IMPACT OF FUTURES TRADING ON VOLATILITY IN SPOT AND FUTURES PRICES OF AGRICULTURAL COMMODITIES IN INDIA

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Abstract: The agricultural product's prices are highly volatile. There is considerable time lag between the time of initial spending and procuring of receipts from the final farm produce. A farmer is highly susceptible to price fluctuations of both farm produce as well as farm inputs. Traditionally, this risk is borne mainly by the producer (sometimes by the government) more than the consumer for a variety of reasons. It has made farmers look for alternatives to mitigate the risk. Futures market is one such option. The present study was carried out on NCDEX. The daily spot and futures price data of selected agricultural commodities were obtained from the website of National Commodity and Derivative Exchange (NCDEX), Mumbai. Three commodities *viz.* wheat, refined soy oil and chana were studied for a period of nine years from year 2004 to 2012 as per the availability of data. Auto Regressive Conditional Heteroskedasticity (ARCH) and Generalised Auto Regressive Conditional Heteroskedasticity (GARCH) model were used to achieve the objective of the study. Major findings of the study revealed that, the spot and futures price series of wheat and refined soy oil were significantly volatile. While, that of chana, spot price was found to be non-significant and hence stable, while futures price was found significant and volatile.

Keywords: ARCH, GARCH, NCDEX, Spot prices, Futures prices

INTRODUCTION

Post independence, agriculture became a vibrant sector of the economy. Green revolution technology was introduced in mid 1960s, which, by 1990s spread to almost all parts of the country depending upon the conditions suitable for adoption of such technology. The contribution of agriculture and allied sector was estimated to be 13.9 percent in the Gross Domestic product (GDP) during the fiscal year 2011-12 (Economic Survey, 2012-13). But in any agriculture-dominated economy, like India, farmers face not only yield risk but price risk as well. Over past two decades, farm produce prices have been more volatile than the prices of manufactured goods.

A central problem of agricultural markets in India has been price instability which has a negative impact on economic growth, income distribution, and on the poor (Srikanth T. and Rani A.R. 2007). The uncertainty of commodity prices leaves a farmer open to the risk of receiving a price lower than the expected price for his farm produce. Globally, futures contracts have occupied a very important place to cope this price risk. Many countries have been establishing and promoting commodity futures markets. At present, the futures and derivatives segment is growing at an exponential rate, which is a positive sign of development (Easwaran and Ramasundaram, 2008).

Futures trading perform two important functions of price discovery and risk management with reference to the given commodity. It is useful to all segments of the economy. It is useful to producer because he can get an idea of the price likely to prevail at a future point of time and therefore can decide between various competing commodities, the best suits him. Farmers can derive benefit from futures markets by participating directly/indirectly in the market to hedge their price risks and to take benefit of prices discovered on the platform of commodity exchanges by taking rational and well informed cropping/marketing decisions (Anonymous, 2008). The National Agricultural Policy 2000 (NAP), sought to "enlarge the coverage of futures markets to minimize the wide fluctuations in commodity prices as also for hedging their risk". It is also observed that commodities futures have been less volatile compared with equity and bonds, thereby providing an efficient portfolio diversification option (Sairam A. and Pasha M.F., 2008).

Rationale and Objective

The possibility of adverse price change in futures increase the risk involved in any business. It has been forcefully argued that futures markets are dominated by speculative interests and farmers are not direct participants, so price rise can partially attributed on such trading, which leads to high price volatility. It is being expected that the futures trading has made significant impact on the volatility of the spot and futures prices over period. Research in this area is still in a very nascent stage in the country. Keeping this in view, the present study were undertaken to know the volatility in spot and futures prices of selected agricultural commodities. This is important to see, whether futures trading is really volatile the spot and futures prices?

METHODOLOGY

The study was conducted on secondary data. The daily spot and futures prices of selected agricultural

commodities were obtained from the website of NCDEX, Mumbai, from 2004 to 2012.

Keeping in view the importance of commodities from both uses as well as futures trading point of view, commodities were selected for the study.

Wheat is one of the most important food crop of India as well as world and it also have maximum value of futures trading in NCDEX among the all cereals food crops. It has 20.35 lakh tonnes by volume which has 2401.69 Rs. Crore value of trade up to January 2012 in financial year 2011-12. Main Delivery centre of wheat is Delhi, it is also delivered at some centre namely Ahmedabad, Bareilly, Indore, Itarsi, Kanpur, Karnal, Khanna, Kota, Moga, Rajkot, Shahjahanpur and Sirsa etc.

Refined soy oil was chosen for the purpose of study because, again it is very important from domestic consumption as well as futures trading point of view. Refined soy oil has maximum value of trade among all the edible oils in NCDEX. It has 613.02 lakh tonnes by volume which has value of 402028.75 Rs. Crore up to January 2012 in current financial year 2011-12. Delivery centre of soy oil is Indore (M.P.).

Chana was chosen for the purpose of study because it is a very important pulse crop of India. Chana shows maximum futures trade among all the pulse crops and in the financial year 2011-12, up to January, 2012 the volume of trade is 769.28 lakh tonnes and value is 241085.75 Rs. Crore. Main delivery centre is Delhi and it is also deliverable at Indore and Bikaner.

So, all the selected commodities have maximum trade in their respective group i.e. cereal, edible oils and pulses not only current financial year but previous years also.

Analytical Framework

Volatility was measured using the univariate ARCH-type models. Autoregressive Conditional Heteroskedasticity (ARCH) models are specifically designed to model and forecast conditional variances. The variance of the dependent variable is modelled as a function of past values of the dependent variable and independent or exogenous variables.

ARCH models were introduced by Engle (1982) and generalised as GARCH (Generalised ARCH) by Bollerslev (1986). These models are widely used in various branches of econometrics, especially in financial time series analysis.

The ARCH specification

In developing an ARCH model, one has to provide two distinct specifications one for the conditional mean and one for the conditional variance.

In this study, the GARCH (1, 1) model was used, which is as follows:

In the standard GARCH (1, 1) specification:

$Z_t = \gamma_0 + \varepsilon_t$ ….. (1)

$\sigma_t^2 = \omega + \alpha e^2_{t-1} + \beta \sigma^2_{t-1}$ ..... (2)

The mean equation given in equation (1) is written as a function of exogenous variables with an error term. Here dependent variable is spot or futures price i.e. Z_t.

Since σ_t^2 is the one-period ahead forecast variance based on past information, it is called conditional variance. The conditional variance equation specified in equation (2) is a function of three terms:

1) The mean: **ω**
2) News about volatility from the previous period, measured as the lag of the squared residual from the mean equation: e^2_{t-1} (the ARCH term)
3) Last period's forecast variance: σ^2_{t-1} (the GARCH term)

The (1, 1) in GARCH refers to the presence of a first-order GARCH term (the first term in parentheses) and a first-order ARCH term (the second term in parentheses). An ordinary ARCH model is a special case of a GARCH specification in which there are no lagged forecast variances in the conditional variance equation.

RESULT AND DISCUSSION

Generally, volatility refers to the fluctuation in prices of commodities/goods. In agricultural commodities, volatility originates mainly from supply disturbances. These disturbances coupled with short-run demand and supply elasticities give rise to acute price fluctuations. In this study, it was measured using the univariate ARCH-type models. The results of volatility analysis using the univariate ARCH-type model for the selected agricultural commodities are:

Table 1: Auto Regressive Conditional Heteroskedasticity (ARCH) with spot price as dependent for wheat

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	0.000731	0.000333	2.191322	0.0284
Variance Equation				
C	3.93E-06	9.93E-07	3.959964	0.0001
RESID(-1)^2	**0.885162**	0.326836	2.708280	0.0068
GARCH(-1)	**0.494815**	0.086843	5.697814	0.0000
R-squared	-0.001296	Mean dependent var		0.000364
Adjusted R-squared	-0.001296	S.D. dependent var		0.010196
S.E. of regression	0.010203	Akaike info criterion		-6.804190
Sum squared resid	0.129282	Schwarz criterion		-6.787696

Log likelihood	4232.804	Hannan-Quinn criter.	-6.797988
Durbin-Watson stat	1.632321		

Table 2: Auto Regressive Conditional Heteroskedasticity (ARCH) with futures price as dependent for wheat

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	0.001525	0.000282	5.414027	0.0000
Variance Equation				
C	9.26E-06	2.83E-06	3.272661	0.0011
RESID(-1)^2	**1.991418**	0.569918	3.494221	0.0005
GARCH(-1)	**0.202725**	0.063827	3.176161	0.0015
R-squared	-0.008723	Mean dependent var		0.000285
Adjusted R-squared	-0.008723	S.D. dependent var		0.013277
S.E. of regression	0.013335	Akaike info criterion		-6.573408
Sum squared resid	0.220859	Schwarz criterion		-6.556915
Log likelihood	4089.373	Hannan-Quinn criter.		-6.567206
Durbin-Watson stat	2.081684			

Table 1 and Table 2 are showed the univariate GARCH (1, 1) parameters for the mean and variance equations of spot and futures price of wheat. The tables were divided into two panels, upper panel represent the mean equation and lower panel represents the variance equation of model. In above tables, sum of the coefficient of ARCH (α) and GARCH (β) terms for spot and futures series were 1.38 and 2.19 respectively which were greater than one and hence, significant. So, we can conclude that both spot and futures series were highly volatile during the period under study.

Table 3: Auto Regressive Conditional Heteroskedasticity (ARCH) with spot price as dependent for refined soy oil

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	-0.000622	0.000334	-1.860141	0.0629
Variance Equation				
C	4.41E-06	2.87E-06	1.537217	0.1242
RESID(-1)^2	**0.730046**	0.405885	1.798651	0.0721
GARCH(-1)	**0.571676**	0.072042	7.935262	0.0000
R-squared	-0.005223	Mean dependent var		0.000194
AdjustedR-squared	-0.005223	S.D. dependent var		0.011292
S.E. of regression	0.011321	Akaike info criterion		-6.699172
Sum squared resid	0.256476	Schwarz criterion		-6.687980
Log likelihood	6709.872	Hannan-Quinn criter.		-6.695063
Durbin-Watson stat	1.784376			

Table 4: Auto Regressive Conditional Heteroskedasticity (ARCH) with futures price as dependent for refined soy oil

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	9.41E-06	2.31E-05	0.407914	0.6833
Variance Equation				
C	6.28E-07	2.97E-08	21.14934	0.0000
RESID(-1)^2	**0.883781**	0.064894	13.61889	0.0000
GARCH(-1)	**0.105816**	0.043295	2.444084	0.0145
R-squared	-0.003451	Mean dependent var		0.000193
AdjustedR-Squared	-0.003451	S.D. dependent var		0.003123
S.E. of regression	0.003128	Akaike info criterion		-9.626985
Sum squared resid	0.019581	Schwarz criterion		-9.615793
Log likelihood	9640.612	Hannan-Quinn criter.		-9.622876
Durbin-Watson stat	0.205816			

Table 3 and Table 4 are showed the univariate GARCH (1, 1) parameters for the mean and variance equations of spot and futures price of soy oil. In the above tables sum of the coefficient of ARCH (α) and GARCH (β) terms for spot and futures series were 1.30 and 0.99 respectively, which were greater than one and nearer to one and hence, significant. So, we can conclude that both spot and futures series are volatile during the period under study, but spot price series was more volatile than futures price series.

Table 5: Auto regressive conditional heteroskedasticity (ARCH) with spot price as dependent for chana

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	0.000630	0.000319	1.975480	0.0482
Variance Equation				
C	3.51E-05	3.95E-05	0.887848	0.3746
RESID(-1)^2	-0.002113	0.041395	-0.051041	0.9593
GARCH(-1)	0.850065	0.233773	3.636290	0.0003
R-squared	-0.000318	Mean dependent var		0.000377
Adjusted R-squared	-0.000318	S.D. dependent var		0.014205
S.E. of regression	0.014207	Akaike info criterion		-5.661438
Sum squared resid	0.377456	Schwarz criterion		-5.649607
Log likelihood	5300.276	Hannan-Quinn criter.		-5.657079
Durbin-Watson stat	1.898771			

Table 6: Auto regressive conditional heteroskedasticity (ARCH) with futures price as dependent for chana

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	0.000239	4.99E-05	4.793075	0.0000
Variance Equation				
C	1.93E-06	1.13E-07	17.06303	0.0000
RESID(-1)^2	0.993015	0.093032	10.67389	0.0000
GARCH(-1)	0.011978	0.048205	0.248472	0.8038
R-squared	-0.000667	Mean dependent var		0.000350
Adjusted R-squared	-0.000667	S.D. dependent var		0.004303
S.E. of regression	0.004304	Akaike info criterion		-8.692153
Sum squared resid	0.034640	Schwarz criterion		-8.680321
Log likelihood	8135.509	Hannan-Quinn criter.		-8.687794
Durbin-Watson stat	0.190824			

Table 5 and Table 6 are showed the univariate GARCH (1, 1) parameters for the mean and variance equations of spot and futures price of chana. In above tables, sum of the coefficient of ARCH (α) and GARCH (β) terms for spot and futures series were 0.85 and 1.00 respectively. Out of which value of futures price series are greater than one and hence, significant, while value of coefficient for spot price series was less than one and hence, non significant. This implies that spot series was not volatile and futures series was volatile during the period under study. Volatility increases the price risk faced by the farmers and other market participants. It can be reduced by adopting the hedging option provided by the futures trading mechanism on one hand and reducing supply side constraints on the other.

Bharadwaj and Vasisht (2009) also obtained similar results while studying price volatility in the spot and futures market of gram. The univariate GARCH (1, 1) parameters for the mean and variance equations of spot price of gram crop showed a value of 0.57, which was relatively smaller than the value obtained in the futures price series. It meant that spot price was less volatile as compared to futures price.

CONCLUSIONS AND POLICY IMPLICATIONS

Finding of the study showed that, the both spot and futures prices are volatile, it may be due to another reason, because period of the study was very short, in which, to measure the real effect of futures trading was very difficult. Volatility in the prices may be due to some other general factors like supply side, international trade and growth of economy.

Hence, the hypothesis that there is no volatility in the spot and futures prices of selected agricultural commodities was not rejected in chana for spot price

series. But, it was rejected in the other two commodities *viz.* wheat and refined soy oil, and also for futures price series of chana. This implies that, there was volatility in the prices even after futures trading, but risk arise due to the price volatility can be minimize through hedging option provided by futures trading. The allegation that introduction of futures trading has led to inflation in agricultural commodity prices has been proved to be false in the above analysis in keeping with the findings of Sen Committee constituted in 2008 for studying the impact of futures trading on agricultural commodity prices. Hence, the prohibition on futures trading in cereals and pulses should be lifted. Price risk can be minimized, if farmers will be used hedging option provided by the futures trading.

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