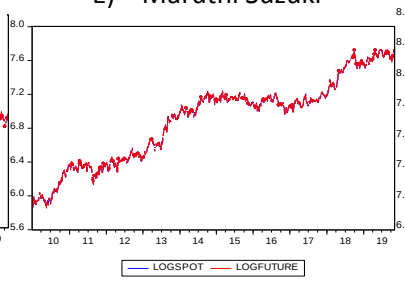
C) HDFC Bank



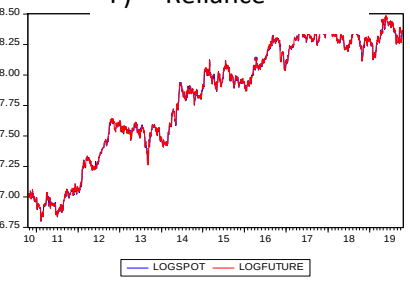
D) Hinduunilvr



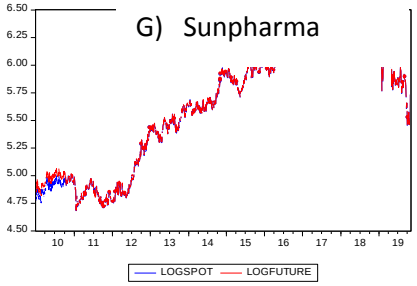
E) Maruthi Suzuki



F) Reliance



G) Sunpharma



H) TCS

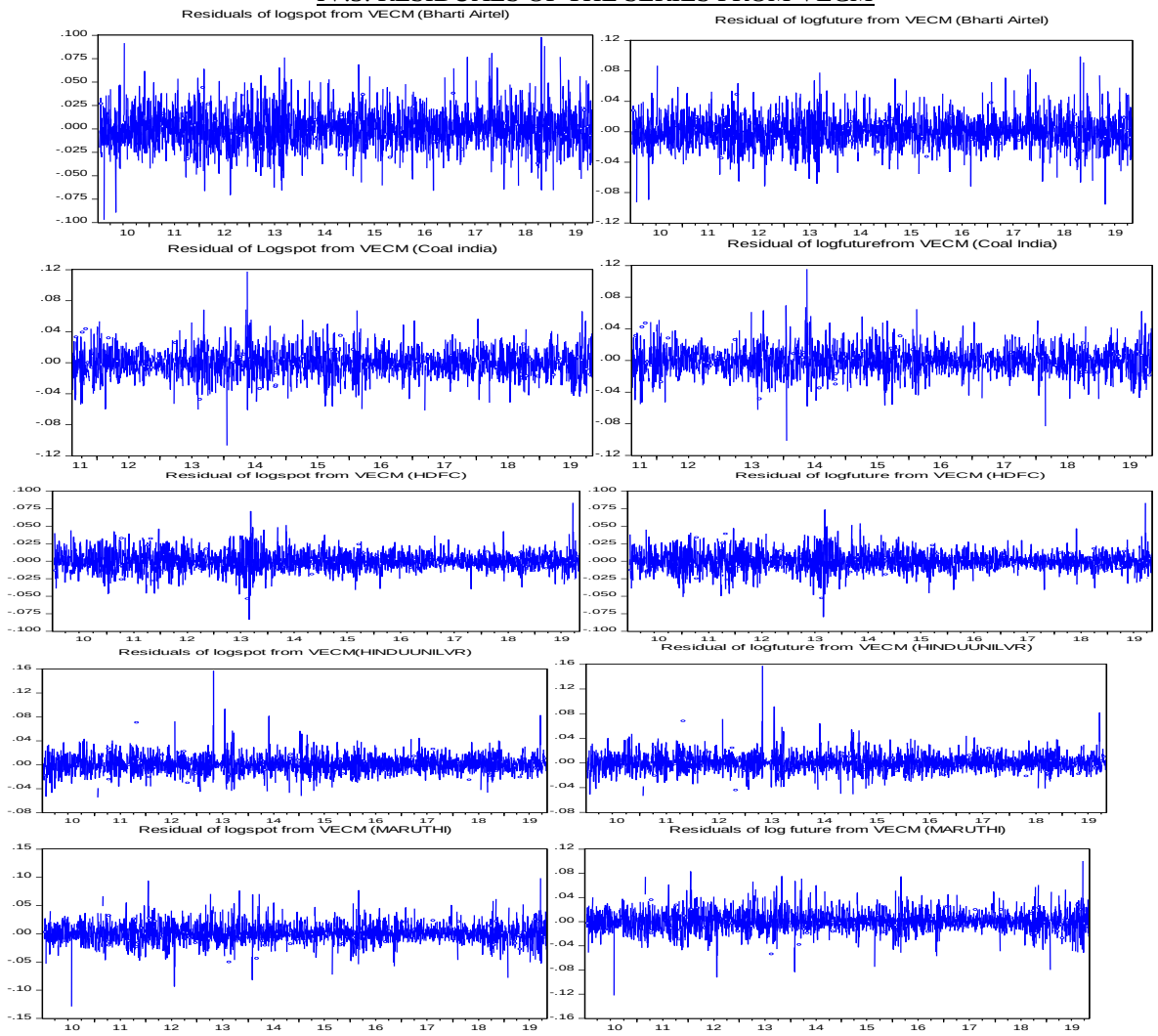
I) Ultratech

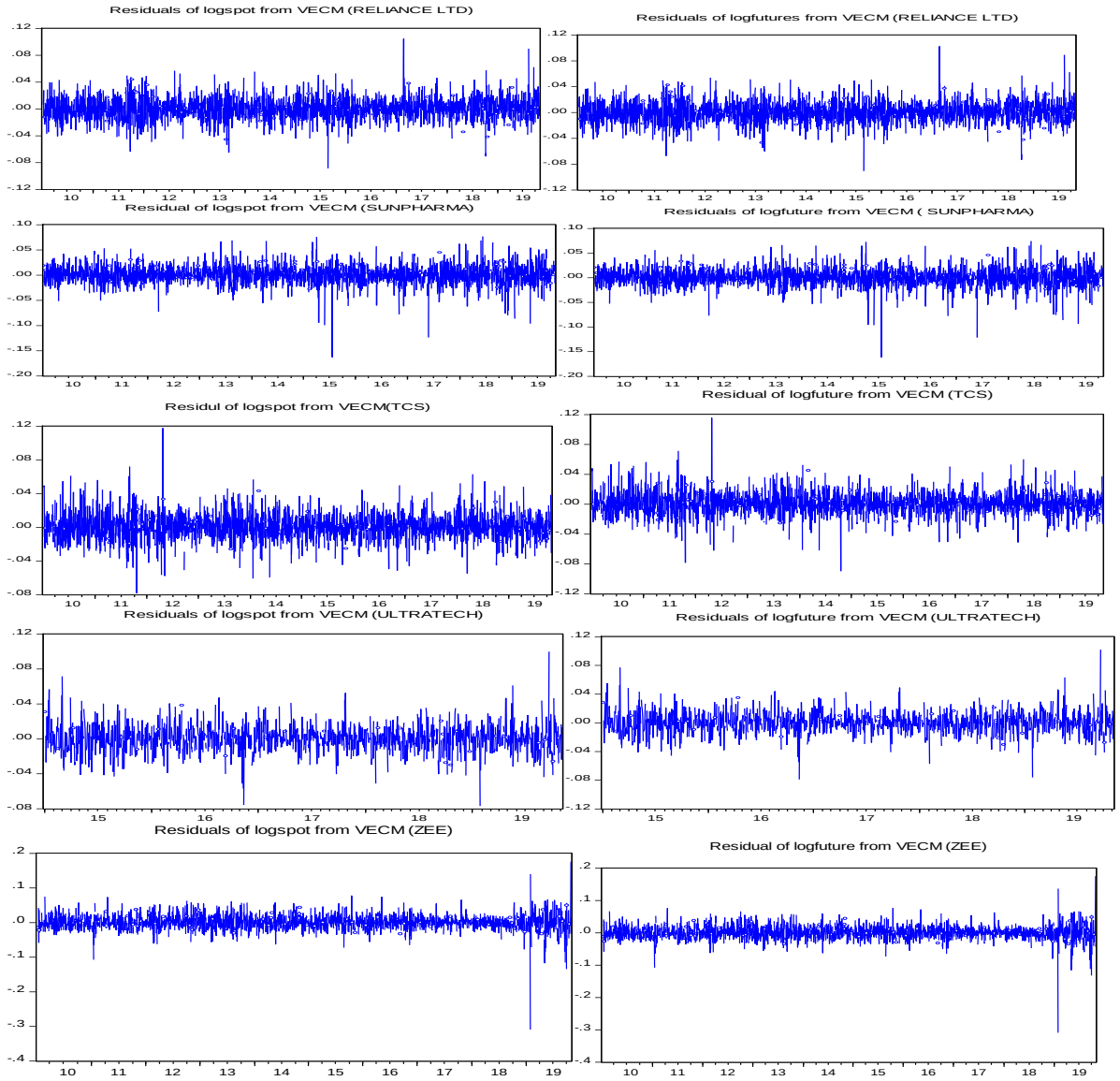
J) Zee Entertainment

TABLE IV.2: UNIT ROOT TEST (ADF)

Securities		t- statistic	prob*
Bharti Airtel	Futures	-3.685652	0.0044
	Spot	-3.605316	0.0058
Coal India Ltd.	Futures	-45.28360	0.0001
	Spot	-44.91575	0.0001
HDFC Bank	Futures	-4.052761	0.0074
	Spot	-3.872866	0.0133
Hinduunilvr	Futures	-48.16637	0.0000
	Spot	-49.00779	0.0000
Maruthi Suzuki	Futures	-48.04142	0.0001
	Spot	-47.84493	0.0001
Reliance	Futures	-47.77011	0.0001
	Spot	-47.64408	0.0001
Sunpharma	Futures	-48.17014	0.0001
	Spot	-48.16409	0.0001
TCS	Futures	-47.25540	0.0001
	Spot	-48.32168	0.0001
Ultratech	Futures	-32.70449	0.0000
	Spot	-32.75566	0.0000
ZEE	Futures	-31.62558	0.0000
	Spot	-32.12003	0.0000

IV.3: RESIDUALS OF THE SERIES FROM VECM





IV.4: TABLE SHOWING STATIC HEDGE RATIO AND HEDGING EFFECTIVENESS

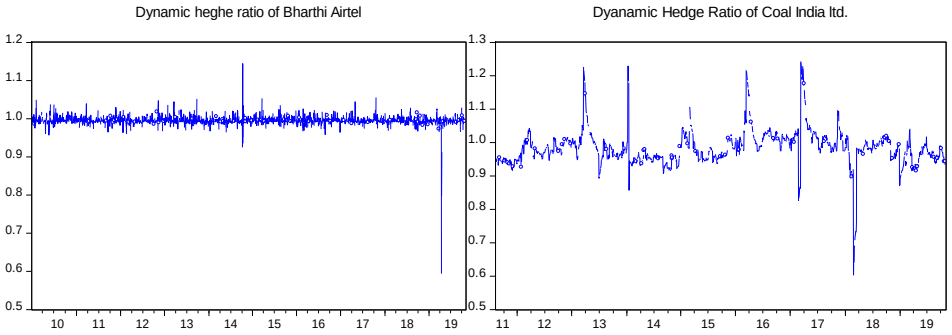
Company name	Sector	Hedge ratio	Hedging effectiveness (%)
Bharti Airtel Ltd.	Telecom	0.995	97.4
Coal India Ltd.	Metals	0.984	90.1
HDFC Bank Ltd.	Financial Services	0.983	95.9
Hindustan Unilever Ltd.	Consumer Goods	1.018	96.3
Maruthi Suzuki India Ltd.	Automobile	0.996	97.5
Reliance Industries Ltd.	Energy	1.005	97.9
Sun Pharmaceutical Ltd.	Pharma	1.00	98.0
Tata Consultancy Services Ltd.	IT	1.00	95.0
Ultratech Cement Ltd.	Cement & Cement Products	1.012	98.3
Zee Entertainment Ltd	Media & Entertainment	1.020	98.0

IV.6: AVERAGE TIME VARYING HEDGE RATIO AND HEDGING EFFECTIVENESS

Company name	Sector	Hedge ratio	Hedging effectiveness (%)
Bharti Airtel Ltd.	Telecom	0.9953	97.42
Coal India Ltd.	Metals	0.9836	90.11
HDFC Bank Ltd.	Financial Services	0.983	96

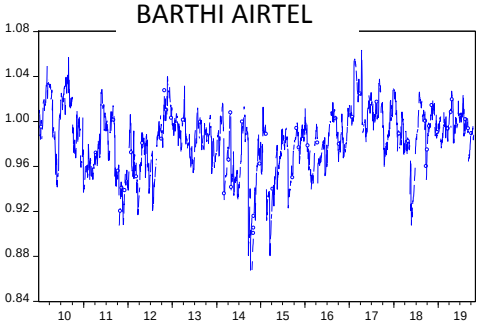
Hindustan Unilever Ltd.	Consumer Goods	1.02	96.2
Maruthi Suzuki India Ltd.	Automobile	0.996	97.5
Reliance Industries Ltd.	Energy	1.006	98
Sun Pharmaceutical Ltd.	Pharma	1.00	98
Tata Consultancy Services Ltd.	IT	1.00	96.1
Ultratech Cement Ltd.	Cement & Cement Products	1.01	98.3
Zee Entertainment Ltd	Media & Entertainment	1.02	98

CHART IV.7: DYNAMIC HEDGE RATIO

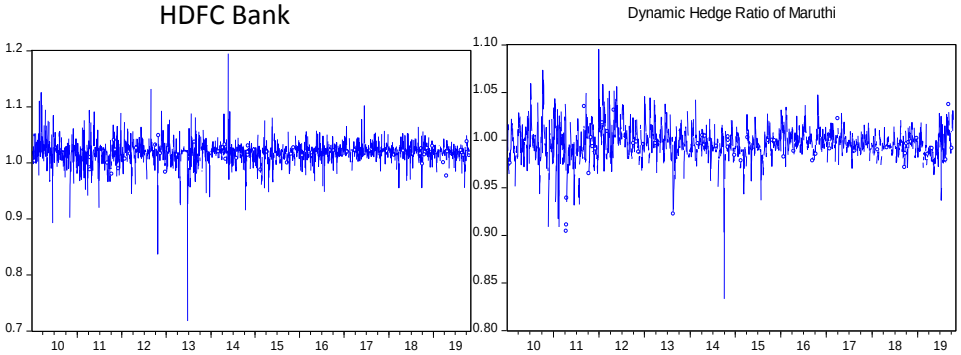


BARTHI AIRTEL

COAL INDIA LTD.

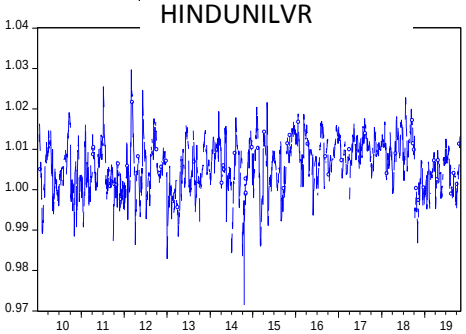


HDFC Bank

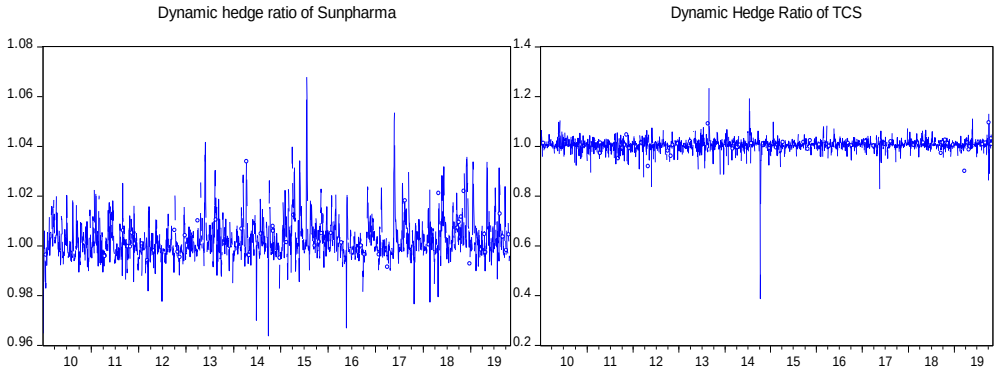


MARUTHI SUZUKI

HINDUNILVR



RELIANCE LTD.



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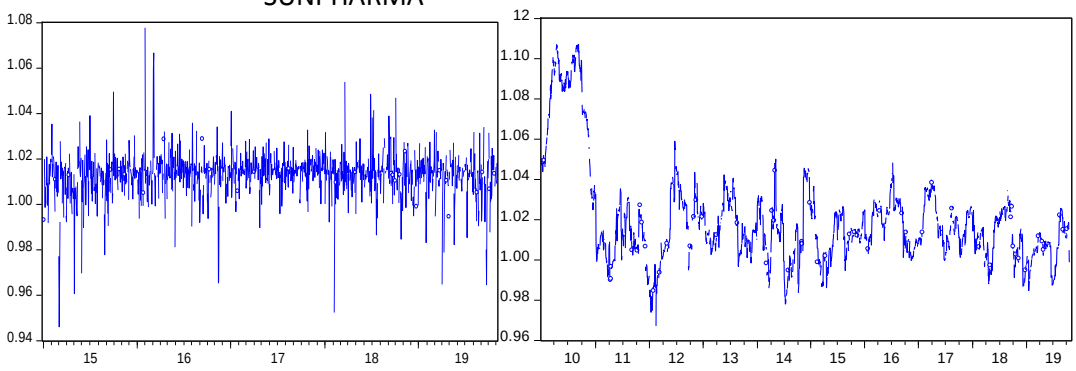

ULTRATECH CEMENT ZEE ENTERTAINMENT LTD

Nithin Jose. "An Inter-sectoral Comparison of Hedging Effectiveness with Futures in Indian Equity Market." *IOSR Journal of Economics and Finance (IOSR-JEF)*, 11(5), 2020, pp. 56-65.