# Do the Commodity and stock markets depict relation? An empirical assessment with MCX Commodities and BSE SENSEX indices

**DR. M. SHARMEEN FAROOQ**

**Associate Professor, Department of Corporate Secretaryship, Ethiraj College for Women, Chennai, India. alinafreen@gmail.com**

**ABSTRACT - Trading in derivative commodity markets are an investment for many individual investors, traders and financial institutions. The paper assesses the commodities indices of Bullion index, Energy index and Base Metal index of our country's largest multi commodity exchange MCX along with BSE Sensex to analyse if there exists any relation between the two. The evaluation encompasses a study of monthly returns, volatility and rollover yield of the indices between the years 2016 to 2022.The results do not show significant difference in returns between the indices but for volatility. The study also applies auto correlation to determine the similarity of the returns and the ARIMA model for the BSE returns. The paper reaches out to the investors to widen their portfolios to better returns with stock and commodity trading in both markets.**

**Key Words: Returns, volatility, rollover yield, ARIMA**

## I. INTRODUCTION

The market for commodities has been in existence from time immemorial. The commodity market represents investment in real commodities which provide the raw materials for industries. The ownership shares are dealt in a stock exchange. As an index is a representation of the performance of the market, several studies are based on the analyses of the indices of the relevant markets. It is perceived that an inverse relationship persists between the gold and stocks. A rational investor in order to optimise his profits will try to diversify his portfolios to include stock and commodity investments. Moreover SEBI replacing FMC for commodity market regulation induces opportunities for investors to trade in a single platform with better risk management. The paper is directed to examine the trend and relation of the stock and commodity markets.

The functional commodity exchanges in India are the Multi Commodity Exchange (MCX), National Commodity and Derivatives Exchange (NCDEX), and Indian Commodity Exchange (ICEX). The MCX is the largest in our country with opportunity enter into online trade in has operational in three indices. With augmented market of volume and value of trading in terms of commodity trading the opportunities to combine trade in both markets are multi fold.

## II. REVIEW OF LITERATURE

The literature on association between markets and forecasting based on models has been on the rise in recent times. The growing evidence of impact of commodity prices on returns and volatility on the financial position of business and the stock market has been the focus of several analyses. Some studies in the Indian context are the following. A study investigated the relationship between Commodity and Equity Markets with four commodity indices and Nifty 50 and found that in short run, Comdex and MCX Metal Lags Nifty leads an in the long run the investment in commodity market will facilitate the portfolio diversification.(10) scrutinized the performance of Indian commodity derivatives market by evaluating the market for trading, volume and value of the commodity derivatives traded(14).One study found that the return of equity (0.93) is essentially the similar to that of commodity(12). analysed indices namely MCXAGRI,MCXMETAL,MCXENERGY and BSESENSEX indices and established that the Indian commodity markets make a higher return in comparison to Indian stock market(11) .Another study deliberated to check the commodity market of chosen agriculture products in India(6) .

Most of the investigations have been empirically tested in developed markets also. Examination on the long term relationship between commodity and stock in particular reference to East Europe and Central Asia Countries was performed (4).Research established that the association between the prices and the returns of an investable commodity and US. equity indices and found them to be not significantly different(1). Research on the development of contracts traded in various commodities and with other economic factors as a risk management tool has been conducted (9). A study examined the cyclical relationship

 DOI : 10.35291/2454-9150.2023.0084 

between stocks and commodities and the impact of commodity and agribusiness indexes in portfolios(6). They could perceive a high negative relation existing between stock and commodity prices**.** A stud**y** observed the probable effect of the investment in index funds and indirect participation in commodity futures(13). The outcome of their study did not sustain the Masters Hypothesis as it failed to explain association between daily returns or volatility in the oil and natural gas futures markets and two ETF funds. Research on exploring the process of price determination of commodity-future relative to the wholesale commodity prices and the methods of controlling the impending risks in order to evaluate speculation results on the movements of commodity prices has been done (15). Investigations on volatility linkages between stock and commodity markets to indicate strong bidirectional spill over exist for diverse sectors in the stock market in United States, which show the simultaneous volatility linkages were carried out (17). Analysis discloses that few commodities are more vulnerable to uncertainty spillovers from stock markets, particularly the energy commodities. They exhibit how GST could be used to separate the impact of precise events and prove that COVID-19 had an inconsistent impact on commodity price volatility (5).

The studies evaluate stock returns and the use of models for the predictions of the returns has also been an interesting subject of discussion and research. Some of these studies are as follows. One such study verifies several hybrid models to predict the returns of stock. One such model ARIMA SVM was identified by them to be a very good predictor of stock returns (7). A study depicted the employ the MC-GARCH model for forecasting the intraday Expected Shortfall under dissimilar distributional assumptions for assessing the MC-GARCH model under the Generalised Error Distribution innovation and ranking the VaR predictability of the MC-GARCH models using an asymmetric loss function. They empirically determine that the non-normal distributions are suitable for together model fitting and forecasting(16). Subsequent to the covid phenomena creating enormous effects on the markets it is considered desirable in this study to undertake a study on the relationship between the two markets, to enable better understanding of existing risk and returns so as to provide optimal investment opportunities.

### 1.3 Objectives & Hypothesis of the Study

The objectives of the study are determined as follows

1. To determine the returns, risk and rollover yield of the indices in MCX and BSE and examine whether there exists significant difference between the indices of MCX and BSE in terms of returns and risk.

2. To determine the trend of the returns and understand patterns with lags in correlation and verify whether Autoregressive Integrated Moving Average (ARIMA) is a good fit to estimate returns of BSE Sensex.

To establish the objectives the subsequent hypotheses are undertaken and put to tested

1. The difference between monthly returns of BSE Sensex and MCX Bullion, Energy and Base Metal of commodity futures market is not equal to zero.

2. The difference between volatility (risk) of BSE Sensex and MCX Bullion, Energy and Base Metal of commodity futures market is not equal to zero.

3. The autocorrelations for the chosen lags in the MCX and BSE indices are not equal to zero.

### 1.4 Sample

The indices selected for the study is MCXBULLION , MCXBASE METAL,MCXENERGY and BSESENSEX indices. With index based investing becoming more popular for the passive investors the choice to include popular indices from the commodity and stock markets were made.

## III. METHODOLOGY

The data for the commodities indices was collected from 2016 to 2022 from www.mcxindia.com and mean returns were computed with average monthly returns which are the returns over the previous month. Volatility has been measured with standard deviation of the returns over the period of study and reflects the increase and decrease within that range. Roll over returns are computed during the roll over period of the indices by comparing the actual returns of the respective index with near month only returns which is specific only for the future commodities market. The historical index prices for BSE Sensex were collected from www.bseindia.com and the returns and standard deviation for volatility was computed from the closing monthly prices. The data pertaining to returns has also been statistically tested with Paired sample t test, Wilcoxan signed rank test, Sign test and Marginal Homogeneity test. The paper also has applied box plots, sequence charts to enable a better understanding of the data. Autocorrelation function has been performed and the results of autocorrelation and partial autocorrelation have been reported for all indices. The ARIMA model has been used to predict the stock returns of BSE and the results are stated.

## IV. FINDINGS AND DISCUSSION

The descriptive statistics of all the selected indices are shown below.

 DOI : 10.35291/2454-9150.2023.0084 

**Table.1.Descriptive Statistics**

| | N | Range | Minimum | Maximum | Mean | | Std. Deviation | Variance | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| **MCX Bullion Index returns** | 81 | .200 | -.066 | .134 | .00489 | .004713 | .042418 | .002 | .584 | .267 | .102 | .529 |
| **MCX Bullion index volatility** | 81 | .019 | .004 | .024 | .00882 | .000387 | .003479 | .000 | 1.976 | .267 | 5.165 | .529 |
| **MCX Bullion Index rollover yield** | 69 | .0132 | -.0076 | .0056 | -.000261 | .000198 | .001651 | .000 | -1.333 | .289 | 7.919 | .570 |
| **BSE Sensex returns** | 83 | .617 | -.424 | .193 | -.00379 | .009187 | .083700 | .007 | -2.240 | .264 | 8.481 | .523 |
| **BSE Sensex volatility** | 81 | .135 | .014 | .148 | .08245 | .003254 | .029284 | .001 | .654 | .267 | .354 | .529 |
| **MCX Energy index returns** | 81 | .759 | -.432 | .327 | .00549 | .012995 | .116959 | .014 | -.795 | .267 | 2.579 | .529 |
| **MCX Energy index volatility** | 81 | .105 | .008 | .113 | .02087 | .001559 | .014035 | .000 | 4.355 | .267 | 24.848 | .529 |
| **MCX Energy index rollover yield** | 80 | .0386 | -.0128 | .0259 | .000250 | .000475 | .004253 | .000 | 2.387 | .269 | 17.665 | .532 |
| **MCX Base Metal index returns** | 72 | .215 | -.078 | .137 | .00888 | .005889 | .049967 | .002 | .432 | .283 | -.453 | .559 |
| **MCX Base Metal index volatility** | 72 | .015 | .005 | .019 | .01041 | .000330 | .002802 | .000 | .305 | .283 | .686 | .559 |
| **MCX Base Metal index rollover yield** | 72 | .0176 | -.0107 | .0070 | -.000452 | .000290 | .002466 | .000 | -1.482 | .283 | 6.186 | .559 |

The mean returns are highest for Base metal, Bullion index followed by BSE Energy index as compared to BSE Sensex. The rollover yield which depicts returns in the commodities derivative market is negative for Bullion indicates lower future price and higher current price with greater demand and price in the spot market and depicts significant losses in hedge funds. This encourages arbitrage as it is beneficial to traders and those involved in speculation. The standard deviation is highest for Energy index. The paired t test has been adopted as the returns and rollover yield relate to the same period. The results of the paired sample t test are exhibited.

**Table 2.Results t test**

| Paired t test-Pairs | t value | Significance |
|---|---|---|
| MCX Bullion index returns - BSE Sensex returns | 1.228 | .265 |
| MCX Energy index returns - BSE Sensex returns | -.024 | .982 |
| MCX Basemetal index returns- BSE Sensex returns | -2.163 | .074 |
| MCX Bullion index rollover yield & BSE Sensex returns | .489 | .682 |
| MCX Energyindex rollover yield - BSE Sensex returns | -.528 | .616 |
| MCX Basemetal index rollover yield - BSE Sensex returns | -.561 | .595 |

The results of paired t test show no significant difference in the returns and rollover yield of BSE Sensex and MCX Bullion, Energy and Base Metal of commodity futures indices. This means that the two markets do not move together. The Wilcoxon Signed rank test, Sign test and Marginal Homogeneity tests were also conducted on the data the results of the Wilcoxon Signed rank test, Sign test and Marginal Homogeneity tests are tabulated below.

**Table 2.1 Results of Wilcoxon Signed rank test, Sign test and Marginal Homogeneity tests**

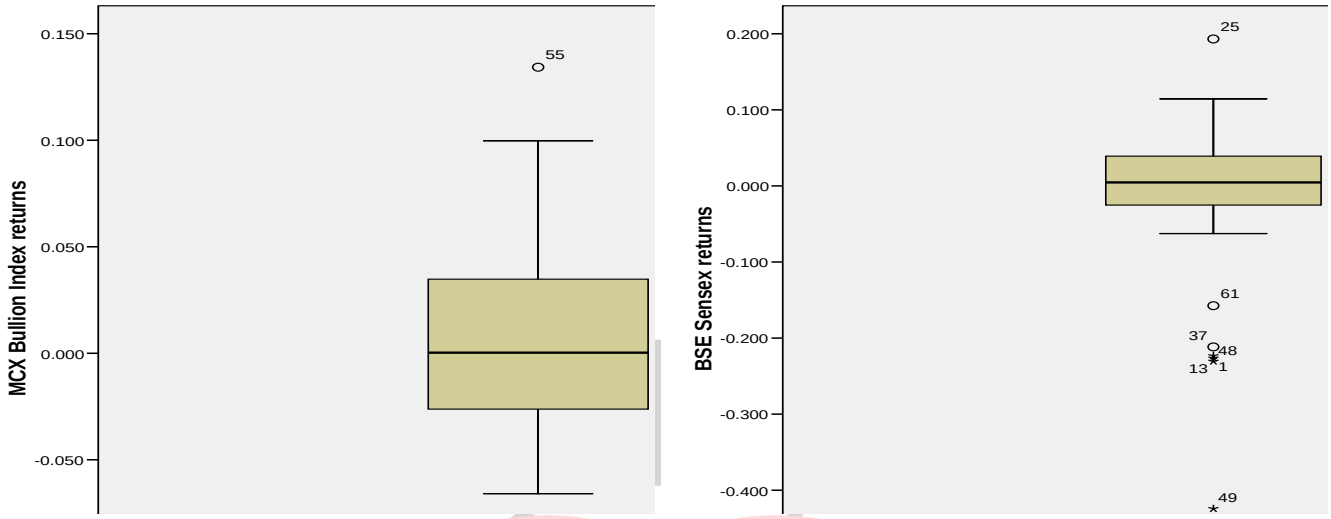
| | Z value | Asymp. Sig. (2-tailed) | Sign Test | Asymp. Sig. (2-tailed) | MH Test | Asymp. Sig. (2-tailed |
|---|---|---|---|---|---|---|
| BSE Sensex returns - MCX Bullion index returns | -.478 | .633 | .00 | 1.00 | .766 | .444 |
| BSE Sensex returns - MCX Energy index returns | -.1.001 | .317 | -1.11 | .267 | -.579 | .562 |
| BSE Sensex returns - MCX Base metal index returns | -1.07 | .915 | -.118 | .906 | -1.152 | .250 |
| BSE Sensex returns - MCX Bullion index rollover yield | -1.001 | .317 | -.963 | .336 | .596 | .551 |
| BSE Sensex returns and MCX Energy index rollover yield | -1.156 | .248 | -1.006 | .314 | -.510 | .610 |
| BSE Sensex returns and MCX Base Metal Index rollover yield | -1.375 | .169 | -1.296 | .195 | -.408 | .683 |
| BSE Sensex volatility - MCX Bullion index volatility | -7.818 | .000 | -8.889 | .000 | -8.400 | .000 |

 DOI : 10.35291/2454-9150.2023.0084 

| | | | | | | |
|---|---|---|---|---|---|---|
| BSE Sensex volatility and MCX Energy index volatility | -7.813 | .000 | -8.6 | .000 | 8.085 | .000 |
| BSE Sensex volatility and MCX Base Metal Index volatility | -7.374 | .000 | -8.367 | .000 | 7.924 | .000 |

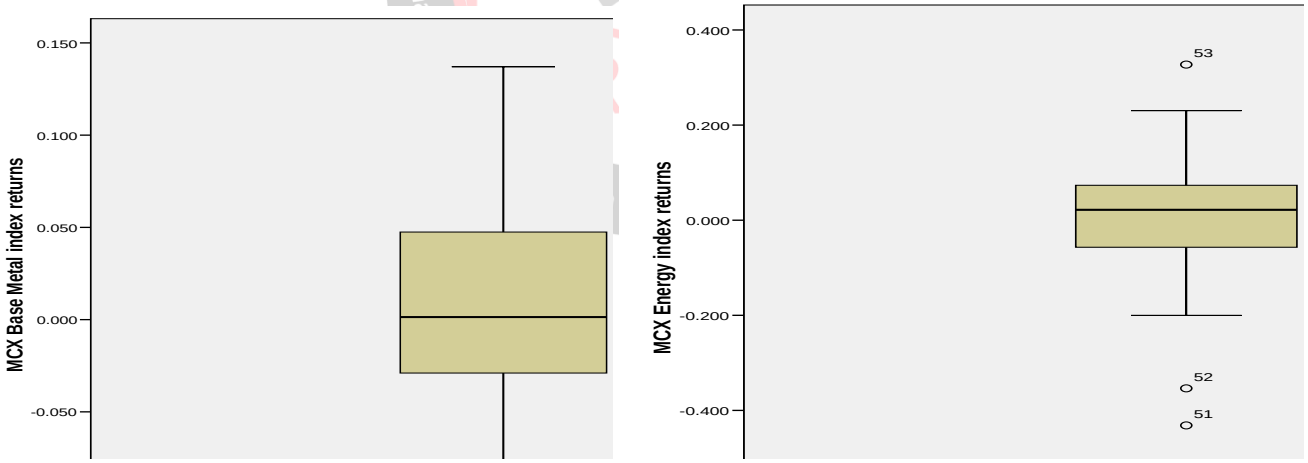
The Z scores of index returns and rollover is negative as MCX Bullion index, Energy index and Base Metal standard deviations are below the mean.The p values are not significant which accepts the null hypothesis of no significant between monthly returns of BSE Sensex and MCX Bullion, Energy and Base Metal of commodity futures market and also its rollover yield. The results are significant only in terms of volatility of BSE Sensex and MCX Bullion, Energy and Base Metal of commodity futures.The following box plots illustrate the distributional characteristics returns of the indices.

**Figure 1 Box Plot Returns in Bullion Market** **Figure 2 Box Plot Returns Sensex**




The box plot for BSE Sensex returns is shorter suggesting the agreement of mean returns. The inter quartile range is higher for MCX Bullion than index BSE Sensex. There are several outliers in Sensex returns which is outside the 1.5X inter quartile range. Hence it can be understood that equity returns are highly fluctuating.

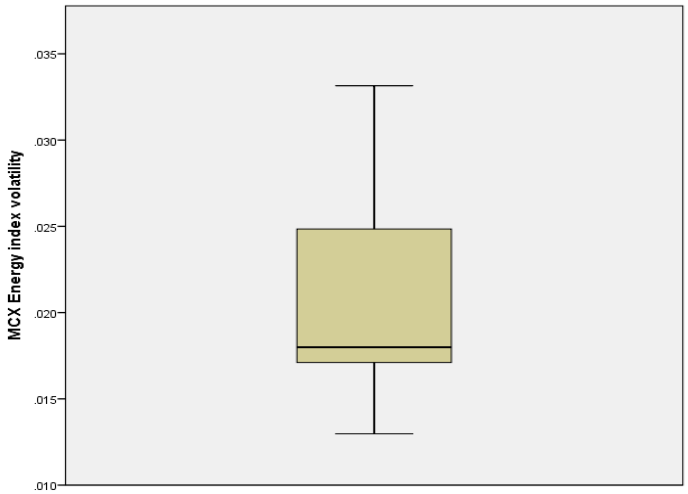
**Figure3. Box Plot Returns- Base Metal index Figure4. Box Plot Returns – Energy index**

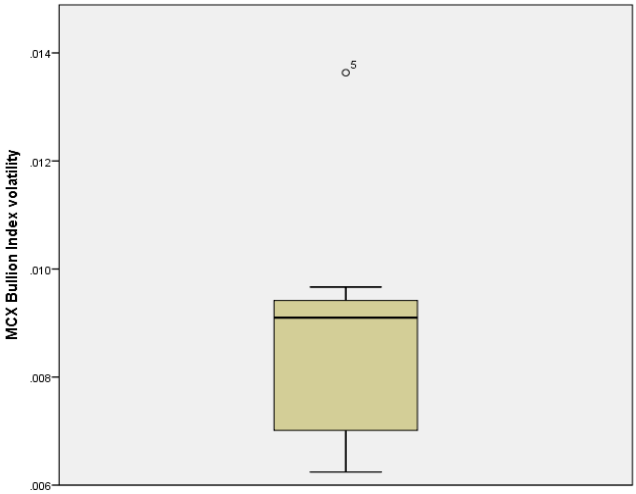



Except the Base Metal index the data is symmetric for the Energy index as revealed by a shorter box. More outliers are witnessed in the energy index as shown by the box plots. The following box plot illustrates the volatility of MCX indices.

 DOI : 10.35291/2454-9150.2023.0084 

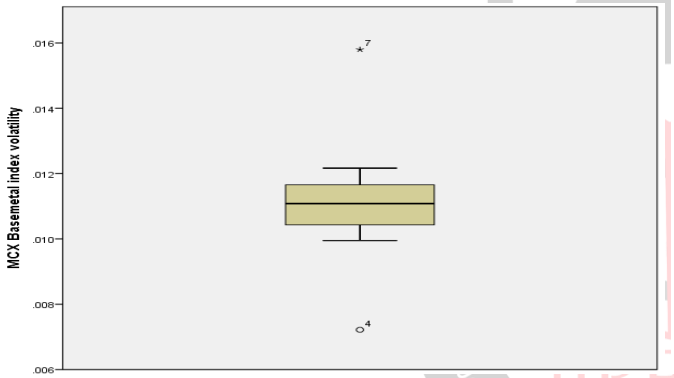
**Figure 5. Box Plot Volatility-Energy index** **Figure 6. Box Plot Volatility-Bullion index**

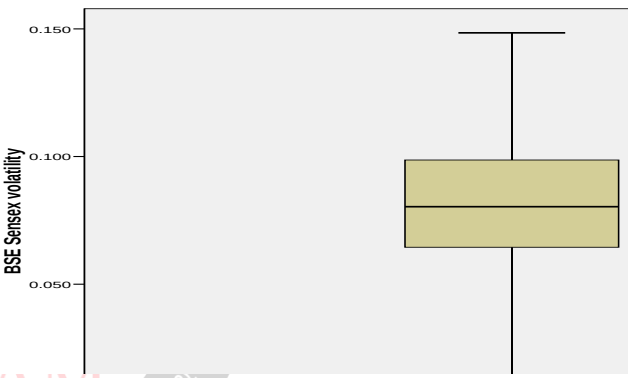



The characteristics of distribution of returns as measured by volatility are seen in the above plots. The indexes are skewed as revealed by the energy index which is highly positively skewed and also its whiskers stretch over a higher range than the Bullion index. The upper whisker in Energy index is tall as there seems to be a good difference in the highest value whereas the lower whisker is longer representing higher difference in minimum value for the bullion index. Bullion index which is highly negatively skewed as the upper quartile is much smaller than the lower quartile.

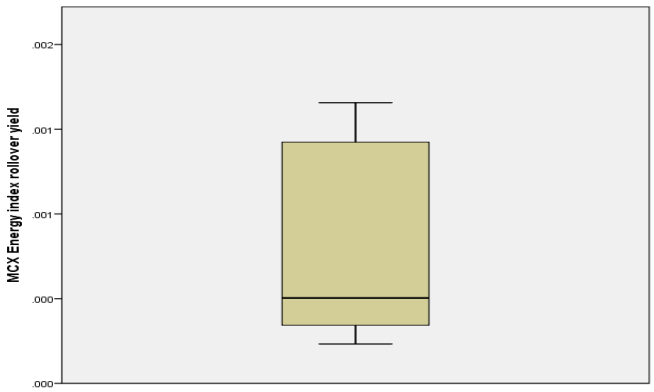
**Figure 7 Box Plot Volatility -Base Metal** **Figure 8 Box Plot Volatility -Sensex**

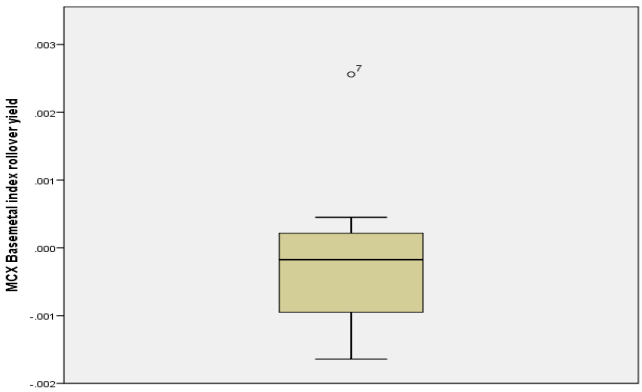



Outliers are more in number in Base Metal index some below the lower quartile and few above the upper quartile. The shorter plot is indicative of closer values as compared to Sensex. The following box plots demonstrate the rollover yield of MCX indices.

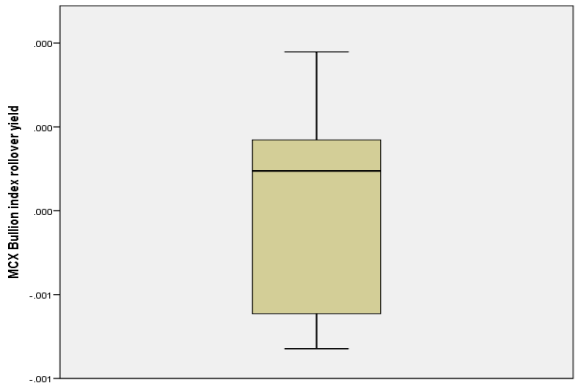
**Figure 7 Box Plot Rollover yield -Energy** **Figure 8 Box Plot Rollover yield -Base Metal**




 DOI : 10.35291/2454-9150.2023.0084 

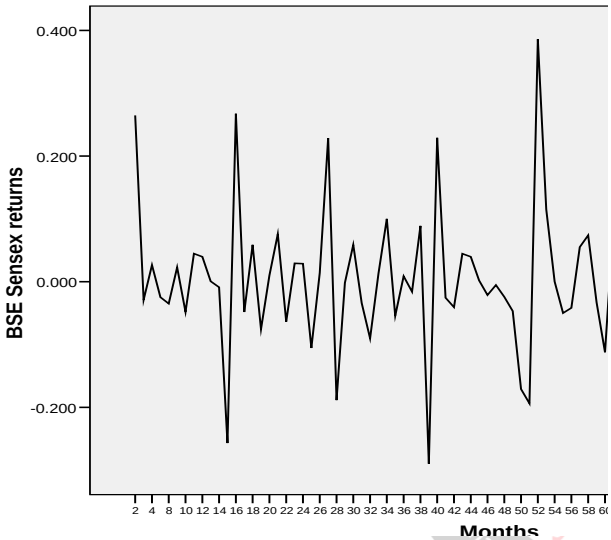
**Figure 8 Box Plot Rollover yield -Bullion**

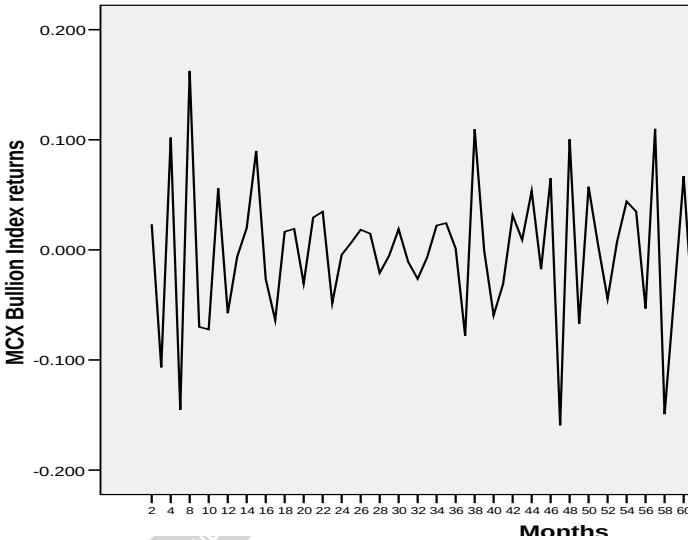



The rollover yield is positively skewed for energy index which indicates that the median is lower than the mean and negatively skewed for Base Metal index and Bullion index.

The four indices returns are observed in terms of sequence plots as follows. The data set adopted in the paper is 83 months collected from 2016 to 2022.

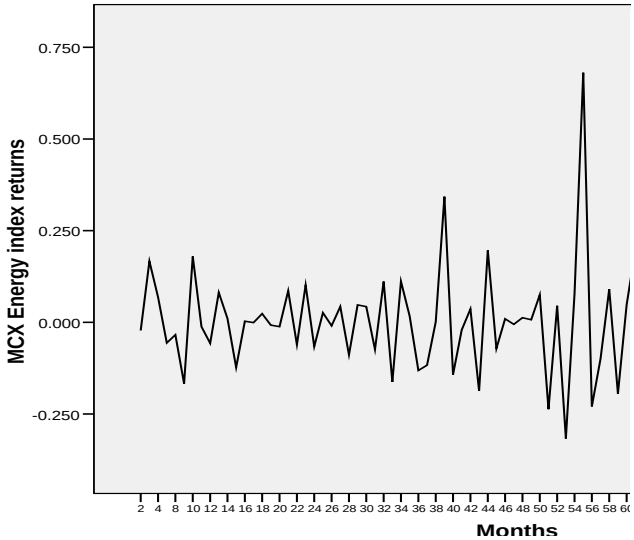
**Chart 1 Returns -Sensex** **Chart 2 Returns -Bullion index**

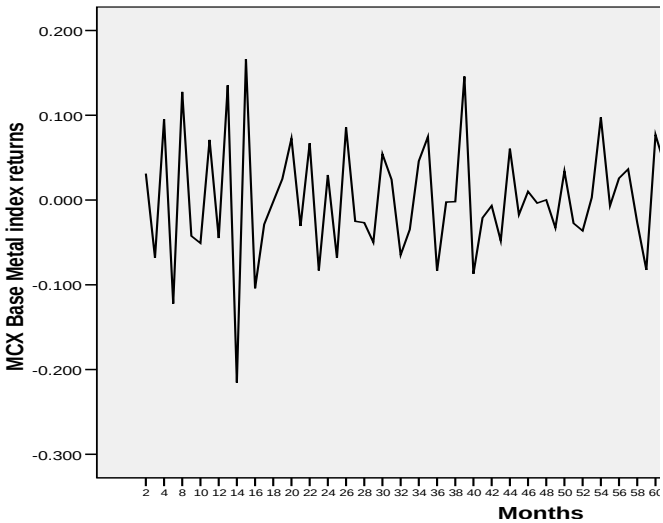



The chart for BSE Sensex shows significant highs and lows at intermittent intervals. The changes in the graph are more pronounced for Sensex than the Bullion index. The returns which are minimum and maximum are more extreme in BSE Sensex. Here it is pertinent to make a note of that these extremes could be avoided with good diversification.

**Chart 3 Returns -Energy index** **Chart 4 Returns -Base Metal index**




 DOI : 10.35291/2454-9150.2023.0084 

The Energy index and Base metal index returns shows several spikes but even with price drops there has seen strength to trend downward and upward trend. More fluctuation can be seen in the later months for Energy that is the covid period whereas the highest changes are witnessed for Base metal in the initial months. The four indices were subject to auto correlation which is generally used with the autoregressive moving average model to gain an enhanced understanding of the returns and choose the number of lags in the ARIMA model and the results are reported.

**Table 3. Autocorrelations -Series: BSE Sensex returns**

| Lag | Autocorrelation | Std. Error(a) | Box-Ljung Statistic | | |
|---|---|---|---|---|---|
| | Value | df | Sig.(b) | Value | df |
| 1 | -.336 | .110 | 9.608 | 1 | .002 |
| 2 | -.163 | .122 | 11.897 | 2 | .003 |
| 3 | .074 | .125 | 12.380 | 3 | .006 |
| 4 | -.032 | .125 | 12.471 | 4 | .014 |
| 5 | -.047 | .126 | 12.667 | 5 | .027 |
| 6 | .004 | .126 | 12.669 | 6 | .049 |
| 7 | .081 | .126 | 13.265 | 7 | .066 |
| 8 | -.119 | .126 | 14.586 | 8 | .068 |
| 9 | .044 | .128 | 14.769 | 9 | .097 |
| 10 | .019 | .128 | 14.804 | 10 | .139 |
| 11 | -.061 | .128 | 15.168 | 11 | .175 |
| 12 | .082 | .128 | 15.823 | 12 | .199 |
| 13 | .016 | .129 | 15.847 | 13 | .257 |
| 14 | .032 | .129 | 15.952 | 14 | .316 |
| 15 | -.080 | .129 | 16.608 | 15 | .343 |
| 16 | -.015 | .130 | 16.631 | 16 | .410 |

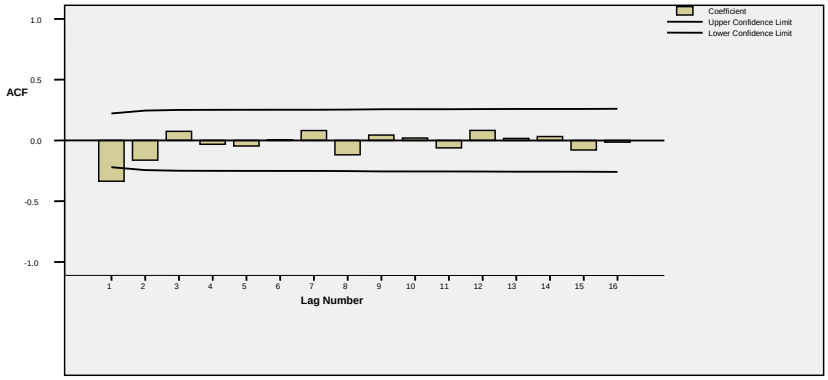
The results of the autocorrelaton functon show equally negative and positive autocorrelation values. Ten of sixteen p values are greater than 0.05, hence the null hypothesis is accepted that it cannot be assumed that they are dependent. The plot of ACF helps us to recognize the order of the MA (q) model of a time series. The plot of PACF helps us to identify the order of the pure AR (p) model of a time series.

**Table 4.Partial Autocorrelations-Series: BSE Sensex returns**

| Lag | Partial Autocorrelation | Std. Error |
|---|---|---|
| 1 | -.336 | .110 |
| 2 | -.311 | .110 |
| 3 | -.127 | .110 |
| 4 | -.126 | .110 |
| 5 | -.135 | .110 |
| 6 | -.121 | .110 |
| 7 | -.003 | .110 |
| 8 | -.135 | .110 |
| 9 | -.059 | .110 |
| 10 | -.063 | .110 |
| 11 | -.106 | .110 |
| 12 | .000 | .110 |
| 13 | .017 | .110 |
| 14 | .094 | .110 |
| 15 | .002 | .110 |
| 16 | -.033 | .110 |

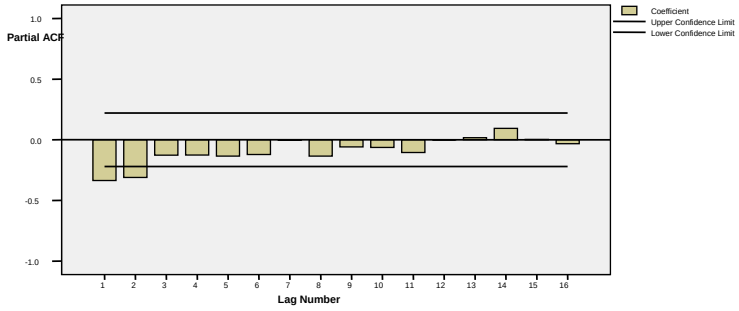
 DOI : 10.35291/2454-9150.2023.0084 

**Chart 5.ACF Plot BSE Sensex returns**




The autocorrelation reveals there is only one lag which is significant otherwise the data is random.

**Chart 6.PACF Plot BSE Sensex returns**




The PACF plot shows two have crossed the significant bound and found decaying in both ACF and PACF. The two plots are shown decaying.

**Table 5.Autocorrelations-Series: MCX Bullion Index returns**

| *Lag* | *Autocorrelation* | *Std. Error(a)* | *Box-Ljung Statistic* | | |
|---|---|---|---|---|---|
| | Value | df | Sig.(b) | Value | df |
| 1 | -.549 | .112 | 24.990 | 1 | .000 |
| 2 | .092 | .142 | 25.698 | 2 | .000 |
| 3 | -.058 | .142 | 25.982 | 3 | .000 |
| 4 | -.052 | .143 | 26.213 | 4 | .000 |
| 5 | .128 | .143 | 27.644 | 5 | .000 |
| 6 | -.111 | .144 | 28.732 | 6 | .000 |
| 7 | .179 | .145 | 31.614 | 7 | .000 |
| 8 | -.214 | .148 | 35.803 | 8 | .000 |
| 9 | .096 | .152 | 36.651 | 9 | .000 |
| 10 | -.014 | .153 | 36.671 | 10 | .000 |
| 11 | -.024 | .153 | 36.725 | 11 | .000 |
| 12 | .170 | .153 | 39.522 | 12 | .000 |
| 13 | -.197 | .155 | 43.308 | 13 | .000 |
| 14 | .096 | .158 | 44.228 | 14 | .000 |
| 15 | -.095 | .159 | 45.133 | 15 | .000 |
| 16 | .075 | .160 | 45.708 | 16 | .000 |

The results of the auto correlation function are significant that the series are auto correlated.

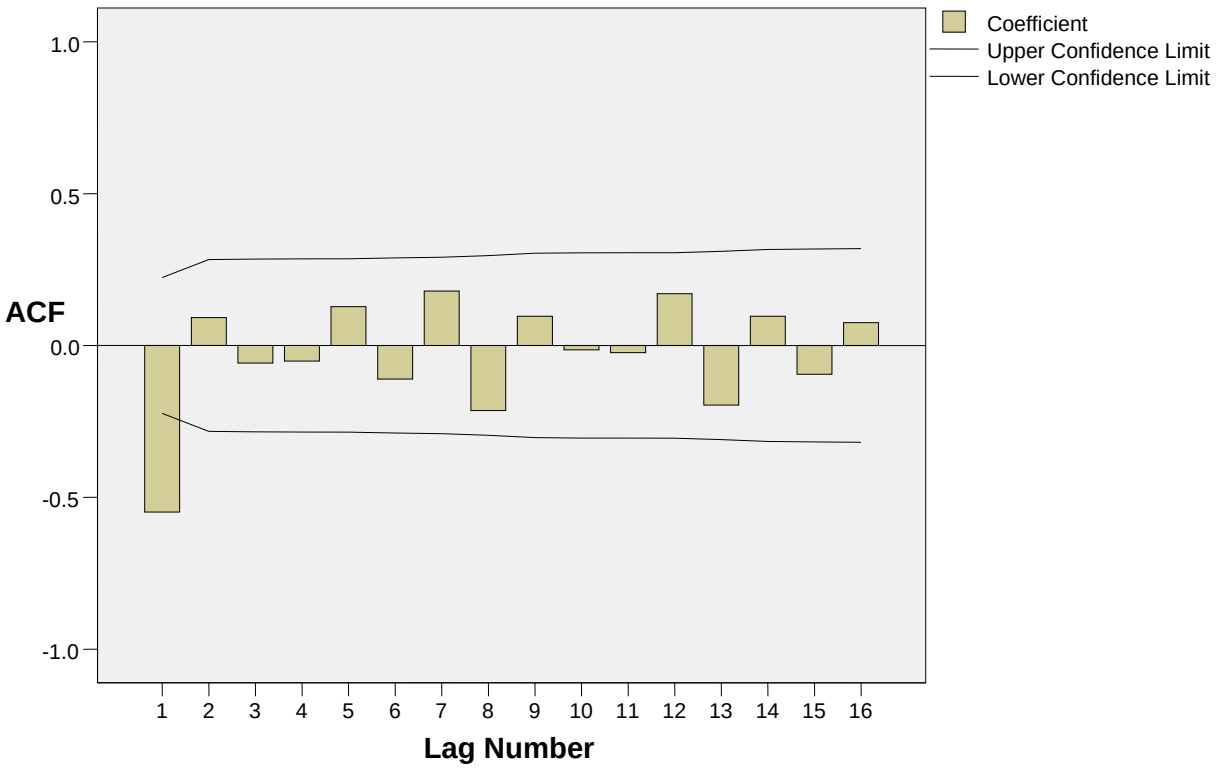
 DOI : 10.35291/2454-9150.2023.0084 

**Table 6.Partial Autocorrelations Series: MCX Bullion Index returns**

| Lag | Partial Autocorrelation | Std. Error | Lag | Partial Autocorrelation | Std. Error |
|---|---|---|---|---|---|
| 1 | -.549 | .112 | 14 | .056 | .112 |
| 2 | -.299 | .112 | 15 | .002 | .112 |
| 3 | -.246 | .112 | 16 | .005 | .112 |
| 4 | -.315 | .112 | | | |
| 5 | -.149 | .112 | | | |
| 6 | -.200 | .112 | | | |
| 7 | .052 | .112 | | | |
| 8 | -.098 | .112 | | | |
| 9 | -.090 | .112 | | | |
| 10 | -.072 | .112 | | | |
| 11 | -.109 | .112 | | | |
| 12 | .129 | .112 | | | |
| 13 | .055 | .112 | | | |

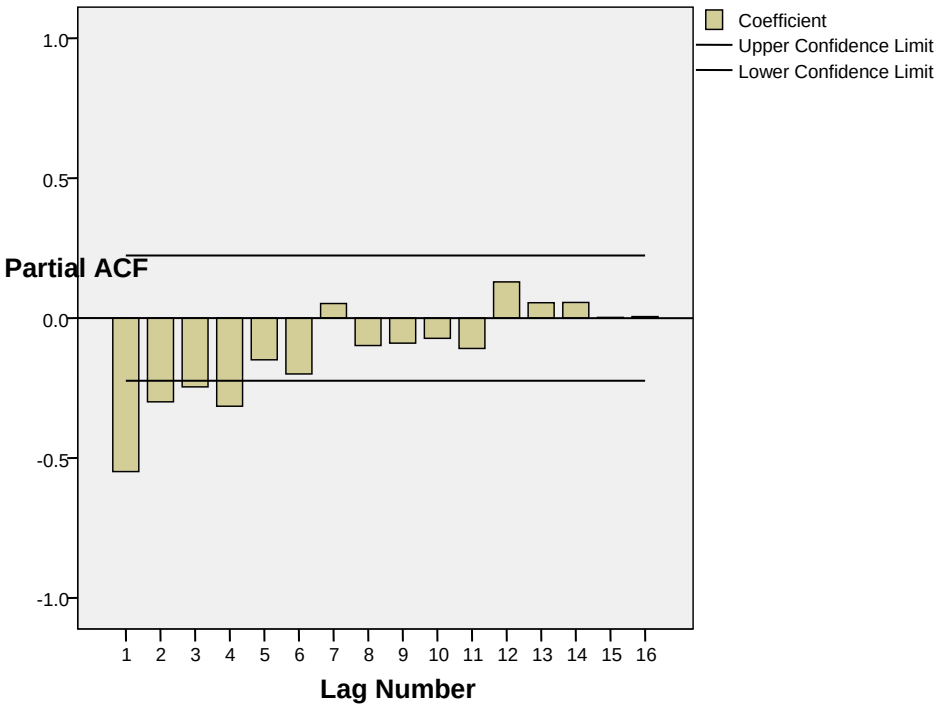
The autocorrelation reveals there is only one lag which is significant otherwise the data is random whereas the PACF shows three have crossed the significant levels.

**Chart 7.MCX Bullion Index returns**




 DOI : 10.35291/2454-9150.2023.0084 

**Chart 8.PACF Plot MCX Bullion Index returns**




The ACF at lag 1 has crossed the significance bound and the PACF, three have crossed the significant bound.

**Table 7. Autocorrelations Series: MCX Energy index returns**

| | Autocorrelation | Std. Error(a) | Box-Ljung Statistic | | |
|---|---|---|---|---|---|
| Lag | Value | df | Sig.(b) | Value | df |
| 1 | -.353 | .112 | 10.375 | 1 | .001 |
| 2 | -.235 | .125 | 15.028 | 2 | .001 |
| 3 | .212 | .130 | 18.867 | 3 | .000 |
| 4 | -.183 | .135 | 21.759 | 4 | .000 |
| 5 | .011 | .138 | 21.770 | 5 | .001 |
| 6 | .086 | .138 | 22.433 | 6 | .001 |
| 7 | .014 | .138 | 22.452 | 7 | .002 |
| 8 | .015 | .138 | 22.472 | 8 | .004 |
| 9 | -.070 | .138 | 22.925 | 9 | .006 |
| 10 | -.036 | .139 | 23.045 | 10 | .011 |
| 11 | .181 | .139 | 26.158 | 11 | .006 |
| 12 | -.248 | .142 | 32.100 | 12 | .001 |
| 13 | .144 | .147 | 34.118 | 13 | .001 |
| 14 | -.008 | .149 | 34.125 | 14 | .002 |
| 15 | -.174 | .149 | 37.167 | 15 | .001 |
| 16 | .275 | .152 | 44.928 | 16 | .000 |

.

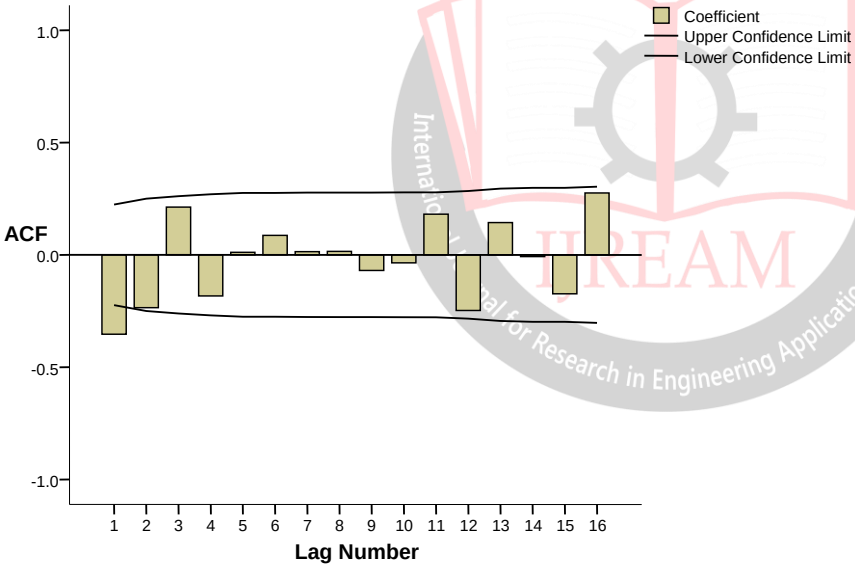
The low p values of the Box Ljung test indicate that the returns are auto correlated. This means there is similarity in the returns over a period of time.The partial autocorrelation are mostly negative.

 DOI : 10.35291/2454-9150.2023.0084 

**Table 8. Partial Autocorrelations Series: MCX Energy index returns**

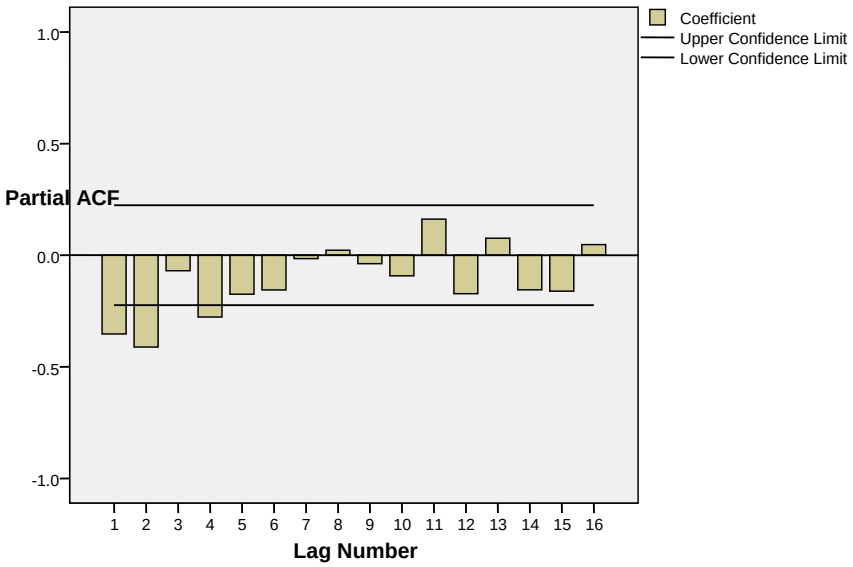
| Lag | Partial Autocorrelation | Std. Error |
|---|---|---|
| 1 | -.353 | .112 |
| 2 | -.412 | .112 |
| 3 | -.070 | .112 |
| 4 | -.277 | .112 |
| 5 | -.175 | .112 |
| 6 | -.156 | .112 |
| 7 | -.016 | .112 |
| 8 | .022 | .112 |
| 9 | -.038 | .112 |
| 10 | -.092 | .112 |
| 11 | .162 | .112 |
| 12 | -.173 | .112 |
| 13 | .076 | .112 |
| 14 | -.155 | .112 |
| 15 | -.161 | .112 |
| 16 | .047 | .112 |

**Chart 9. ACF Plot MCX Energy index returns**




 DOI : 10.35291/2454-9150.2023.0084 

**Chart 10.PACF Plot MCX Energy index returns**




The ACF at lag 1 has crossed the significance bound and the PACF , three have crossed the significant bound.

**Table 9.Autocorrelations-Series: MCX Base Metal index returns**

| Lag | Autocorrelation | Std. Error | Box-Ljung Statistic | | |
|---|---|---|---|---|---|
| | Value | df | Sig.(b) | Value | df |
| 1 | -.635 | .119 | 29.824 | 1 | .000 |
| 2 | .178 | .159 | 32.208 | 2 | .000 |
| 3 | -.027 | .162 | 32.265 | 3 | .000 |
| 4 | -.033 | .162 | 32.350 | 4 | .000 |
| 5 | .086 | .162 | 32.932 | 5 | .000 |
| 6 | -.134 | .163 | 34.354 | 6 | .000 |
| 7 | .117 | .165 | 35.466 | 7 | .000 |
| 8 | -.142 | .166 | 37.121 | 8 | .000 |
| 9 | .206 | .167 | 40.660 | 9 | .000 |
| 10 | -.210 | .171 | 44.399 | 10 | .000 |
| 11 | .167 | .175 | 46.799 | 11 | .000 |
| 12 | -.102 | .177 | 47.711 | 12 | .000 |
| 13 | .034 | .178 | 47.816 | 13 | .000 |
| 14 | -.057 | .178 | 48.114 | 14 | .000 |
| 15 | .061 | .178 | 48.461 | 15 | .000 |
| 16 | .023 | .178 | 48.509 | 16 | .000 |

The low p values of less than.05 means that the Box Ljung test indicates that the returns are auto correlated. This means there similarity subsists in the returns over a period of time.

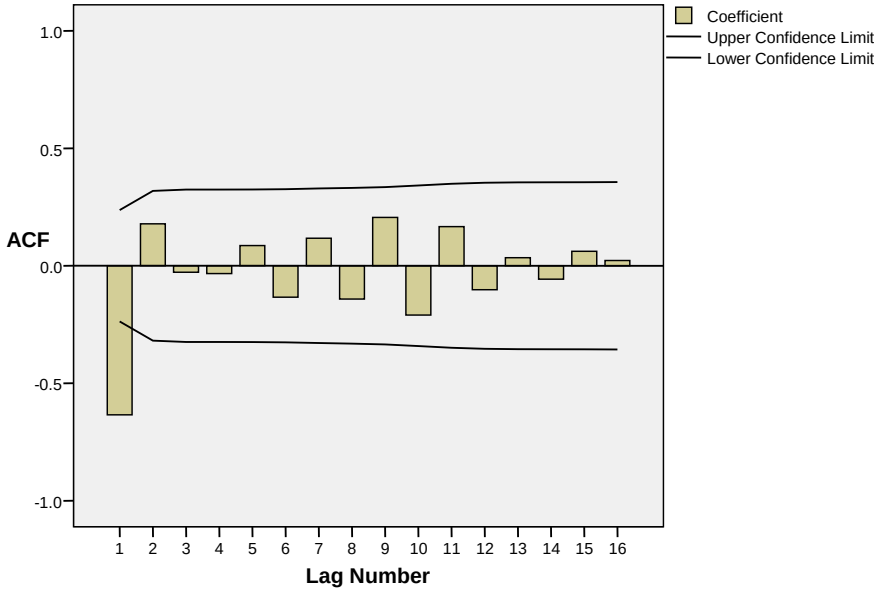
**Table 10.Partial Autocorrelations Series: MCX Base Metal index returns**

| Lag | Partial Autocorrelation | Std. Error |
|---|---|---|
| 1 | -.635 | .119 |
| 2 | -.376 | .119 |
| 3 | -.215 | .119 |
| 4 | -.195 | .119 |
| 5 | -.038 | .119 |

 DOI : 10.35291/2454-9150.2023.0084 

| | | |
|---|---|---|
| 6 | -.137 | .119 |
| 7 | -.078 | .119 |
| 8 | -.232 | .119 |
| 9 | .001 | .119 |
| 10 | -.117 | .119 |
| 11 | .000 | .119 |
| 12 | -.044 | .119 |
| 13 | -.033 | .119 |
| 14 | -.215 | .119 |
| 15 | -.137 | .119 |
| 16 | -.062 | .119 |

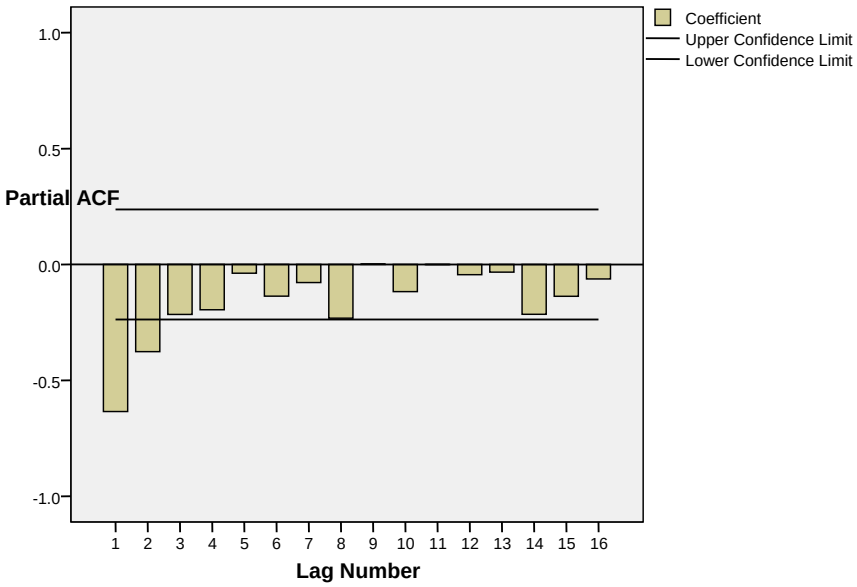
**Chart 11. ACF Plot MCX Base Metal index returns**




The ACF plots given below for MCX Base Metal returns at lag 1 has crossed the significance bound and the PACF , two have crossed the significant bound.

 DOI : 10.35291/2454-9150.2023.0084 

## Chart 12.PACF Plot MCX Base Metal index returns




The analysis of the ACF and PACF plots, it appears that an ARMA model is suitable for the Box-Jenkins condition is that the value of and for an ARIMA(0,0,0) model should be equal to or less than 2, or the total number of parameters should not be more than 3. Therefore, the AIC and log-likelihood values are checked only for those ARMA model with parameters p and q having a value of 2 or less. Manish Kumar,Thenmozhi M,(2014).

ARIMA Model is frequently used to comprehend time series analysis in order to derive significant characteristics of the data and help in the prediction of the stock returns. Non seasonal ARIMA models are used. The model has been applied to the BSE SENSEX returns but cannot be applied on MCX indices due to missing figures and the results are presented below.

**Table 11. ARIMA Statistics**

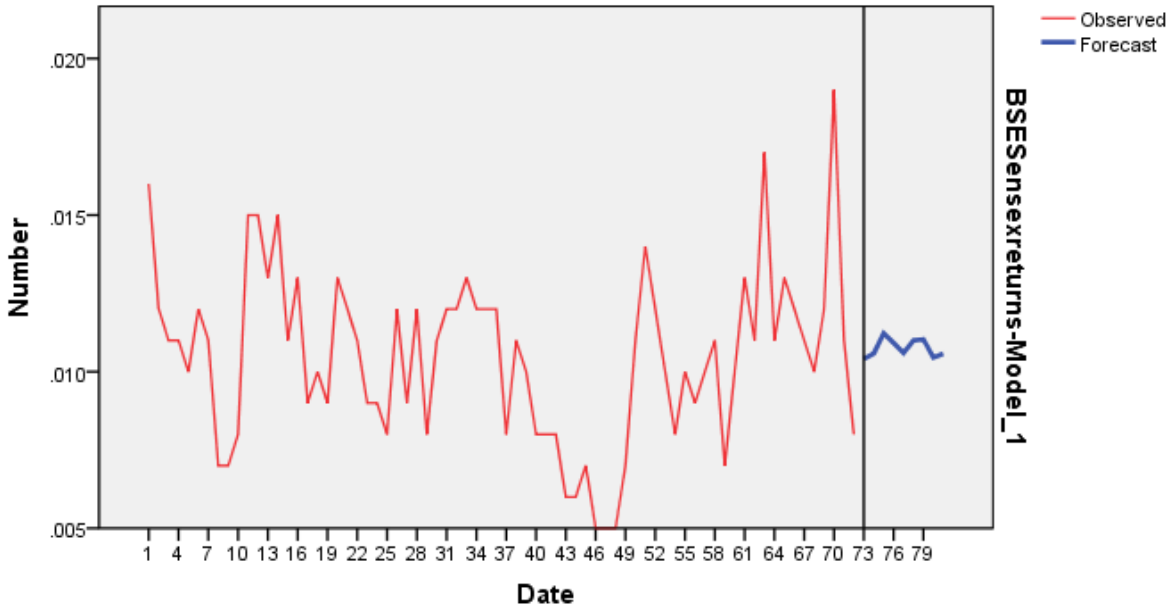
| Fit Statistic | Mean | Minimum | Maximum | Percentile | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 5 | 10 | 25 | 50 | 75 | 90 | 95 |
| Stationary R-squared | .032 | .032 | .032 | .032 | .032 | .032 | .032 | .032 | .032 | .032 |
| R-squared | .025 | .025 | .025 | .025 | .025 | .025 | .025 | .025 | .025 | .025 |
| RMSE | .003 | .003 | .003 | .003 | .003 | .003 | .003 | .003 | .003 | .003 |
| MAPE | 23.208 | 23.208 | 23.208 | 23.208 | 23.208 | 23.208 | 23.208 | 23.208 | 23.208 | 23.208 |
| MaxAPE | 105.940 | 105.940 | 105.940 | 105.940 | 105.940 | 105.940 | 105.940 | 105.940 | 105.940 | 105.940 |
| MAE | .002 | .002 | .002 | .002 | .002 | .002 | .002 | .002 | .002 | .002 |
| MaxAE | .009 | .009 | .009 | .009 | .009 | .009 | .009 | .009 | .009 | .009 |
| Normalized BIC | -11.509 | -11.509 | -11.509 | -11.509 | -11.509 | -11.509 | -11.509 | -11.509 | -11.509 | -11.509 |

**Table 12.ARIMA Model Statistics**

| Model | Number of Predictors | Model Fit statistics | Ljung-Box Q(18) | | | Number of Outliers |
|---|---|---|---|---|---|---|
| | | Stationary R-squared | Statistics | DF | Sig. | |
| BSE Sensex returns-Model_1 | 3 | .032 | 39.314 | 18 | .003 | 0 |

As the p value is less than the significance level it can be concluded that the coefficient for the autoregressive term is statistically significant. The model shows significant values. Hence it is a good fit.

 DOI : 10.35291/2454-9150.2023.0084 




With the results obtained, the ARIMA models with as an emerging forecasting technique can be used for prediction of returns in short-term. From the analysis the different investors can choose stocks according to its returns.

## V. CONCLUSION

The paper concludes that there is no significant difference in the returns as revealed by the tests. But the volatility difference exists between the markets as stock markets are more volatile. Hence a better understanding of the returns has been gained from an analysis of the box plots. Investors can benefit with more diverse portfolios in these markets. The equity markets are subject to more risk and diverse returns. This means some stocks underperform or over perform; hence a properly diversified portfolio spread over both markets could fetch higher returns from both markets. Investors could optimise returns by adopting investment in both markets. The negative rollover yield in Bullion and Base Metal encourages arbitrage as it is beneficial to traders and those involved in speculation. The results of autocorrelation are significant for all the commodity market indices which mean there is similarity in the returns over a period of time. This would be used to predict returns better in the commodity markets and design portfolios which would consider the similarity in patterns. The ARIMA model could also be applied by investors to fairly predict returns in the stock market. Hence it can be concluded that the two markets depict relations and equity markets have depicted more changes than the commodity markets. Better and more accurate predictions could be made with ARIMA model on the basis of different data sets of growth and decline. Further studies on devising portfolios could be undertaken to optimise investment options for the investor.

## REFERENCES

[1] Ankrim, E. & Hensel, C. (1993) Commodities and Equities: A "Market of One". Financial Analysts Journal, 49(3), 20-9

[2] Dhankar,J N(2007)Reducing risk through commodity exchanges Journal of ICFAI university press, 59-68

[3] Hector O. Zapata,Joshua Detre, Tatsuya Hanabuchi,(2012)Historical Performance of Commodity and Stock Markets,Journal of Agricultural & Applied Economics 44(03) DOI: 10.1017/S1074070800000468

[4] Ildirar, Mustafa & İşcan, Erhan. (2015). The Interaction between Stock Prices and Commodity Prices: East Europe and Central Asia Countries. 41-47

[5] Jan Jakub Szczygielski, Ailie Charteris, Lidia Obojska,(2023),Do commodity markets catch a cold from stock markets? Modelling uncertainty spillovers using Google search trends and wavelet coherence,International Review of Financial Analysis,Volume 87, 102304, 1057-5219,https://doi.org/10.1016/j.irfa.2022.102304.(https://www.sciencedirect.com/science/article/pii/S1057521922002587)

[6] Maheshwari Y,Kalyan Nalla Bala (2020)A Study on Performance of Equity Stocks in Indian Commodity Market,January 2020,SSRN Electronic Journal,DOI: 10.2139/ssrn.3527924

[7] Manish Kumar,Thenmozhi M,(2014),Forecasting stock index returns using ARIMA-SVM, ARIMA-ANN, and ARIMA-random forest hybrid models,International Journal of Banking Accounting and Finance,Vol 5, No 3. pp 284-308 https://doi.org/10.1504/IJBAAF.2014.064307

[8] Mauro, P. (1995), "Impact of Performance of Commodity Markets on Equity Markets in India", Quarterly Journal of Economics, 110, 681-712.

[9] Narender L. Ahuja,(2006) "Commodity Derivatives Market in India: Development, Regulation and Future

 DOI : 10.35291/2454-9150.2023.0084 

Prospects" International Research Journal of Finance and Economics, ISSN 1450-2887 Issue 2

[10] Nirmala, S & Kuriakattil, Deepthy. (2018). Relationship Between Commodity And Equity Markets: Evidence From India, 4. 2454-9150. 10.18231/2454-9150.2018.0271.

[11] Parimal Kumar Sen ,Sheikh Maruf Rahman,( 2017) A Study on the Risk-Return Profile of Select Commodities with Special Reference To The Indian Stock Market, Inspira-Journal of Commerce, Economics & Computer Science (JCECS) 89 ISSN : 2395-7069 General Impact Factor : 2.0546, Volume 03, No. 04, Oct.-Dec., pp. 89-92

[12] Revathy S. Santhi V, Sathesh Kumar T.( 2014)A Comparative Study on Equity, Commodity, Currency Derivatives in India - Evidence From Future Market With Special Reference to BSE Ltd, MUMBAI, Shalax International Journal of Management,1(3),6-14

[13] Scott Irwin, Dwight R. Sanders(2012)Testing the Masters Hypothesis in commodity futures markets,Energy Economics, 2012, vol. 34, issue 1, 256-269,

[14] Shaik Masood, Moinabad, & T Satyanarayana Chary,(2016) Performance of Commodity Derivatives Market in India ,Amity Journal of Finance,1(1),131-148.

[15] Shrinivas Manekar (2018) Effect on Commodity Prices & Risk Management in Indian Commodity Market International Journal of Research in Social Sciences Vol. 8 Issue 9, September 2018, 970-983.

[16] Summinga-Sonagadu, Ravi & Narsoo, Jason. (2019). Risk Model Validation: An Intraday VaR and ES Approach Using the Multiplicative Component GARCH. Risks. 7. 10. 10.3390/risks7010010

[17] Danyan Wen, Yudong Wang (2021)Volatility linkages between stock and commodity markets revisited: Industry perspective and portfolio implications, https://doi.org/10.1016/j.resourpol.2021.102374

 DOI : 10.35291/2454-9150.2023.0084 