

# Assessment of Price Volatility of Commodities traded on MCX India and relationship between Futures Price of selected Commodities and different Parameters on Economic Factors affecting Commodity Markets

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## Abstract

The Multi Commodity Exchange of India (MCX) selected for the study purpose. The objectives for the study are; to understand the basic knowledge of commodity market and the regulators of commodity market; to understand the concept of volatility and analyze the volatility of commodities; to study the relationship of commodities futures prices with different economic factors and understand the diversification benefits of commodity market. The commodities are traded under various categories at MCX were selected. The categories are Agro commodities, Base Metal, Energy and Bullion. Each categories contains different commodities. The commodities like; Cardamom, Cotton, Crude Palm Oil, Mentha Oil, Aluminum, Copper, Lead, Nickel, Zinc, Gold, Silver, Crude Oil, Natural Gas selected for the analysis purpose. The commodities selected for the period of January 2009 to December 2019. The closing prices of commodities were selected and then used to calculate the returns. For the testing of different hypothesis under study various data have been downloaded from the Commodity Insights Yearbook. The Commodity Insights Yearbook published for different years by MCX, India. The data related to global supply, global consumption, Indian imports and spot prices for different commodities for the period of January 2009 to December 2019. The futures contract prices of different commodities also selected to calculate the spread between near month and far month futures prices to identify the situations like Contango and Normal Backwardation.

The data analysis includes the calculation of historical volatility with the help of returns calculated of different futures contract prices of commodities. The volatility helps the investors in making the investment related decisions. The hypothesis under study was formed to check the relationship between commodities futures contract price with the global supply, global consumption, Indian Imports and spot prices of that commodities. The hypothesis was tested with the help of descriptive statistics, correlation, regression and ANOVA. The results of this study are useful to investors who wish to invest in commodity markets. There are various investment channels available for investment, but commodities are not so popular. This research helps to understand all aspects of the commodity market and the relationship between commodities and other economic parameters. The study also focuses on the calculation of historical volatility of prices, which will help to obtain short-term profits for investors. The portfolio diversification helps the investors in understanding the importance of commodities as an important investment avenue.

**Keywords:** Commodity market MCX, Volatility, Futures Contract Price, Spot Prices, economic parameters

## 1. INTRODUCTION

In India, merchandise trade has a long history. A huge number of years back, commodity futures trading had started. Be that as it may, after the foundation of the Bombay Cotton

Trade Association Co., Ltd. in 1875, sorted out product trade started. The commodity futures market assumes an indispensable role in the Indian economy. Since India is a huge farming nation, commodities assume a significant role in economic development and development.

Commodity futures contracts assist cost with gambling the executives. Futures contracts trading on the securities exchange with Nifty and Sensex are famous. Be that as it may, similar to the futures agreements of commodities traded on the MCX, India needs prevalence. This shows the absence of general mindfulness regarding the commodity trading. The futures contract for different commodities traded on the MCX helps the investor to hedge the risk, diversify the portfolio and also helpful in the price discovery. The commodity market in India is related with many other industries. The volatility of the futures contract on commodity also very useful to gain short-term profit to the investors. These all factors stimulate carrying on research in Indian commodity market.

## 2. REVIEW OF LITERATURE

There are various researches in the area of finance and risk management have studied the commodities market and their impact on various other parameters of growth and development. According to the study, the commodity market plays important role in the development of economy. The researchers have identified different milestones achieved by the commodity market to reach at the current position. Moreover, various studies also carried out for understanding different methods for calculation of volatility. There are number of researches have been made in order to find out the volatility of the commodities. There are different ways to calculate the volatility and how to use the volatility measures for the investment purpose and for the portfolio diversification. However, many authors studied the GARCH models, Augmented Dickey Fuller (ADF) and Phillips- Pearson (PP) test to ensure the price fluctuations.

Many researches also focused on the relationship between the commodities like gold and silver, crude oil and other economic parameters which gives the detail understanding regarding how the correlation between two variables works. Thus, the literature study helps in gathering the detailed idea about how the commodity market works and different factors which affects the prices of commodities.

**Chow-Foon, et al, (2019)** examine the cost of carry and risk premium theories to understand

pricing of forward and future contracts. The paper studied the cost of carry model and the convenience yield to explain the disparity between forward and spot prices. Two approaches for pricing of forward contracts have been studied. One approach focused on how hedgers and speculators affect the future prices and another approach is the portfolio which helps in understanding risk premium derived from large and diversified portfolio. (Chow Foon Y, 2019)

**Bastianin and Manera (2017)** analysed the impact of oil prices shocks on the volatility of US stock market. The analysis is done on three different oil market i.e. aggregate demands, oil supply and oil-specific demand shocks. The study revealed that volatility increases to the oil prices caused by the unexpected change in the demand side but, supply side the effect of volatility is very less. (Bastianin & Manera, 2017)

**Ding and Zhange (2017)** studied the effects of liquidity risk on the return and volatility co-movement in the commodity futures market. The results of the study revealed that the liquidity risk is the common casual factor which affects both the return and volatility. The liquidity spillover also affects the cross-sectional correlation dynamics. (Zang & Ding, 2017)

**Joseph, et al, (2016)** studied about the effect of interest rates on the volatility of commodity and the correlation of commodity prices. The data used for the study is from the Federal Reserve Bank of Cleveland and the commodities traded at New York Metal Exchange, London Metal Exchange and Chicago Board of Trade (CBT). The study revealed that as the interest rates reduce; the volatility of prices also reduced and increases the price correlation of commodities. (Gruber & Vigfusson, 2016)

**Algieri (2016)** analyzed the impact of speculation and GARCH price volatility and the excessive speculation and conditional GARCH price volatility. As per the result it concluded that excessive speculation generates conditional value volatility and there is a connection between value volatility and hypothesis. The value volatility of the maize, rice, soya beans and wheat are driven by excessive price volatility. (Algieri, 2016)

**Lyocsa and Molnar (2016)** studied volatility forecasting of gold and silver as commodity. The heterogeneous autoregressive (HAR) models used to predict one-day forward volatility of gold and silver high frequency data. The results are shown that there was no spill over between gold and silver prices. (Lyocsa& Molnar, 2016)

**Bhattacharya and Gupta (2016)** studied the modelling time-varying volatility in Indian Commodity futures return. The study focuses on various volatility models to predict the conditional variance of the rate of return in Indian commodity future market. In this research paper, the volatility of Aluminium, Copper and Zinc are studied. They focused on key issues like, whether the volatility of asset future returns exhibits long run dependence, and which model is used for forecasting purpose. The volatility returns should be considered while making investment decisions and according to the study the volatility process of Aluminium, Copper and Zinc futures is well described by the APARCH and EGARCH standard models. (Bhattacharya & Gupta, 2016)

**R H Raghavendra, et al, (2016)** examine the relationship between spot and future market of agriculture commodities in India. In this study five commodities like Soyabean, Jeera, Turmeric, Chana and Maize were examined by checking connection among future and spot costs. The spot costs and the future costs from the NCDEX were considered. According to the examination, there was the presence of lead-slack connection among future and spot costs. Spot costs and future costs assume a significant role in the value disclosure process, and will react quickly to each other. (Raghavendra RH, 2016)

**Chakraborty and Das (2015)** studied the multivariate multi scale Entropy Approach to testing commodity market efficiency. The study tested the productivity of the Indian Commodity market after the beginning of future trading on the national level and three non- agricultural commodities have been tried. As indicated by the outcomes, Indian commodity market proficiency shifts after some time and relies upon the nature of commodities. The agricultural commodities show the significant fluctuations in efficiency. The export-oriented commodities reduced

efficiency because of slow down. The seasonality also effects in efficiency of agricultural commodities. The movements of the commodity prices in the international market are crucial for the non-agricultural traders. The study put emphasis on analysis of longer period. Because it is required for arriving at conclusion about efficiency. (Chakraborty& Das, 2015)

**Vasantha and Mallikarjunappa (2015)** studied the lead-lag relationship and price discovery in Indian commodity derivatives and spot market of pepper. The study used Johnson's cointegration test and EGARCH model. Use enhanced Dickey Fuller (ADF) and Phillips- Pearson (PP) tests to ensure stable price series. With the help of tailed analysis, it can be found that the spot market is more productive than the futures market in value disclosure, and the spot market assumes a main role in the futures market. The spot market assumes the main role in view of members later on the market thus there is a dainty trading volume, absence of mindfulness among the member about the futures market. The spot market retains data quicker than the futures market, so it assumes a significant role in the value revelation process. (Vasantha&Mallikarjunappa, 2015)

**Chand, et al, (2015)** studied about the historical background on Indian Commodity market and analysed that Indian commodity market has a long history and goes over many high points and low points. As two-third of the Indian population rely on the agrarian product, the commodity market assumes an essential role in the development of the economy. The commodity market has experienced huge advancement as far as straightforwardness, mechanical development, and trading action. Creating nations are expending commodities, so the worldwide commodity market is bigger than the securities exchange. The commodity market is the place different products, for example, valuable metals, unrefined petroleum, vitality, and delicate commodities, for example, espresso and palm oil are purchased and sold. It is important to build up a lively, dynamic and fluid commodity market, which will assist financial specialists with supporting their dangers. Thus, commodity market required policy liberalization, initiating new development policy and regulatory

framework. (Dr. Bhagat, Omre, & Chand, 2015)

**Ambrish and Singh (2015)** studied about the basics of investment in commodity market in India. The study efforts on the various categories of derivatives. There are different derivative instruments are available for the investment purpose. The investments in commodity market provide diversification benefits and it will help in achieving potential growth in the investments. The study focuses on the agricultural market in India and provide insight about the 'Mandi system' and 'E-Choupals' system which is designed to tackle the challenges of Indian agriculture market. The study also focuses on MCX, NCDEX, and different trading system in commodity market. The risk associated with commodity market also covered by the study. The study revealed that fragmentation in the agricultural market and price differentials in agricultural produce is the major problem in Indian agriculture. However, demutualization of commodity exchanges may help to overcome this problem. (Ambrish& Singh, 2015)

**Jaiswal and Manoj (2015)** conducted study on gold prices variations and its impact on commodity market in India. They founded out that among all factors, inflation rate and US dollar affects the most to the gold price variations. As gold has acted as haven for investors, they tend to preserve some amount as gold portfolio. This is a key factor in fluctuations of gold prices. (Jaiswal&Manoj, 2015)

**Misra and Goswami (2015)** studied about the predictability of sugar futures of the Indian commodity market. The study comprises only one commodity sugar. For analysis purpose the least square regression technique is used. To anticipate future spot costs, distinctive straight and nonlinear models are utilized. The ANN model, STAR-GARCH model, and straight measurable model are utilized to relate commodity spot and futures costs. The investigation shows that by utilizing propelled gauging methods and futures costs to decide the normal future spot costs, specialized traders will profit. (Misra&Goswami, 2015)

**Selvalakshmi and Arumucs (2014)** studied about the impact of price level changes in

Indian Commodity market. This investigation assesses the degree to which factors of large scale economic prompts changes in commodity costs. It incorporates different factors like stockpiling stock, flexibly, and request, economic execution, costs of commodities, worldwide patterns, substitute commodity costs, reserve funds and venture, rural yield, and storm. All these having sway on commodity costs. The commodity market offers different possibilities for hedgers, theorists, and arbitrageurs. This investigation centers around the different commodities traded at MCX of India and across different fragments like bullions, metals, vitality, climate, oil and oilseeds, pulses, etc. With the help of the various test and analysis it is observed that all the macro-economic factor is having positive impact on the prices of commodity. It is mandatory for trader to understand the effects of the various economic parameters. Moreover, there are certain Governmental influences like various policy instruments, tariffs, subsidies, and the price floors. These efforts are necessary to maintain the effect of the price variations and help in sustaining the trade balance in the economy. (Selvalakshmi&Arumugam, 2014)

**Aggarwal Nidhi, et al, (2014)** studied about the price discovery and risk management of commodities markets in India. The study examined commodity futures contracts for price discovery and risk management. The results revealed that future prices help in identifying efficient information and help in manage risk. The commodities markets help in price discovery process, but the hedging effectiveness was lower.

**M. A. Lagesh, et all (2014)** studied the portfolio diversification benefits of traditional asset market and commodity future indices of India. For the analysis purpose the connection between commodity future indices and stock indices were estimated. The other investment avenues like bond index Treasury charge index were additionally examined. The outcomes concentrated on exceptionally short relationship among the commodity futures lists and other resource files which is potential for the portfolio broadening. Consequently, commodity futures contracts are effective to achieve diversification benefits when combined with other investment avenues. (Lagesh M A, 2014)

**Prakash and Sundararajan (2014)** studied the relationship between gold and silver. Since gold and silver have become close substitutes for each other, the price movements of gold and silver are similar. Use a variety of factors that affect the trend of gold and silver; the study shows that gold is the best alternative source of investment. Silver prices also have a certain degree of positive impact on gold prices. In India, gold is regularly utilized as a hedge against swelling and as an elective resource for the individuals who have inert assets for theoretical purposes. (Prakash & Sundararajan, 2014)

**Joseph, et al, (2014)** studied about the frequency domain causality investigation between futures and spot prices of Indian commodity markets. In India, gold is regularly utilized as a

support against expansion and as an elective resource for the individuals who have inert assets for theoretical reason frequency domain analysis gives a successful elective device by looking at the causality in the frequency domain, while the costs of customary econometric causality analysis are just moved in the time domain. For the analysis, day by day information of eight commodities from four classes, (for example, gold chunks, vitality, metals, and farming commodities) from January 2008 to December 2012 were utilized. As per the outcomes, all commodities have a single direction relationship from futures to spot. With the assistance of frequency domain analysis and power of the causal connection among futures and spot costs can be achieved precisely. This shows the futures market has an incredible value revelation work in totally chose commodities, which additionally shows the proficiency of the Indian commodity futures market. (Joseph, Sisodia, & Tiwari, 2014)

**Rajvanshi (2014)** studied intraday trading activity and volatility of energy and metal futures. This study focuses the analysis of volume volatility relationship. This will provide understanding into the structure of financial markets, which affects market members. With the end goal of analysis; raw petroleum and metal futures, (for example, gold, silver, copper, and zinc) of a vitality future are utilized for a long time. The

examination originally utilized intra-day information from the Indian commodity market to investigate the volume volatility relationship, and afterward gave more bits of knowledge and proof to the hypothetical models that clarify the volume volatility relationship. As per the discoveries, there is a synchronous connection among amount and volatility. Traders receive information and take corresponding actions at different times. The Indian Commodity Market acts on the trading volume data. (Rajvanshi, 2014)

**Gakhar and Meetu (2013)** studied the Derivative market in India, Evolution and trading mechanism. The study also he focused on the future growth prospects. It is obvious from this study that since 1991, new economic reforms have begun to enhance investor confidence in commodity market transactions. Some of the issues related to various products include the lack of economies of scale, taxation and legal bottlenecks, the increase in Indian banks' off-balance sheet exposure, and the need for independent regulators. In addition, this research focuses on the trading system of the commodity market. The derivative market also includes various participants like the hedgers, speculators and arbitrageurs. Thus, commodity market is the developing market. There will be opportunity for the enormous growth and development for the market. It will also lead to the development of the Indian economy. (Gakhar & Meetu, 2013)

**Anjum and Harwinder (2013)** studied the different types of commodities and regulatory framework of Indian Commodity Market. As per the study, there has been lots of change and growth in the commodity future market gives the odds of financial influence to different members of the commodity market. In India there is a three-tier administrative structure of things to come trading. It incorporates Ministry of Consumer Affairs of Indian government, forward market board of trustees and commodity exchange. In India Commodity Exchanges are extensively classifications into two sorts; National exchanges and Regional exchanges. National exchanges incorporate the MCX, NCDEX, NMCE, ICEX and ACE. Regional Commodity Exchanges incorporates sixteen local exchanges. The commodities traded in these exchanges are sorted in bullion, base metals, vitality products, rural products.

Forward Market Commission performs all the roles related to smooth functioning of the commodity market and provide the better control mechanism. (Harwinder&Anjum, 2013)

**Bhowmik (2013)**, studied about the stock market volatility. The study analysed the variability of different stock prices. The study also focuses on the effect of the volatility and elements of volatility. As indicated by the paper, volatility is the capacity of vulnerability. The study shows that the growth of industrial production is the main cause of fluctuations. Inflation also played role for the variability of prices. Business cycle affects the stock market's price volatility. Volatility can also be defined as the annualized rolling standard deviation over thirty six months. The political condition of any country should also have impact of volatility prices. The changes in government, announcement of any policy and the other amendments in the policy will lead to change in the prices. The other factors like weather conditions, and effect of production process will have impact on the prices of commodity. The study also focuses on the volatility affects the economic growth and volume of trade. (Bhowmik D. , 2013)

**Ravi (2013)** studied about the price discovery and volatility spill over in Indian Commodity Futures Markets using the selected commodities. As per the study the Indian Commodity Market is poised to play important capacity of value revelation and hazard the board. According to the analysis, the futures market is more effective than the spot market of the commodity. The future market is the one that will help in the capacity of value disclosure. The examination uncovered that commodity market costs are increasingly unpredictable. The procedure of data scattering is likewise more viable later on market than in the spot market. Along these lines, the volatility overflow is more in the spot market and will affect the buying behaviour of the commodity. (Ravi, 2013)

**Nemavathi and Nedunchezian (2013)** studied the impact of price behaviour of gold commodity and gold ETF. According to study, the precious metal's value is determined by inflation, interest rate and presence of lucrative alternative investment avenues in economy.

With use of different statistical tools founded out that commodity gold has high risk compared to gold ETF. Commodity market is at top when volatility is very low. The commodities are less risky, but the performance of the product depends on the volatility of the market. (Nemavathi & Nedunchezian, 2013)

## 1. STATEMENT OF THE PROBLEM

The authors made their research problem towards the Indian Commodity Market and analyze price volatility of commodities traded on MCX, India and to identify relationship between futures price of commodities and different economic factors. The researchers had made attempt to know the relationship between commodity futures prices and economic variables such as global supply, global consumption, Indian imports and spot prices. Due to the imbalance between demand and supply, commodity prices are highly volatile. The economic growth and industrial production tend to boost the demand for different commodities at global level. The important factor which affect the commodity's demand is its consumption for various reasons. The global consumption data incorporates the demand for the commodity. The global supply and global consumption are influenced by the tariffs, infrastructure, government policies, exchange rate liberalization, etc. All these factors affect the global supply and consumption which ultimately affect the commodity futures prices (Bajapai, 2020), (Motiwal Oswal, 2015), (Centre for Advance Trade Research, 2019). The Imports for goods also affects the Commodity price. Because of India's dependence on imports; it has an impact on commodity futures prices. India's imports affect commodity prices and cause fluctuations. (Rathod, 2014) (Bathala, 2012) Commodity spot prices also affect futures prices, because commodity futures prices are derived from the arbitrage cost relationship with spot prices. The commodities are preserved for future may incurred various costs like storage cost, insurance cost, maintenance cost, all of these affect the future prices (Sharma 2010), (Nickolas, 2020). With the reference of above mentioned facts, the following variables were selected to analyze their relationship with the futures price of commodities.

In this study, an attempt has been made to

review all relevant information available on the Indian commodity market and the MCX. A detail study also carryout to work on the research problem regarding price volatility of commodity's futures contract on MCX and different factors affecting the futures prices of commodities.

#### **4.OBJECTIVES OF THE RESEARCH STUDY:**

- 1 To understand the growth of the commodity market and the regulatory framework.
- 2 To understand the concept of volatility and the working mode of MCX, India.
- 3 To analyze the price volatility and diversified returns of commodities traded on MCX, India.
- 4 To study the relationship of futures prices of commodities with the different economic parameters.

#### **5.HYPOTHESIS OF THE STUDY**

The following hypothesis are formed to study.

The hypothesis for the learning is as follow;

#### **6.MATERIALS AND METHODS USED**

##### **6.1 RESEARCH DESIGN:**

The study includes combination of two research design i.e. exploratory and descriptive. The exploratory research design helps to gain better understanding regarding the commodity market and how it operates and help in forming the hypothesis by the support of secondary data. The descriptive investigation design as it helps to describe the phenomenon. Thus, exploratory research form the basis of Descriptive research and knowledge gained through exploratory research are used to select research-related issues. Exploratory research design provides a hypothesis, so descriptive research is needed to prove the hypothesis. The task of descriptive research is to put the pictures created by the exploratory research design into the frame.

##### **6.2 RESEARCH METHODOLOGY:**

In this study, the information and data used are consistent with time, cost, and availability of information. This study is based on the following available information;

##### **6.3 SOURCES OF INFORMATION:**

Secondary data collected to solve research problems and achieve research goals. It also makes use of available articles, books, research reports, reports, journals, magazines, and access to related websites.

##### **6.4 RESEARCH TYPE:**

The outline of the study comes from concepts related to commodity markets and futures trading. This type of research is non-experimental.

##### **6.5 UNIVERSE AND POPULATION:**

The scope of the study is all commodity markets in India. The study population was selected as the Indian multi-commodity exchange and selected commodity futures contracts.

##### **7. SAMPLING PLAN:**

Sampling plan in research provides the outline of the research. With the help of sampling plan a generalized idea of research can be derived. A good sampling plan help to identify the research work in a proper manner. In the present study the plan is to identify the different categories of commodities futures contract traded at Multi Commodity Market, India and calculate volatility of that futures contract values. The commodities and their future contract prices are occupied for the learning.

##### **8.SAMPLING METHOD:**

The term sampling describes to the technique of selecting a sample from the given population in order to draw the conclusion regarding the universe. The sampling is known as the key for any research work undertaken. In the present study; the sampling is non-probability and based on judgment and availability of data. At Multi Commodity Exchange, India the commodities remain operated under different heads like Agri Commodities, Base Metals, Bullions and Energy. Initially when commodity exchange started; there were various commodities traded under each category. But, as time progresses, most commodities are largely constrained by the supply and demand conditions in the global and domestic markets. So, many commodities were dropped from the trading list and a few commodities were left.

Thus, for the present study, the commodities which are currently traded at MCX, India and whose futures contract prices are available selected for the study purpose. So, the sampling method studied was based on the availability of data.

### 9.SAMPLING UNIT:

The sampling unit is the most basic element which contain the characteristic of the target population. For the present study of price volatility of commodity; the sampling unit is the commodities and their futures contract prices at Multi Commodity Exchange, India.

### 10.SAMPLE SIZE

The sample size means the researcher has to decide how many elements of the target population are to be selected for the analysis work. In the present study, the commodities traded on Multi Commodity Exchange, India under different categories like Agri commodities, Bullion, Base Metal and Energy. The list of selected commodities futures contract under each category is as follow;

**Agri Commodities:** Cardamom, Cotton, Crude Palm Oil (CPO), Mentha Oil Energy; crude oil & natural gas

**Metal Commodities:** Aluminum, copper, lead, zinc, nickel

**Bullion:** gold & silver

### 11. DATA COLLECTION

The study covers eleven calendar year from the January 2010 to December 2020. Through overall period of the study span, the closing prices of commodity futures contract were selected. The data may differ on the basis of introduction of the contract and on the drop of the contract due to the buying and selling pressures. The data analyzed in the study is secondary data. It comprises the closing prices of futures contract for the various commodities traded on the Indian Multi Commodity Exchange (MCX). The series of closing prices of futures contracts It has been downloaded from the exchange's website. The daily closing prices of futures contract are converted into monthly data for the volatility calculation and further analysis purpose.

For the testing of different hypothesis under

study various data have been downloaded from the Commodity Insights Yearbook. The Commodity Insights Yearbook published for different years by MCX, India. The data related to global supply, global consumption, Indian imports and spot prices for different commodities were downloaded aimed at the dated of January 2010 to December 2019. The analysis further extended to portfolio construction. For portfolio construction different index data for the five calendar year January 2016 to March 2020 derived from the website of different exchanges. The data comprises of the closing prices of NSE fifty, BSE Sensex, and MCX iCOMDEX.

### 12.LIMITATIONS OF THE STUDY

The limitations of this study are as follows:

- The results of this research work are limited to the selected exchange, the Multi Commodity Exchange (MCX).
- In the present study limited commodities were selected for the research work.
- High frequency data were not available so study has been confined to daily closing price data.

### 13.DATA ANALYSIS AND INTERPRETATION

MCX is India's first commodity derivative exchange which facilitates trading of commodities online. The MCX, India offers trading in various commodities. The commodities are divided into four broad categories like Bullion, Base Metal, Energy and Agri Commodities. The data for each commodity analyzed for the period of 11 years from 2009 to 2018. The data for each commodity for the year 2009 to 2018 were downloaded from the website of MCX. The data were then further used for the volatility calculation. The volatility calculation is based on historical volatility method. The analysis helps to identify the movement of prices and help the investors to invest and guide in taking the decision related to investments. The detailed volatility calculation for each commodity are as follows;

#### Volatility Calculation:

The term volatility means fluctuations in the price. The volatility is also defined as the

dispersion of returns. It can be measured by the various statistical analysis. The volatility also called the uncertainty related to the any changes in prices. The fluctuations may be upside or downside. The high volatility means the prices of commodity value volatility and there is a connection between value volatility and speculation. The value volatility can change radically over a brief timeframe period and lower volatility implies that price doesn't fluctuate and tends to be steady.

The volatility calculation is based on the historical volatility method. The historical volatility is also called the statistical volatility which measures the fluctuations of underlying commodity by measuring the price changes over the period of time. The calculation for the historical volatility are based on the changes from one closing price to the next.

For calculating the volatility; the futures contract traded on MCX are taken. The closing prices of futures contract available in the historical data tab were downloaded for the year 2009 to 2019. The daily closing prices of each selected commodity were downloaded and the daily data were converted into monthly data for

calculation of the volatility. The commodities are grouped under four categories which are as follows;

### 1) Agri- Commodities:

Agri commodities contributes to the most to the various business in our Indian economy. So, agriculture is called the backbone of Indian economy. India is known as the agrarian economy which ranked second in the farm production in entire world. As the population of India increases; the agricultural production faced major challenges regarding supply, storage and distribution. The Government also announced various reforms related to the agricultural production (Vijayashankar & Krishnamurthy, 2012). The agricultural commodities selected for the study includes; 1) Cardamom, 2) Cotton, 3) Crude Palm Oil (CPO), 4) Mentha Oil.

#### 1. Cardamom:

The closing prices of futures contract on Cardamom are downloaded from the historical data provided by the Multi Commodity Exchange. The volatility calculation and monthly closing prices of the cardamom futures contract are analyzed as follows;

**Table 1 Monthly Closing Prices of Cardamom Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	547.64	1242.98	1496.15	621.1	1025.54	715.52	993.74	793.37	1478.98	1108.15	1572.24
Feb	582.47	1131.57	1240.97	784.07	982.85	750.4	1100.56	672.01	1497.06	1138.16	1523.63
Mar	616.7	1211.83	1094.3	1072.61	899.47	816.13	1027.56	687.12	1403.79	1092.95	1561.79
Apr	689.3	1340.7	1073.27	1100.31	820	930.18	1027.19	737.78	1298.96	979.85	1747.71
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
May	741.33	1502.18	885.23	1283.01	742.96	990.15	812.15	819.53	1112.97	926.76	2305.82
Jun	851.04	1790.88	793.72	1276.22	738.25	932.31	809.06	849.22	1092.83	931.98	2727.79
Jul	851.74	1729.76	834.01	1385.99	712.52	952.41	805.84	876.84	1101.16	1092.64	3285.98
Aug	830.08	1428.83	769.14	1131.8	762.4	950.58	798.96	1066.02	1167.09	1241.09	3548.98
Sep	820.65	1148.2	712.36	933	737.18	909.1	812.81	1149.13	1187.3	1398.96	2976.63
Oct	755.75	971.56	619.25	900.97	715.36	860.12	785.93	1184.95	1038.21	1396.34	2828.97
Nov	838.77	1000	633.61	859.87	718.83	822.25	695.18	1323.48	952.26	1456.14	2709.09
Dec	954.1	1356.1	591.61	985.35	670.13	864.8	689.56	1320.96	1028.32	1497.49	3211.99

**Table 2 Volatility of Cardamom Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.06797	0.13001	0.008	0.15507	0.0475	0.0609	0.0825	0.0852	0.0724	0.0784	0.1272

**Graph 1 Volatile Cardamom Futures Contract Prices**

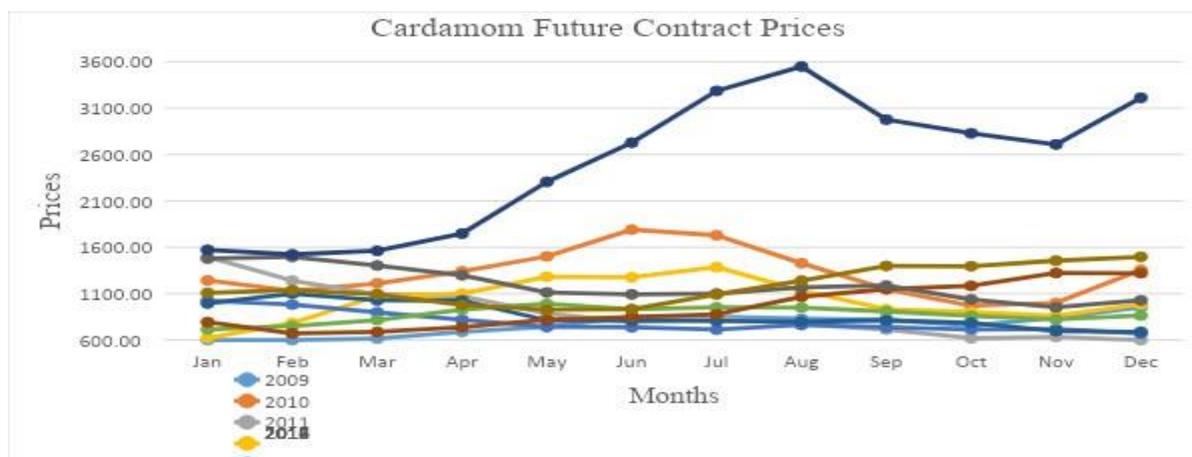


Table 1 represents the monthly closing prices of cardamom futures contract. Table 2 contains the volatility calculated from the closing prices. The graph 1 represents the volatile futures contract prices. It is inferred from the graph that price volatility is higher in the year 2010; again controlled in the year 2011 and hiked in the year 2012. From 2013 to 2018 there were normal fluctuation but in the year 2019

volatility increases.

**2. Cotton:**

The cotton futures contract started in the year 2012 so data of closing prices of cotton futures contract available from the year 2012. The closing prices and its volatility calculation is as follows;

**Table 3 Monthly Closing Prices of Cotton Futures Contract**

Month	2012	2013	2014	2015	2016	2017	2018	2019
Jan	17735.6	16395	20247.78	14954.29	16442	21214.76	20358.69	20820
Feb	17703.2	17220.83	20711.82	14877	16236.19	20739.5	19933	20335.5
Mar	16780.38	18595	20567.2	15017.27	15813.05	21231.3	20430.5	21902.86
Apr	17045.22	18419	20334.74	15823.81	16910	12858.42	20639.52	22102
May	16705.19	18048.85	20167.27	16319.05	17459.09	20809.13	20945.22	21613.4
Jun	15856.8	19192.08	19705.24	16046.36	19819.09	20232.73	22432.86	21776.5
Jul	17508.46	19639.26	19037.39	15763.04	22001.43	20334.76	22513.18	21315.65
Aug	17876.92	21537.04	18200	15993.81	21148.18	18551.36	23544.55	20613.33
Sep	16881.6	21446.4	17413.18	16078.18	20261.36	18682.38	22573	19648.59
Oct	16256.54	21215	16352.38	16141.43	19565	18845.71	22614.55	19503.91
Nov	16615	18941.48	15923	15801.9	18945.91	18344.55	22056.36	19161.9
Dec	16438.4	18928.85	15826.82	16222.27	18959	19466.5	21507	19117.14

**Table 4 Volatility of Cotton Futures Contract**

Year	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.04	0.055	0.0226	0.0217	0.058	0.8515	0.0314	0.031

**Graph 2 Volatile Cotton Futures Contract Prices**

Table 3 presents the monthly closing prices of cotton futures contract and table 4 refers the volatility of futures contract. The above graph 2 represents the volatility of cotton futures contract prices. The cotton prices are highly

volatile in the year 2017. There was low volatility in the year 2012-13. The prices were considerably stable in the year 2014- 15 and 2018-19.

### 3. Crude Palm Oil (CPO):

The monthly closing prices of CPO futures

contract and the calculated volatility are analyzed as follows;

**Table 5 Monthly Closing Prices of CPO Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	281.24	357.26	556.6	531.51	439.17	535	451.71	421.07	588.39	550.19	546.02
Feb	281.85	360.45	569.78	527.54	452.33	561.54	455.98	474.5	564.6	577.35	562.57
Mar	308.06	369.15	527.71	568.91	456.33	592.51	445.49	507.12	533.27	637.75	530.09
Apr	383.9	362.59	517.33	618.92	462.73	566.21	437.95	561.19	516.19	646.95	537.51
May	350.55	370.48	523.88	591.61	468.37	540.75	449.47	541.75	507.01	655.34	518.64
Jun	312.91	368.26	502.19	554.05	498.12	520.61	455.36	518.16	489.62	640.66	508.63
Jul	348.19	376.62	479.43	568.48	501.14	531.32	431.57	509.2	485.51	622.05	503.57
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Aug	348.19	414.37	486.13	558.6	526.1	499.75	385.43	548.46	502.72	595.64	543.58
Sep	330.34	418.01	493.83	514.04	535.78	452.19	395.9	572.25	539.44	597.31	554.91
Oct	314.52	413.76	468.51	421.15	529.48	450.57	417.6	527.25	539.59	585.96	559.26
Nov	328.18	483.74	500.05	431.21	566.98	449.09	390.51	531.43	569.2	526.73	642.12
Dec	352.58	527.47	519.71	411.06	553.1	429.84	402.88	566.44	562.95	503.14	736.2

**Table 6 Volatility of CPO Futures Contract**

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.09361	0.05168	0.04203	0.07606	0.02765	0.04532	0.04793	0.06226	0.03886	0.05131	0.06269

**Graph 3 Volatile CPO Futures Contract Prices**



Table 5 and 6 represents the closing prices and volatility of CPO futures contract. The volatile prices of CPO futures contract are depicted from the above graph 3. The prices are highly volatile over the period of study. The prices are highly fluctuating and this type of investment

provides benefits of volatility. The volatility is highest in the year 2009, 2016 and 2019.

**Mentha Oil:**

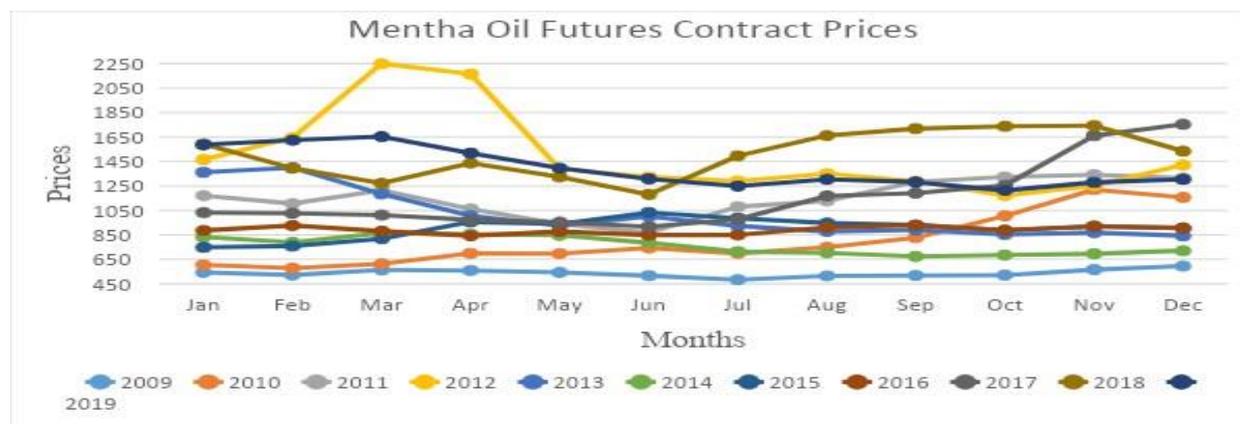
The closing prices of Mentha oil futures contract and volatility of the prices are as follows;

**Table 7 Monthly Closing Prices of Mentha Oil Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	543.8	604.02	1171	1466.12	1361.2	832.66	748.63	886.28	1032.72	1592.1	1586.07
Feb	522.28	578.17	1105.92	1645.29	1398.53	789.11	758.88	926.74	1027.04	1395.06	1623.73
Mar	563.89	613.08	1215.38	2257.35	1184.36	865.38	818.9	880.47	1011.81	1272.06	1653.73
Apr	558.94	698.85	1061.49	2164.33	1005.49	854.35	955.66	842.59	973.27	1436.65	1517.38
May	543.78	697.44	940.49	1390.4	924.92	846.47	939.64	877.71	954.61	1323.76	1395.19
Jun	516.51	743	868.87	1323.22	1000.39	785.14	1032.37	848.32	916.31	1180.1	1307.22
Jul	483.49	698.32	1079.98	1289.98	923.81	712.64	985.73	849.13	977.91	1495.64	1248.04
Aug	514.65	748.92	1126.7	1350.09	877.77	703.5	946.54	909.98	1168.62	1661.67	1303.76
Sep	517.76	827.4	1284.23	1289.38	890.84	673.81	929.16	929.16	1191.07	1718.56	1281.51
Oct	520.95	1004.79	1323.44	1170.87	852.7	685.31	887.21	887.21	1255.31	1737.64	1212.81
Nov	565.81	1220.21	1341.12	1252.35	868.86	695.72	919.91	919.91	1660.84	1742.59	1278.8
Dec	595.64	1156.97	1315.53	1421.87	842.24	721.03	906.1	906.1	1754.44	1534.91	1304.43

**Table 8 Volatility of Mentha Oil Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.050485	0.087939	0.103518	0.177882	0.073704	0.051013	0.062857	0.040712	0.094749	0.114871	0.049261

**Graph 4 Volatile Mentha Oil Futures Contract Prices**

The above table 7 represents the monthly closing prices of Mentha oil futures contract. The table 8 includes the volatility of Mentha oil futures contract. From the above graph.4 the volatility of Mentha oil futures contract can be interpreted. The prices are highly volatile in the year 2012 and 2018. The prices are comparatively less volatile for the other years.

## 2) Base Metal:

The term base metal applied to the metal which oxidize or corrodes easily and reacts differently with the diluted hydrochloric acid to form hydrogen. Base metals are generally very common and inexpensive compared to precious

metals. With the large investments and technological advances and the benefits of liberalization and open market metal industry increased the output and also the quality of products. The base metal which is currently traded on MCX are; Aluminium, Copper, Lead, Nickel and Zinc. Other than these metals Brass Phy, Iron, Steel, Tin, etc. were initially traded (Multi commodity Exchange, 2010). The volatility calculation of metal commodities futures contract is as follows;

### 1. Aluminium:

The closing prices of Aluminium futures contract and volatility of the Aluminium are presented below;

**Table 9 Monthly Closing Prices of Aluminium Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	70.3	104.19	111.52	110.07	111.36	108.21	113.17	100.33	121.19	141.14	146.13
Feb	67.95	95.79	114.62	109.38	111.47	106.06	113.32	106.05	124.83	140.26	149.07
Mar	69.85	102.08	115.57	111.12	105.12	104.78	114.41	102.59	125.41	135.48	146.65
Apr	72.57	103.75	119.13	106.99	101.86	110	113.73	104.92	124.57	149.71	146.8
May	72.8	90.43	116.6	109.97	101.54	104.6	115.73	104.9	123.65	155.76	148.75
Jun	77	91.36	115.1	106.63	106.61	110.39	108.54	107.45	121.7	152.57	145.75
Jul	81.3	93.55	112.51	104.75	106.6	117.67	105.21	109.74	123.6	141.77	143.86
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Aug	94.67	99.19	108.45	103.22	115.43	124.03	101.42	110.08	129.6	145.85	139.63
Sep	90.18	100.35	110.03	111.78	113.53	122.05	106.04	106.62	135.79	148.5	145.83
Oct	88.15	106.83	107.86	105.37	112.5	120.41	98.41	111.44	139.22	150.16	137.32
Nov	92.27	106.54	106.22	107.28	110.81	127.2	97.79	117.21	136.53	140.95	134.22
Dec	102.42	106.96	106.78	113.41	108.36	120.08	99.91	117.24	134.42	136.13	134.44

**Table 10 Volatility of Aluminium Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.0573	0.0590	0.02117	0.0394	0.0358	0.0436	0.0358	0.0286	0.0237	0.0476	0.0264

**Graph 5 Volatile Aluminium Futures Contract Prices**



Table 9 and table 10 presented the monthly closing prices of aluminum futures contract and volatility of aluminum futures contract. In the above graph 5 the volatile nature of Aluminium futures contract prices are presented. The volatility was high in the year 2009 and 2018. The prices were more or less stable during the

year 2010, 2011 and 2012.

**2. Copper:**

The closing prices of futures contract value of copper and volatility calculations of the copper futures contract are analyzed below;

**Table 11 Monthly Closing Prices of Copper Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	161.84	339.53	439.43	414.55	442.99	458.51	364.19	302.56	394.22	453.94	418.86
Feb	164.92	319.06	451.47	417.77	437.59	445.71	357.16	313.84	398.93	452.62	448.74
Mar	195.43	341.8	433.23	430.5	422.24	411.23	375.16	333.04	386.48	445.25	448.21
Apr	225.9	346.13	424.32	426.92	394.04	407.28	380.44	321.05	369.55	448.81	447.85
May	225.94	317.15	407.45	430.1	402.95	411.73	406.92	314.86	370.97	461.28	424.11
Jun	241.59	302.74	407.15	414.41	410.25	409.47	375.4	327.15	390.52	467.19	410.86
Jul	254.93	318.32	433.12	423.56	416.36	432.45	351.92	330.5	418.3	428.08	444.91
Aug	299.62	341.42	408.3	418.86	456.59	425.83	335.32	317.35	430.63	416.51	443
Sep	302.77	357.7	399.76	445.64	469.19	422.45	350.52	319.91	448.54	436.09	447.24
Oct	298.32	371.56	367.29	432.12	450.45	414.2	343.04	318.97	444.19	452.42	439.37
Nov	312.38	382.68	386.23	424.04	446.9	409.91	315.41	370.26	445.67	435.9	437.51
Dec	330.06	417.1	403.42	442.56	457.46	404.42	312.06	385.95	480.25	429.57	439.95

**Table 6.1.12 Volatility of Copper Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.0624	0.0556	0.0459	0.0296	0.0411	0.0301	0.0504	0.9702	0.0325	0.0399	0.0627

**Graph 6.1.6 Volatile Copper Futures Contract Prices**

The analysis of closing prices of futures contract of copper presented in the table 11 and volatility in the table 12. The above graph 6 presents the volatility of futures contract value of copper. The volatility is highest in the year 2009, 2015 and 2019. The copper prices are

highly volatile.

### 3. Lead:

The closing prices of lead futures contract and volatility of futures prices are as follow;

**Table 13 Monthly Closing Prices of Lead Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	55.74	109.61	117.48	107.46	126.86	134	121.85	111.47	151.54	164.27	141.78
Feb	54.44	99.33	117.2	105.37	128.34	131.66	111.95	121.06	155.14	166.46	147.48
Mar	64.18	99.33	118.24	104.84	119.39	126.1	112.42	120.81	150.25	155.69	143.05
Apr	70.25	101.09	120.69	107.78	110.9	126.37	125.78	115.58	143.9	155.05	135.64
May	70.3	87.25	109.15	109.49	112.17	126.63	127.95	114.77	137.58	160.98	127.59
Jun	80	79.9	113.28	104.61	122.95	124.91	117.51	115.75	138.26	165.96	153.38
Jul	81.4	101.87	119.76	104.86	122.89	126.4	112.64	123.46	146.83	153.53	155.04
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Aug	91.63	97.36	108.9	106.14	137.51	132.31	111.13	123.34	150.82	145.26	155.08
Sep	106.96	101.24	109.26	118.06	133.9	136.5	112	130.08	153.83	146.61	155.3
Oct	104.84	106.3	96.68	113.86	130.91	129.56	112.63	135.94	163	149.28	157.6
Nov	107.43	107.11	101.78	119.54	132.22	125.31	107.51	147.98	160.14	141.03	155.11
Dec	109.12	109.69	106.77	124.63	133.55	125.45	113.89	149.23	161.22	140.23	152.44

**Table 14 Volatility of Lead Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.0686	0.0977	0.0626	0.0408	0.0549	0.0286	0.0559	0.0397	0.3512	0.0399	0.0627

**Graph 7 Volatile Lead Futures Contract Prices**



Table 13 presents the closing prices of lead futures contract. Table 14 presents the volatility of the lead futures contract. The above graph 7 presents the volatile lead futures contract. The volatility of lead futures contract was high in the year 2009 and 2018, 2019. The prices are comparatively stable during the year 2011 to

2014.

**4. Nickel:**

The closing prices of Nickel futures contract and price volatility of nickel futures contract are analyzed as below;

**Table 15 Monthly Closing Prices of Nickel Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	564.64	852.25	1165.43	1015.8	952.76	877.51	925.59	574.3	684.3	817.68	813.75
Feb	524.4	883.1	1292.6	1019.05	958.1	883.9	905.72	570.44	714.29	877.05	905.83
Mar	500.56	1024.23	1209.39	949.27	915.7	954.95	864.53	585.8	674.9	871.99	909.43
Apr	567.2	1155.73	1177.66	934.26	854.61	1052	809.25	592.43	624.41	917.51	892.36
May	615.15	1016.68	1091.32	931.9	825.07	1150.47	862.99	584.33	592.75	972.76	843.56
Jun	717.74	906.6	1009.37	928.22	838.05	1115.43	819.9	603	577.99	1027.72	874.68
Jul	775.3	919.05	1061.19	900.22	825.09	1151.81	728.34	689.99	613.9	950.54	950.35
Aug	936.81	1003.43	996.52	879.8	905.35	1136.31	678.36	691.96	702.17	939	1111.7
Sep	844.04	1045.4	975.33	940.6	885.62	1102.83	658.78	686.86	725.95	905.93	1252.67
Oct	869.12	1062	939.68	913.22	871.71	974.5	673.97	687.76	742.2	911.52	1224.6
Nov	792.87	1033.47	912.78	896.58	866.38	975.47	614.43	755.75	778.65	808.55	1116.53
Dec	808.18	1092.18	962.41	955.64	867.4	1002.65	581.69	742.72	740.62	769.03	1023.83

**Table 16 Volatility of Nickel Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.0973	0.0828	0.0575	0.0383	0.03949	0.0609	0.0487	0.0461	0.0617	0.0588	0.0819

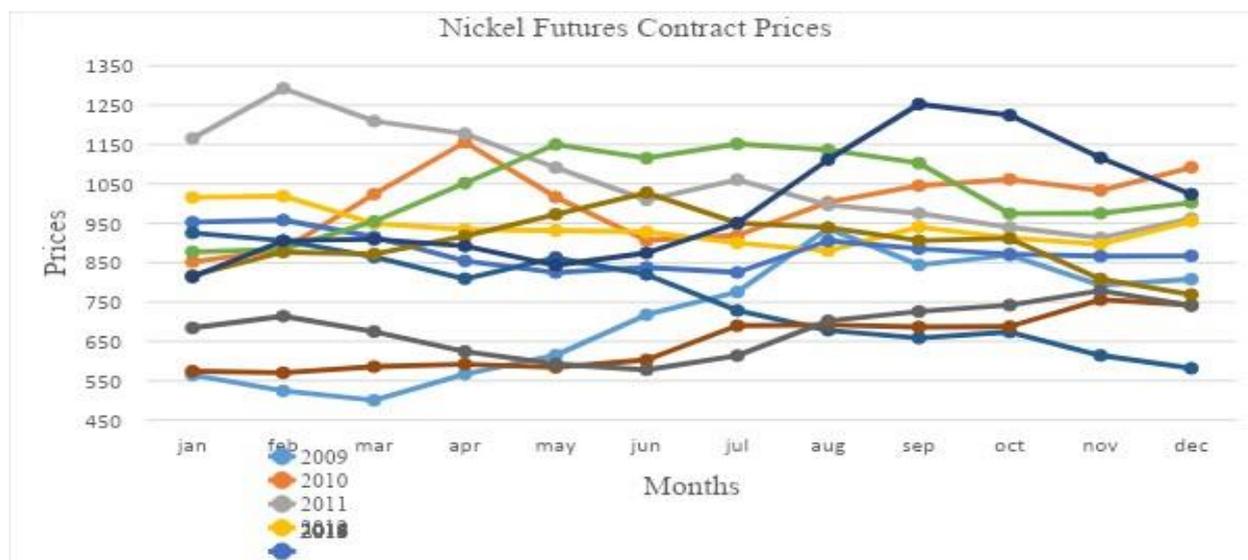
**Graph 8 Volatile Nickel Futures Contract Prices**

Table 15 presents the closing prices of Nickel futures contract and table 16 presents the volatility of futures contract of Nickel. The above graph 8 represents the volatile nature of Nickel futures contract. The prices of Nickel futures contract are highly volatile. The price

volatility was highest in the year 2011, 2013 and 2019.

**Zinc:**

The zinc as a commodity traded on MCX. The commodity futures closing prices and price volatility is as follows;

**Table 17 Monthly Closing Prices of Zinc Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	59.62	112.98	108.85	101.4	110.87	126.85	131.81	102.68	184.75	218.33	181.04
Feb	55.55	100.51	112.8	115.3	115.3	126.49	130.68	116.97	190.48	227.01	193.15
Mar	63.05	103.94	106.35	106.04	106.04	122.35	127.62	120.78	183.33	212.96	198.09
Apr	71.59	106.17	106.03	101.53	101.53	122.83	138.88	123.54	169.7	210.61	226.36
May	73.49	91.73	98.22	101.48	101.48	122.45	145.64	125.41	167.67	207.68	214.59
Jun	74.9	81.95	100.6	107.93	107.93	127.34	133.69	136.64	166.4	209.09	203.12
Jul	76.62	86.72	106.8	110.54	110.54	138.83	127.78	146.82	179.86	181.54	193.18
Aug	87.97	96.13	100.39	120.42	120.42	142.09	118	153.11	191.56	175.47	184.53
Sep	91.16	100.76	99.56	119.02	119.02	140.28	114.5	153.99	200.19	176.05	184.1
Oct	96.88	105.84	92.82	116.78	116.78	140.14	113.03	154.99	211.4	197.31	185.77
Nov	102.63	104.63	98.36	118.02	118.02	139.24	105.23	174.5	209.03	184.84	190.59
Dec	111.43	103.24	100.87	123.18	123.18	137.08	102.28	180.53	205.44	182.98	181.84

**Table 18 Volatility of Zinc Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.0582	0.0782	0.0495	0.0572	0.0462	0.03101	0.0499	0.0419	0.0456	0.0615	0.0512

**Graph 9 Volatile Zinc Futures Contract Prices**

Table 17 includes the monthly closing prices of Zinc futures contract. Table 18 represents the volatility of zinc prices. The graph 9 depicts the volatility of zinc futures contract. The prices were more or less stable during the period of study.

### 3. Bullion

Bullion considered as the precious metal because of its scarce availability. The valuable metals utilized as a cash in past years. Today, they are utilized as a type of venture and mechanical commodities. A portion of the valuable metals like gold serves as a reserve for

many countries. In India reserve bank holds the gold as a reserve. The MCX provides the commodity trading in gold, silver and platinum. But now only gold and silver are traded as the bullion category. The platinum is not currently traded at MCX, India (mcxindia, 2010).

#### 1. Gold:

The gold as a commodity traded on MCX, India. The closing prices of gold futures contract and price volatility of gold futures contract are analyzed below;

**Table 19 Monthly Closing Prices of Gold Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	13520.5	16693.4	20262.8	27639.88	30684.19	29188.74	27412.95	26005.65	28336.95	29643.09	32110.52
Feb	14910.21	16550.54	20432.88	28262.62	30177.6	29575.36	26674.24	28431.68	29257.1	30396.55	33659.53
March	15263.42	16584.07	20887.11	27965.63	29543.24	29779.15	26145.91	29154.73	28660.17	30454.24	32392.89
April	14426.92	16743.8	21561.88	28578.22	27688.78	28597.15	26791.1	29017.95	29025.37	31123.09	31954.45
May	14566.32	18029.12	22157.77	28813.19	26592.58	28017.86	27075.57	29650.95	28448.04	31152.26	31922.48
June	14605.77	18730.04	22429.89	29904.52	27184.15	26904.7	26782.64	30298.05	28803.59	30865.05	33330.15
July	14686.3	18526.93	22713.35	29500.19	26805.74	27832.78	25508.48	31278.1	28190.76	30104.95	34688.61

Aug	14920.12	18506.33	26081.64	30259.78	30213.11	28220.4	25934.05	31284.45	29021.86	29718.65	38909.95
Sept	15726.04	19077.68	27378.73	31649.68	30812.4	27045.91	26355.27	31066.09	29868.05	30563.3	39219.76
Oct	15857.96	19557.08	26767.41	31119	29637.38	27017.57	26763.71	29885.68	29542.3	31682.09	38421.91
Nov	17022.04	20133.08	28552.37	31562.31	30049.44	26111.55	25429.19	29447	29416.5	30948.64	38010.43
Dec	17130.19	20580.73	28207.93	31058.27	29078.16	26806.36	26557.24	27465.14	28661.45	31425.68	38146.86

**Table 20 Volatility of Gold Futures Contract**

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.040595	0.02467	0.04354	0.02209	0.04946	0.02875	0.03086	0.041114	0.0225827	0.0212866	0.04094

**Graph 10 Volatile Gold Futures Contract Prices**



Table 19 represents the closing prices of gold futures contract. Table 20 presents the volatility of futures contract. In the above graph 10 the volatile nature of gold futures contract are shown. The gold prices are increasing year by year. The volatility is less but pricing are increases. The highest volatility was in the year

2019. Thus, gold prices are less volatile but it is value increasing in nature.

#### **Silver:**

The closing prices of silver futures contract and price volatility of silver futures contract are analyzed as below;

**Table 6.1.21 Monthly Closing Prices of Silver Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	18620.19	27405.88	43953.52	53813.16	58672.31	44660.11	38183.29	34148.7	41027.14	39186.64	39442.87
Feb	21552.63	24969.63	47015.91	57156.52	56243.21	45912.5	37116.76	36758.9	42603.85	38412.85	40052
March	22151.53	26652.42	53518.44	57646.25	54298.28	45663.37	36606.91	37016.64	41306.17	38605.59	38201.06
April	20824.63	27557.4	63158.42	56121.83	47324.08	47324.08	36783.24	38562.62	41633.11	39127.71	40136.2
May	22362.79	22544.92	56322.69	54363.44	44056.65	41239.59	38563.43	40277.68	38918.05	39926.13	38792.22
June	23117	23065.12	53640.08	53931.35	42604.72	42227.05	36790.55	41056.27	39063.36	39982.24	39093.55
July	21925.44	28809.17	56524.15	52960.5	40876.41	44776.3	34637.17	46984.57	37534.62	38885.76	41292
Aug	22366.92	29388.23	60797.92	54835.96	48411.85	42958.2	34820.05	45835.05	38814.38	37371.64	46281.86
Sept	26407.96	32182.76	60925.31	62954.25	51330.76	40739.27	35309.14	46018.9	40461.48	37387.45	48504.9

Oct	26851.19	35276.96	53490.69	60646.58	48690.04	38176.9	36959	42273.81	39692.81	38742.23	46562.87
Nov	27666.08	40146.12	56199.42	61114.81	46479.19	35478.85	34272.19	41791.41	39376.73	36889.86	45354.43
Dec	27625.85	44525	54102.15	60291.52	44337.24	37034.59	33856.41	40033.95	37616.9	38021.11	44960.1

**Table 6.1.22 Volatility of Silver Futures Contract**

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.07066	0.112876	0.094451	0.051536	0.078724	0.05627	0.03992	0.059257	0.036448	0.028037	0.047885

**Graph 11 Volatile Silver Futures Contract Prices**



The table 21 and table 22 includes the closing prices of silver futures contract and volatility of futures contract respectively. The graph 11 represents the volatile nature of silver. The prices were highly volatile in the year 2010, 2011, 2013 and 2014. For the rest of the year; prices were less volatile and remain steady.

**4. Energy:**

In the energy forms crude oil and natural gas establish the greater part of the absolute vitality. The Crude oil is one of the significant wellsprings of vitality because of high vitality

thickness and simple transportability. Natural gas is a blend of hydrocarbon gases likewise famous due to its spotless and safe wellspring of vitality. The energy sector in India is one of the important driving forces for the economy (mcxindia, 2010). The MCX provides futures contract in the energy sector. The futures contract help in reduces the uncertainty and manage the risk.

**Crude Oil:**

The closing prices of crude oil futures contract and price volatility of crude oil contract are presented below for the analysis.

**Table 23 Monthly Closing Prices of Crude Oil Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	2064.15	3614.8	4099.48	5151.69	5145.8	5923.07	2976.28	2165.6	3599.76	4034.68	3635.95
Feb	1988.37	3535.04	4112.79	5048.92	5149.16	6252.04	3165.33	2112	3585.85	4013.1	3935.7
March	2467.88	3698.92	4637.62	5366.11	5073.08	6146.92	3007.18	2552	3277.75	4082.14	4071.14
April	250.88	3763.28	4902	5369.52	5003	6166.05	3444.14	2744.76	3307.15	4357.76	4474.45
May	2878.16	3409.12	4552.25	5153.44	5219.34	6054	3796.8	3149.81	3141.08	4717.08	4267.61
June	3349.88	3516.46	4316.8	4633	5597.4	6284.9	3820	3289.47	2920.27	4572.62	3821.89
July	3127.59	3569.85	4326.32	4886.15	6269	6154.43	3270.34	3031.47	3011.8	4855.18	3974.52
Aug	3455	3581.65	3916.69	5231.03	6736.88	5849.85	2806.52	3002	3077.72	4728.59	3915.05
Sept	3360.61	3479.4	4081.61	5163.88	6812.44	5687.63	3018.18	3022.59	3213.76	5066.3	4075.1
Oct	3545.23	3648.68	4265.84	4766.53	6202.69	5178.45	3027.76	3333.54	3365.28	5211.14	3858.13
Nov	3634.08	3817.3	4924.38	4774.66	5916.25	4677.85	2862.42	3113.63	3680.4	4088.45	4098.24
Dec	3491.46	4038.23	5190.96	4839.75	6081.8	3742.08	2503.5	3555.5	3722.1	3479	4260.62

**Table 24 Volatility of Crude Oil Futures Contract**

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	1.0111	0.0436	0.0724	0.0531	0.0559	0.0729	0.0979	0.0846	0.0518	0.0975	0.0602

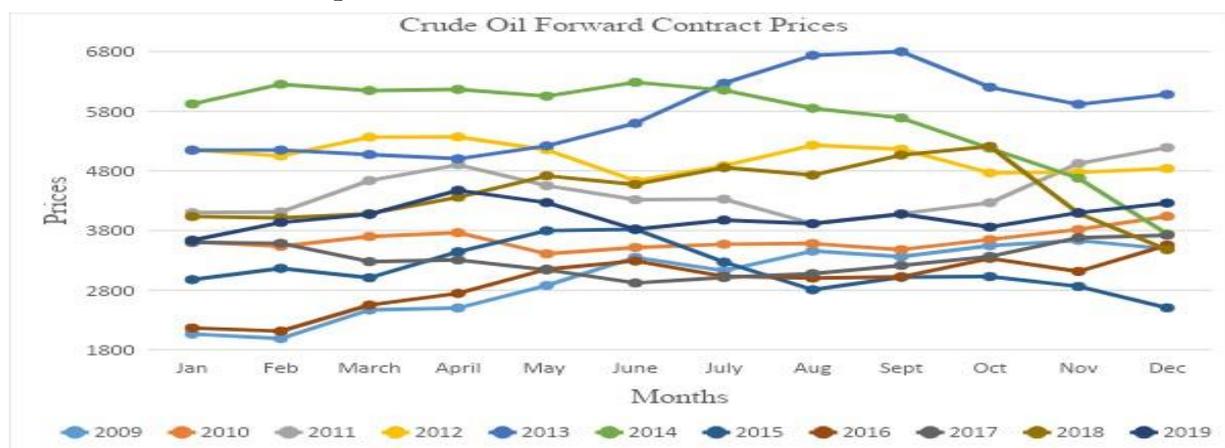
**Graph 12 Volatile Crude Oil Futures Contract Prices**

Table 23 and table 24 represents the closing prices of futures contract and volatility of prices of crude oil futures contract. The above graph 12 shown the volatility of crude oil futures contract. The prices were highly volatile over the period of study. Every year the prices

fluctuates and provide the benefit of investments.

### 1. Natural Gas:

The closing prices of natural gas futures contract and price volatility of futures contract for natural gas presented below for the analysis;

**Table 25 Monthly Closing Prices of Natural Gas Futures Contract**

Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Jan	248.33	258.24	204.73	139.94	183.11	281.68	184.11	150.7	225.56	198.37	199.68
Feb	215.87	242.71	184.04	125.86	178.67	322.52	171.72	131.99	195.42	172.57	192.87
March	206.15	196.62	183.7	116.87	206.68	273.77	172.71	122.14	197.25	176.19	196.35
April	181.54	182.98	191.16	107.5	228.86	279.17	163.17	134.76	206.64	179.88	185.03
May	190.32	192.04	196.07	136.97	224.21	269.36	182.78	140.92	208.88	192.18	182.18
Month	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
June	190.38	223.75	203.15	141.02	222.8	275.3	177.19	176.82	193.52	199.59	162.75
July	175.82	216.21	193.66	64.15	218.18	242.76	179.15	186.43	191.05	191.59	159.84
Aug	165.45	197.43	181.23	156.42	216.05	238.89	180.02	183.44	186.33	203.12	162.5
Sept	169.22	180.21	184.39	159.03	232.25	239.98	175.9	193.69	194.8	209.75	182.63
Oct	225.88	162.08	180.73	188.49	226.9	233.77	156.41	206.33	190.89	237.62	168.96
Nov	216.07	183.96	182.2	203.35	230.6	262.42	152.28	196.49	198.81	294.66	191.41
Dec	250.01	193.48	171.51	189.64	266	221.44	136.4	243.42	179.05	275.64	163.49

**Table 26 Volatility of Natural Gas Futures Contract**

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatility	0.1195	0.104	0.0458	0.464	0.0653	0.0958	0.0611	0.1062	0.0607	0.0897	0.082

**Graph 13 Volatile Natural Gas Futures Contract Prices**

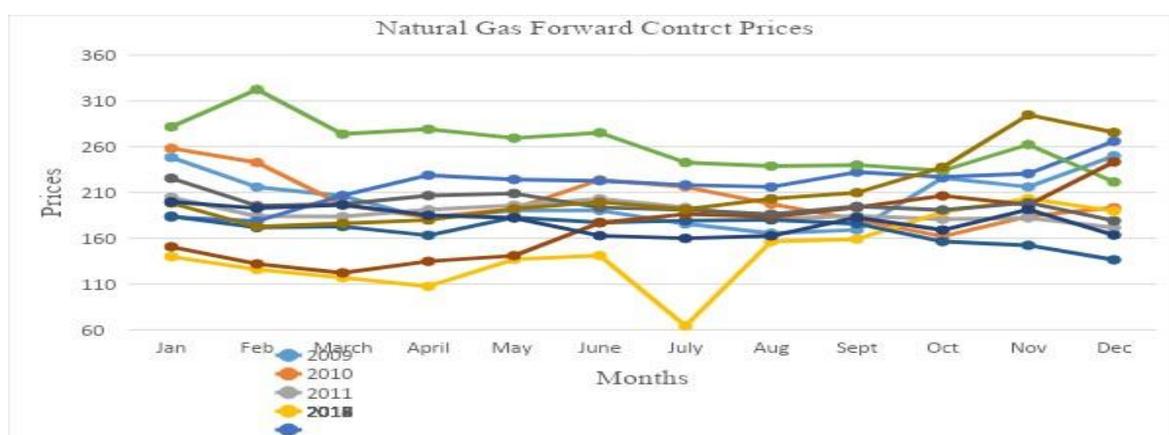


Table 25 and table 26 presents the closing prices of futures contract and volatility of futures contract of natural gas. The above graph 13 shown the volatility of natural gas futures contract prices. The volatility was higher in the year 2012 and in the 2014. In the year 2018 and 2019 prices were quite volatile. In the other year’s prices were quite stable and so there was less volatility measured. The above analysis of historical volatility helps in understanding the

nature of commodities. The historical method of volatility calculation gives an indication to the investors for the taking better decision regarding investment.

**14. RECOMMENDATIONS:**

After the detailed data analysis and findings regarding volatility and different factors affecting the commodity prices; the following

are the suggestions which may help the investors to better understand the commodity market in India and also guide how to invest their money to gain the maximum advantage of it.

- The commodity market in India started in long back, it was not very systematic market but it existed since thousands of years ago. The exchanges did on commodity market were not initially secured and only buyer and seller was involved so there was a high possibility of risk and default. But, over the period of time; the commodity market was formalized and third party as exchange was entered which takes guarantee of default and the transactions became more secured and safe.

- There are various commodity exchanges available in India but more popular exchanges. The investors should invest in commodities market to gain the benefits of the investment.

- MCX provides online trading in the different commodities. It is highly improvised and run through highly automated system. There are indices available on the MCX. The trading is supported by the different computerized mechanisms. The investor can do trading by their own at any time and place. The investor should take advantage of this system.

- The volatility is one of the best factor to understand and take benefit out of it. The volatility gives the proper understanding of prices of different commodities. Every investor should try to understand how this volatility works and how to take advantage of it.

- The volatility also helps in taking the hedging benefits as the price fluctuation benefits the investor for hedge. The hedging also helps in reducing the risk of losses in the investments.

- The analysis of different hypothesis which narrates the impact of global supply, global consumption, Indian Imports and spot prices on different commodities. These could be used for the investment purpose. While investing in particular futures contract; the investor should keep a check on factors affecting that particular commodity. The impact of such will help in reducing the risk of losses. The different economic parameters should also be taken care while investing in the commodities which have impact of such factors.

- Investment in commodity markets

also provides the benefits of portfolio diversification. Investors can diversify their investment through proper understanding of commodity markets. Commodity market investment diversifies the overall risk of the portfolio.

- India's commodity market is growing. Investment in this market will contribute to the country's economic development. The commodity market also linked with other international market which also gives the benefits of international markets.

## 15. SCOPE FOR FURTHER RESEARCH:

The present study includes the volatility calculations of prices of commodities futures contract and then testing the hypothesis which narrated the relationship of futures prices of commodity with the global supply, global consumption, Indian Imports and Spot prices of commodity. The present study is based on the selected commodities in each category of commodity. The further study can be extended with taking more commodities in each category.

In the present study historical volatility used for the volatility calculation. There are various other methods and models that can be used to calculate volatility. There are various other methods and models that can be used to calculate volatility. The further research can be possible with the use of other volatility calculation approaches and application of different models for volatility calculation. Multi Commodity Exchange of India (MCX) also provides various indices like rainfall index, MCX iCOMDEX, etc. The further study can also be possible with the help of this indices and how these indices perform.

## 16. CONCLUSION:

The commodity market is a key player in Indian economy. There are various other businesses also linked with the commodities, so prices of the commodity will help in identifying the cascading effect on the other related merchandises. The commodity market is an important indicator of economic development. The Multi Commodity Exchange of India provides online trading in different commodities and this will benefit the investors to enhance their investment horizon, taking the benefits of portfolio diversification and reducing the risk of losses. Moreover, the

knowledge of various economic parameters, and other related factors gave better investment opportunities to the investors. Thus, the better understanding of commodities, their market, and how their prices are fluctuating benefits the investors for better investment and reduction in losses.

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