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Futures Trading: Informational Content of Open Interest and Trading Volume on Futures Price

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Abstract

In an agriculture dominated country, like India, farmers face not only yield risk but price risk as well. Commodity futures market play major role in the price risk management process, especially in agriculture. This study empirically analyses the informational content of open interest and trading volume on futures price determination on the basis of selected agricultural commodities. Breusch-Godfrey Serial Correlation LM Test is used for analyzing the role of informational content of open interest and trading volume on futures price. Empirical result shown that open interest playing a major role in futures price determination on commodity futures trading. In case of trading volume, the results show that a significant negative impact on futures price. The study strongly argues that the stockholders will be benefited through informational content of open interest and volume there by reducing the risk involved in the futures market. By monitoring the price trend, volume and open interest the technician is better able to measure the buying or selling pressure behind market moves. This will provide traders with valuable information to develop a suitable pricing strategy and an appropriate production and marketing plan for producers farming.

Keywords: Futures price, Open interest, Trading volume, Regression, Breusch-godfrey serial correlation LM test, Informational content.

Contents

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1. Introduction

Country like India where agricultural production is heavily dependent on monsoon and agricultural output is prone to vary depending upon weather conditions. Hence, Price variability is one of the most important problems faced by agricultural farmers in India. Along with price variability, producers of agricultural commodities are expected to face high price risk. This unwanted risk again accelerated by the new economic reforms under World Trade Organization (WTO) policy regime. Consequently the government intervention is significantly declined in agricultural commodities market. As a result price of agricultural commodities are determined by market forces. In order to reduce these unwanted price risks, it requires a well-developed commodity derivatives market which will expect to function for over all benefit of the farmer as well as consumer. In order to manage price risk and discovering better price for commodities, derivatives entered into commodity markets. Since then, the commodity futures trading including agricultural futures have witnessed tremendous growth in terms of trading volume. The growth in trading volumes and with increasing integration of Indian economy with the rest of the world there was huge rise in prices of agricultural commodities. The rise in prices does not directly benefit to the farmers since there are a chain of intermediaries between the farmer and the ultimate consumer. The Government has therefore been strengthening its approach towards futures trading of agricultural commodities at times suspending or totally banning it (the futures trade) and at other times permitting it. After the removal of banning during 2008 there is a sharp decline in the trading volume of agricultural commodities. It is therefore necessary to conduct a study to find out whether the trading volume or open interest determines the price behavior of the futures contract. By using the informational content of open interest and trading volume of pepper and rubber in the futures contract, this study empirically analyzing these non- price variables has any relationship in the futures price determination.

2. Relationship between Futures Price, Open Interest and Volume

The concept of open interest represents all contracts outstanding given for a particular commodity (Hull, 2002). Outstanding refers to contracts which are not yet offset by a transaction (reversed out), by delivery, by exercise, etc. (CFTC, 2012).Open interest is defined as the number of contracts existing in a futures market that have not yet been closed out (Geman, 2005). Open interest is the total number of futures contracts that are not closed or delivered on a particular day. Open interest is a calculation of the number of active trades for a particular market. It is often used to confirm trends and reverse trend for futures contracts. The open interest situation is stated each day and represents the increase or decrease in the number of contracts for that day. Open interest increases when new market entrant (buyers and sellers) coming to the markets in greater number than current position holder going away the market. Open interest declines when current position holder exits their position in a greater number than new market entrants changed their position. It is remain unchanged when current position holder trades are balance by new market entrant traders. Open interest is an important indicator for hedging (Kamara, 1993) and market depth (Bessenbinder and Segain, 1993).Open interest collective with price provides understanding about the leading market.

The volume offers information about market liquidity (the higher the volume, the higher its liquidity). It is possible for the volume traded to exceed the open interests at the end of the day (Hull, 2002).Volume measures the forces or strength behind a price trend. Volume describes the total amount of trading goings on or contracts that have changed hands in a given commodity market for a single trading day. The greater is the amount of trading, the higher will be the trading volume (Geman, 2005). Thus, volume represents a measure of strength or pressure behind a price trend. The greater is the volume, the more likely will the existing trend continue. Volume and open interest help investors find evidences to market movement and strengthen the chances of improving their financial position.

3. Literature Review

Studies regarding to the information content of open interest and volume for futures price in commodity futures market is limited. Franken and Parcell (2003) examined the relationship between closing price and open interest in Indian stock index futures market. The results show that the information of open interest can be used to predict future prices in the long run. Moreover, the long-run information role of open interest is a good indicator for the usefulness of technical analysis in markets**.** Bhuyan and Chaudhury (2005) investigated whether options open interest contains information that can be used for trading purposes. Regression results indicate that the prediction of stock price movement based on the distribution of options open interest to have reasonably good accuracy. The open interest based active trading strategies generate better returns compared to the passive benchmarks. Srivastava (2003) used data from November2002 to February 2003 on 15 most liquid stocks of NSE and options on them and analysed, using the methodology developed by Bhuyan and Chaudhury (2005) the power of open-interest and volume to predict the underlying spot price. He found both the variables to have significant explanatory power, while open-interest being more significant. Pathak and Rajesh (2010) study shows that both net open interest and trading volume are relevant for the futures return. Brieden and Lunn (2009) investigated the effects of open interest and trading volume on the future stock price for the SPX index derivative market and found that the open interest variables were significant and the trading volume variables were not. Gulati (2012) examined the relationship between closing price and open interest in Indian stock index futures market. The evidence of Granger Causality shows that the information of open interest can be used to predict future prices in the long run. Moreover, the long-run information role of open interest is a good indicator for the usefulness of a technical analysis in future markets. Suhashini and Chandrasekar (2013) empirically tested the price, volume and open interest for futures currency pairs. They tested the relationship between change in future return on change in volume, change in volume on change in open interest, change in future price on change in spot price by Granger Causality test. The results show that most of the variables have bidirectional causality at all lags and some have unidirectional causality.

4. Data and Methodology

The present study empirically examines the importance of open interest and trading volume on futures price determination. Open interest, trading volume and futures price data of rubber and pepper collected from historical data set of NMCE (National Multi Commodity Exchange) Kochi and NCDEX (National Commodity & Derivatives Exchange Limited). Period taken for the study for rubber is from January 1, 2008 – 14 September 2013 and for pepper January 2008 to December 2013. The present study makes use of OLS (Ordinary Least Square) methods to carry out the empirical analysis.

We use the following methodology for our empirical analysis: First we calculate the descriptive statistics for all the variables. In order to examine the informational content of open interest and trading volume on futures price OLS method is used. Before going to use OLS technique one should test the stationary properties of the variable in the case of time series data. As our data is time series in nature, the study needs to test stationarity property of the variables using unit root test, namely Dickey and Fuller (1979) unit root test to avoid the spurious regression results.

Time series stationarity is a statistical characteristic of a series' mean and variance over time. If both are constant over time, then the series is said to be a stationary process (i.e. is not a random walk/has no unit root), otherwise, the series is described as being a non-stationary process (i.e. a random walk/has unit root). Differencing techniques are normally used to transform a time series from a non-stationary to stationary by subtracting each datum in a series from its predecessor. For our purpose here, since we will difference our series once, there is one unit root, so it is I (1) series. The commonly used methods to test for the presence of unit roots are the Augmented Dickey-Fuller (ADF) tests (Dickey and Fuller, 1979). The test is as follows:

$$\Delta Y_t = \beta_1 + \beta_2 t + \propto Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + u_t \qquad (1)$$

Where Δ is difference operator, β_1 the intercept, t is time or trend value (t=1, 2, 3, . . .,T) that Y_t contain. This we added to the equation as a variable with coefficient.Y_{t-1} is lag of dependent variable which included in the equation to avoid the problem of serial correlation. Here u_t is error term and $\propto$ is coefficients of dependent variable. The null hypothesis is that Y_t contain a unit root (non-stationary) and the alternative hypothesis is that Y_t is stationary. The decision rule of Dickey Fuller test is based on the estimate of $\propto$. If the estimated $\propto$ is statistically less than zero then we reject null hypothesis of non-stationarity. If the estimated $\propto$ is not significantly less than zero, then we can't reject null hypothesis of non-stationarity. The criterion of selection for unit test is that the absolute value of the test statistics should be higher than the critical absolute value (Dickey and Fuller, 1979) and p-value of the test is less than 5 per cent significance level.

The model hypotheses are:

H_O: $\propto$=1(Nonstationary)

H_1: $\propto$< 1(Stationary)

5. Regressions

The following equation is used as the basic model to show the informational content of open interest and trading volume on futures price.

Futures price = f (open interest, trading volume)

The following model is specified to measure the informational content of both variables on futures price. We estimate this by ordinary least squares (OLS) techniques which can be written as:

$$FP_t = \beta_1 + \beta_2 OI_t + \beta_3 VOL_t + v_t \qquad (2)$$

Where, FP_t dependent variable of futures price of pepper and rubber , OI_t explanatory variables of open interest of pepper and rubber, VOL_t explanatory variables as trading volume of pepper and rubber, v_t is error term, t the subscript will denote the t^{th} observation, β_1 the intercept, β_2, β_3 coefficients of variables. Equation (2) gives the effect of explanatory variables such as open interest and trading volume of pepper and rubber on futures prices of pepper and rubber.

5.1. Empirical Results

This section presents the analysis of the empirical results and its discussion. The result is based on OLS regression analysis. Before going to use the regression technique, the present study used to examine the descriptive statistics of the variables. After that the stationary property of the time series data has been calculated. Summary statistics of the data used for analysis is given in Table1.

Table-1. Descriptive Statistics

	FPRUBBER	OIRUBBER	VOLRUBBER	FPPEPPER	OIPEPPER	VOLPEPPER
Mean	16411.82	1233.521	1090.671	1533.773	2609.127	23720.33
Maximum	26162.00	5412.000	11574.00	19421.00	12172.00	44660.00
Minimum	6210.000	0.000000	2.000000	0.000000	0.000000	9842.000
Std.Dev.	4647.192	1136.549	1304.852	2568.224	3062.906	10696.99
Skewness	-0.344062	1.242208	2.044990	2.843740	1.237546	0.421089
Kurtosis	2.258570	4.421453	8.861189	12.86004	3.385242	1.632109
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Observation	1535	1535	1535	1650	1650	1650

Source: Author calculation based on NCDEX and NMCE price data

The summary statistics shows that mean values of the FPRUBBER, OIRUBBER, VOLRUBBER, and FPPEPPER are similar to some extent but OIPEPPER and VOLPEPPER found larger. The variability of the variables is measured by standard deviation. Here the variability among the variables are quite differs from each other. The maximum and the minimum values show the range in between which the values of the variables are lying. The value of skewness and kurtosis for trading volume, open interest and futures price of rubber and pepper

displayed some interesting characteristics. Skewness helps us to determine the nature and extent of the concentration of the observations towards the highest or the lowest values of the variables. The negative skewness implies that the FUPEPPER have a heavier tail of large values which indicates that the frequency curve of the distributions is little bit symmetric bell shaped curve. Here the skewness values of all other variables are positive. If they are stretched more to the right side or have a longer tail towards the right side which show all are positively skewed. Kurtosis is concentrated with the flatness or peakedness of the frequency curve. Here the value of kurtosis exceeds 3, for OIPEPPER, OIRUBBER, FUPEPPER, VOLRUBBER which is indicates that variable has platy kurtic while variables FPRUBBER and VOLRUBBER is less than 3 which indicate that variable is leptokurtic (more peaked than normal curve).

Table-2. ADF unit root Test result

Augmented Dickey Fuller Unit Root Test **Exogenous: Constant, Linear Trend, Lag Length: 2 (Automatic - based on SIC, maxlag=2)**		
Variables	**Statistics**	**p value**
DFPRUBBER	38.77130	0.0000
DFPPEPPER	38.89092	0.0000
DOIRUBBER	14.87354	0.0000
DOIPEPPER	40.89435	0.0000
DVOLRUBBER	35.18521	0.0000
DVOLPEPPER	34.94995	0.0000

Note: 1.DFPRUBBER and DFPPEPPER represents differentiated futures price of rubber and pepper
2. DOIRUBBER and DOIPEPPER represent differentiated open interest of rubber and pepper
3. DVOLRUBBER and DVOLPEPPER represent differentiated trading volume of rubber and pepper

Each series are stationary after differentiating. The p-values are statistically significant and we can conclude that each of the price series is I (1), hence reject the null hypotheses and accept the alternative hypotheses data is stationary and proceeded to the next step of regression analysis.

Empirical result obtained from ordinary least square method is not considered as good one because of low value of the R^2 (0.099925) and adjusted R^2(0.098750) means that model is not fit. Durbin-Watson d-statistics is low (Enders, 2004) which shows that existence of auto-correlation problem in the model.

The result which is drawn from the simple OLS technique can't be considered as good one. The overall goodness of fit of the regression model is measured by the coefficient of determination, R^2. It tells what proportion of the variation in the dependent variable is explained by the explanatory variable. If R^2 lies between 0 and 1; the closer it is to 1, the better is the fit of model but here it is too low (0.099925 and 0.098750) and the tested regression is statistically not significant.

Table-3. Informational Content of Open Interest and Trading Volume on Futures Price of Rubber

Dependent Variable: DFPRUBBER, Included observations: 1535			
Variables	**Coefficient**	**Std. Error**	**Prob.**
C	15417.09	166.3964	0.0000
DOIRUBBER	-0.381573	0.144078	0.0082
DVOLRUBBER	1.343589	0.125495	0.0000
R-squared 0.099925, Adjusted R-squared 0.098750, F-statistic 85.04041, Prob(F-statistic 0.000000, Durbin-Watson stat 0.066250, Akaike info criterion 19.62389, Schwarz criterion 19.63432			

For p value: at 1 per cent level is 0.01; 5 per cent level is 0.05

The standard error in this model is relatively large which indicates that presence of multicolinearity. But here cannot detect the problem of multicolinearity because only two independent variables are exists. Hence check the problem of autocorrelation affecting the model or not. To assess serial correlation Breusch-Godfrey LM test is used.

5.2. Breusch-Godfrey Serial Correlation LM Test

Statisticians Breusch and Godfrey (BG) have developed a test of autocorrelation it allows the lagged values of the regressand; higher-order autoregressive schemes i.e., AR (1), AR (2) etc., and simple or higher-order moving averages of error terms, such as u_t. Lagrange Multiplier (LM) test of autocorrelation analyzing how well the lagged residual explain the residual of the original equation. If lagged residuals are significant in explaining this times residuals on the basis of chi-square then we can say there is no serial correlation. If sample size is large, Breusch Godfrey LM test based on $N*R^2$ follow a chi-square. $N*R^2$ exceeds the critical value at the chosen level of significance, and then it indicates there is serial correlation exist.In serial correlation the value of error terms in one time period depends on some systematic way on the value of the error term in other time periods. In regressions involving time series data, successive observations are likely to be interdependent. We experience autocorrelation when $E(u_iu_j) \neq 0$, no autocorrelation between the error term if given any two X values, X_i and X_j (i =j), the correlation between any two error term u_i and u_j(i =j) =0.

The regression model to illustrate for the test is as follows:

$$FP_t = \beta_1 + \beta_2 OI_t + \beta_3 VOL_t + u_t \quad (3)$$

$$u_t = \alpha_1 u_{t-1} + \alpha_2 u_{t-2} + \ldots\ldots\ldots + \alpha_p u_{t-3} + \varepsilon t \quad (4)$$

Where, FP_t is futures price of pepper and rubber, OI_t open interest of pepper and rubber VOL_t trading volume of pepper and rubber u_t error term, β_1 intercept β_2, β_3 is coefficients of independent variables,u_{t-1}, u_{t-2}, u_{t-3} = lagged values of error termα_1, α_2, α_3, $\alpha_p$are coefficient of error term and ε_t is residuals of error term. The model (4) assumes if α_1, α_2,

$\alpha_{3,\ \ldots.}\alpha_p = 0$ indicate that the error terms between two the series are equal to zero or there is no serial correlation exist between series.

Table-4. Breusch-Godfrey Serial Correlation LM (BG) Test

Dependent variable Dfprubber ,Included observations: 1535			
Obs*R-squared 1469.415	**Prob. Chi-Square(2) 0.0000**		
Variable	**Coefficient**	**Std. Error**	**Prob.**
C	6.270884	34.41754	0.8554
DOIRUBBER	0.553206	0.030115	0.0000
DVOLRUBBER	-0.631578	0.026400	0.0000
R-squared 0.957274, Adjusted R-squared 0.957162, F-statistic 8569.879, Prob(F-statistic) 0.000000, Akaike info criterion16.47355, Schwarz criterion16.49094, Durbin-Watson stat1.440659			

For p value: at 1 per cent level is 0.01; 5 per cent level is 0.05

The result which is drawn from the BG LM test is considered as good one in comparison to the simple OLS method. The serial correlation causes OLS to produced incorrect standard error, and R^2 value. In this model observed R square and corresponding probability chi-square values are statistically significant specify that there is no serial correlation in the model. R square (0.957274) and adjusted R^2(0.957162) are nearer to 1 which shows the goodness of fit of the model. The R^2 or coefficient of determination is included to represent how much variation in the dependent FP_t variable is captured by the regression. Both Akaike Info Criterion (AIC) and Schwarz Info Criterion (SIC) which are used for the selections of better model, (penalize for introducing more regressors in the model). Suggest that this model is better, the lower the value of SIC and AIC, the better the model (Gulati, 2012) as AIC and SIC have values 16.473 and 16.490 for the BG model as compared to 19.623 and 19.634 for the simple OLS model. Therefore, we consider the regression results of Table 4 for our analysis, as the estimated regression results satisfy all the criteria for a good model. The estimated regression test result value helps in examining the informational content of open interest and volume for discovering price.

From the above BG LM test both variables have mutual impact on the futures price. The coefficient value (0.553206) of open interest is statistically significant at 1 per cent(0.0000) level, which indicates information content of open interest is significant impact on futures price while trading volume has insignificant or negative (-0.631578) impact on futures price of rubber. Next, we estimated the equation with Ordinary Least Square (OLS) method to find out the informational content of open interest and trading volume for futures price of pepper during the period of study. Here, DFUPEPPER is considered as dependent variable. But the result is not quite good because of low value of R^2 and adjusted R^2 and low value of the Durbin-Watson statistics which shows the existence of auto-correlation problem.

Table-5. Informational Content of Open Interest and Volume for Futures Price of Pepper

Dependent Variable: DFUPEPPER, Included observations: 1650			
Variables	**Coefficient**	**Std. Error**	**Prob.**
C	26143.39	333.2566	0.0000
DOIPEPPER	-1.275191	0.125509	0.0000
DVOLPEPPER	0.589442	0.149684	0.0001
R-squared0.075637, Adjusted R-squared 0.0745F-statistic67.38341, Prob(F-statistic)0.000000, Akaikeinfocriterion21.31769, Schwarz criterion 21.32753, Durbin-Watson stat 0.015140			

For p value: at 1 per cent level is 0.01; 5 per cent level is 0.05,

The simple OLS technique can't be considered as good one. Here p-values of open interest and trading volume are statistically significant. Though the values of both R^2 and adjusted R^2 is very low which show our model is not fit, at the same time the Durbin-Watson (DW) statistic is very low i.e. 0.015140 which indicate the presence of auto-correlations. To solve the problem of auto-correlation of error term, we have allowed a Bruesch Godfrey model of test. The result of the OLS technique with BG test is presented in Table 6.

Table-6. Breusch-Godfrey Serial Correlation of Pepper

Dependent Variable: DFUPEPPER: Included observations: 1650			
Obs*R-squared 1628.743	**Prob. Chi-Square(2) 0.0000**		
Variable	**Coefficient**	**Std. Error**	**Prob.**
C	-123.9748	37.89798	0.0011
DOIPEPPER	0.192413	0.014319	0.0000
DVOLPEPPER	-0.242177	0.017033	0.0000
R-squared 0.987117,Adjusted R-squared0.987085,F-statistic31509.97,Prob(F-statistic)0.000000,Akaike info criterion16.96829, Schwarz criterion16.98468, Durbin-Watson stat1.634313			

For p value: at 1 per cent level is 0.01; 5 per cent level is 0.05

Breusch Godfrey LM test for serial correlation on the basis of lagged values of error terms. It is tested on the basis of observed R square and p values of the chi-square. Here the observed R Square and chi square values are significant at 1 per cent and we can say that there is no auto correlation among variables. The values of both R^2 and adjusted R^2 are nearer to 1(0.987117 and 0.987085) which shows the goodness of fit or overall fitness of model. Both

Akaike Info Criterion (AIC) and Schwarz Info Criterion (SIC) which are used for the selections of better model suggest that the BG model is better as AIC and SIC have values 16.968 and 16.984 for the BG model as compared to the simple OLS model (21.31769,21.32753). The p value and corresponding F-statistics (0.0000) are significant which measure the overall significance of the estimated regression. Therefore, we consider the BG LM model reported in Table 6 for our analysis. The estimated regression test result value helps in examining the informational content of open interest and volume for futures price.

The regression result of Table 6 shows that information content of open interest of pepper (OIPEPPER) playing a major role for determining futures price of pepper. The positive sign of coefficient and significant p-value shows that impact of open interest is higher compared to trading volume. On the other hand the estimated coefficient of trading volume is negative impact on futures price. Estimated p value and F statistics indicate that the overall fit of the model. R^2 and adjusted R^2 indicate that in case of futures price of pepper almost completely explained by the independent variables included in the model.

Regression coefficients specify that information content of open interest has a positive relation to determine futures price whereas trading volume has a negative impact. Trading volume and open interest relationship provides insights into the structure of markets and is crucial to the debate regarding the distribution of speculative prices as the dominance of speculators and the presence of hedging and arbitrage activity. To understanding the value of open interest and volume one can often make profit in the futures market. When we compare the information content of open interest and trading volume on futures price, it is observed that both of them have statistically significant power (0.0000) to determine the futures price but coefficient shows that open interest has higher role. Therefore the study strongly argues that the stockholders will be benefited through informational content of open interest and volume there by reducing the risk involved in the futures market. By monitoring the price trend, volume and open interest the technician is better able to measure the buying or selling pressure behind market moves. The number of open positions in the market is measured in terms of open interest, thus the open interest in a contract tells us about the popularity of the trend in the market. This information can be used to confirm a price move is to be trusted or that a price move is not to be trusted. This will provide traders with valuable information to develop a suitable pricing strategy and an appropriate production marketing plan for producers farming

6. Conclusions

This study makes an empirical analysis on the informational content of open interest and trading volume on commodity futures price determination on the basis of pepper and rubber. The study uses BG LM test technique for its empirical analysis. The result states that information content of open interest has significant positive impact on both the futures price of pepper and rubber during the study period. In case of trading volume, the results show that it is significant but its impact on futures price is negative. There are many reasons that traders pay attention to futures price and open interest. Open interest, or the total number of open contracts, applies primarily to the futures markets. It is often used to confirm trends of futures contracts. An increase in open interest along with an increase in price is said to confirm an upward trend, while an increase in open interest along with a decrease in price confirms a downward trend. Open interest depends on the futures price movements that have captured all relevant information about hedgers and speculators. Volume and open interest help investors to find evidences on market movement and strengthen the chances of improving their financial position. Therefore the study strongly argues that the stockholders will be benefited through informational content of open interest and trading volume there by reducing the hedge involved in the futures market. The price-trading volume, and open interest relation, is important as it provides insights to the structure of markets and is crucial to the debate regarding the distribution of speculative prices as the dominance of speculators and the presence of hedging and arbitrage activity. To understanding the value of open interest and volume one can often make profit in the futures market. In this empirical analysis the positive sign of open interest said that more traders are actively participating in the futures market of pepper and rubber. Open interest is determining the future price in futures contracts. By monitoring the price trend, volume and open interest the technician is better able to measure the buying or selling pressure behind market moves. This information can be used to confirm a price move or advise that a price move is not to be trusted. This will provide traders with valuable information to develop a suitable pricing strategy and an appropriate production-marketing plan for producers farming operation. But theoretical study on the relationship between futures price, open interest and trading volume is limited and is a sturdy area for future research.

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