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**Short Research Article**

# A Study on Growth and Volatility in Cash and Futures Market of Castor in India

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**Abstract**

This study has analyzed the growth and volatility in cash/spot and futures prices of castor. The time series data on WPI (Wholesale Price Indices) were obtained from office of Economic Advisor, Govt. of India for a period of 1994-2013 and the data on spot and futures prices were collected from NCDEX (National Commodity Derivative Exchange of India Ltd.) website for a period of 10 years i.e. July, 2004 to July, 2014. The results revealed that in post futures period CGR (compound growth rate) for the wholesale prices of castor was higher as compared to the pre-futures period and it was significantly positive, which shows increment of prices in castor. Further it indicates that it is not only due to the futures trading but other factors like-consumption and export pattern and government policies were responsible for that. The range of percentage of CV (Coefficient of Variation) in Post futures period was less (3.35% to 12.05%) as compared to the pre-futures period (2.74% to 15.95%). Price trend is also found in spot and futures prices and in the year 2011-12 prices were high due to export coupled with weakness in Indian rupee, attracted the exporters. Analysis of price volatility has revealed its persistence in spot and futures prices for a longer period of time as the sum of the coefficient of ARCH (Auto Regressive Conditional Heteroskedasticity-α) and GARCH (Generalized Auto Regressive Conditional Heteroskedasticity-β) were estimated 1.00 and 0.91 (closer to one), which further indicates the price discovery and usefulness of futures trading.

## 1. Introduction

Indian policy makers have traditionally coped with uncertainty and risks associated with price volatility by resorting to policy instruments which attempted to minimize or eliminate price volatility-a virtually closed external trade regime, price control, pervasive government controls on private sector activities, extensive market interventions and crop insurance. Over the time, in the face of greater price exposure and thereby the urgent need for price risk management, importance of commodity futures trading and other tools for the transfer of risk is increasingly being realized (Kataria and Chahal, 2007). Futures trading 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. Starting with trade in 7 commodities in 1999, futures trading is now available in 113 commodities through 17 exchanges (six of these have status of National Exchanges), 5098 members and 40,15,781 clients registered with the exchanges and 25,000 terminals spread over more than 800 towns/cities of the country provide access to trading platforms (Forward Market Commission, 2014).

The cumulative value and volume of futures trade for the financial year 2012-13 was ₹ 170 trillion and 1451 mt. Share of agricultural commodities in total value and volume of futures trade was 13.21 percentage i.e. ₹ 21.56 trillion and 30.30% i.e. 439.8 mt respectively (Economic Survey of India, 2013). Castor has 5.87% shares to the value of commodities traded through NCDEX, Mumbai. During financial year 2012-13, volume and value of castor traded under NCDEX was 24.353 mt and ₹ 938.28 billion. Overall, the Indian commodity market has shown tremendous growth in terms of both value and the number of commodities traded in the last five years. So, people perceive that commodity futures trading are contributing to speculation driven rise in prices. This is important to see, whether futures trading will really affecting the prices? It is also being expected that the futures trading has made significant impact on the volatility of the spot and futures prices over period. There is a more important question to know regarding prices, both spot and futures, whether spot will affect futures prices or vice-versa or how the transmission of prices occurs between the markets.

 

*1.2. Objectives*

1. To analyse the growth in wholesale prices of castor during Pre and Post futures trading era.
2. To study the volatility in spot and futures prices of castor

## 2. Materials and Methods

The nature of data used for the study was entirely based on secondary source. Time series data on the monthly wholesale price index (WPI) from 1994-2013 of castor seed were obtained from the Office of Economic Advisor, Ministry of Commerce and Industry, Government of India, Dept. of Industrial Policy and Promotion (DIPP), 2014. The entire time series data on WPI for castor were divided into two periods for a better understanding of the role of futures trading in changing price scenario viz., from 1994 to 2003 base series 1993-94 which is considered as the Pre-futures period (Period-I) and 2004 to 2013 base series 2004-05 which is considered as the Post-futures period (Period-II). For linking the new series (2004-05) of WPI with old one (1993-94), ratio method was used.

The daily spot and futures prices of castor seed were obtained from the website of National Commodity Exchange of India Ltd. (NCDEX), Mumbai, from July, 2004 to July, 2014 (for a period of 10 years-2447 observations).

*2.1. Growth rate analysis*

The compound growth rates of wholesale prices indices of the castor under study were computed through SPSS software by using the following formula:

$r=[\text{antilog } (\ln b) -1]^{*} 100$ …… (1)

*2.2. Measurement of volatility*

*2.2.1. Calculation of Coefficient of Variation:*

Price variability was assessed through coefficient of variation.

Coefficient of variation (CV)=Standard Deviation/Mean*100

Standard Deviation=√Variance

Variance is calculated for wholesale prices.

$$\text{Variance} = \frac{\Sigma^{n} i=1(Pi- \bar{P})^{2}}{n-1}$$

$P_{i=}$ prices for $i^{th}$ observation of wholesale

$\bar{P}$=Average of wholesale prices

n=number of observations

*2.2.2. ARCH and GARCH model for measuring volatility in spot and future prices*

In order to compute the extent of price volatility in the spot market consequent to futures trading in castor, the ARCH and GARCH models was fitted. Maximum likelihood estimation results of the models explain the best statistical fit, lending support for hypotheses of volatility. ARCH models were introduced by Engle (1982), considers the variance of the current error term to be a function of the variances of the previous time-period's error terms. ARCH relates the error variance to the square of a previous period's error. An ordinary ARCH model is a special case of a GARCH specification by Bollerslev (1986), in which there are no lagged forecast variances in the conditional variance equation.

In the standard GARCH (1, 1) specification:

$Z_i = \gamma_0 + \gamma_1 X_{1t} + ….. + \gamma_k X_{kt} + \varepsilon_t$ …… (2)

And the variance of random error is :

$\sigma_t^2 = \omega + \alpha e^2_{t-1} + \beta \sigma^2_{t-1}$ ..... (3)

Where, $Z_{it}$ is the spot price in the $t^{th}$ period of the $i^{th}$ commodity, Last period's forecast variance: $\sigma^2_{t-1}$ (the GARCH term-β), volatility from the previous period, measured as the lag of the squared residual from the mean equation: $e^2_{t-1}$ (the ARCH term-α). The sum of (α+β) gives the degree of persistence of volatility in the series.

## 3. Results and Discussion

*3.1. Growth in the wholesale price indices (WPI) of castor:*

The average annual compound growth rates for the monthly wholesale price indices of castor during the pre-futures i.e. 1994-2003 and post-futures period i.e. 2004-13 are given in Table 1. It can be seen from that the average annual compound growth rate for the WPI of castor was significantly positive during the pre-futures period (4.33%) as well as during the post-futures period (12.43%) but the growth was higher in post-futures period, which shows that acceleration had taken place in post-futures period. Further it indicates that after evolution of futures trading prices of castor increased, but it may be not sure that increase in the price of castor is only due to the futures trading. There are other several factors which affect increment in prices like-consumption and export pattern, estimated output based on the acreage, weather conditions and pest infestation etc., leftover stocks from the previous year's production after meeting the demand, government policies and intervention and shifting cropping patterns in producing countries. In (Table 2). export of castor oil from India is given, which increased from 163.86 thousand t in the year 2002-03 to 404.49 thousand t in the year 2011-12.

It may be possible that the acceleration in growth rate of WPI in castor has simply rebound and caught-up with the earlier price trend, which in turn could have been aided by more efficient price discovery. But introduction of futures trading cannot

Table 1: Growth performance of monthly wholesale price indices (WPI) for castor during the Pre-futures (1994-2003) and Post-futures period (2004-13)

| Period | CGR (%) | SE | t-value |
|---|---|---|---|
| Pre-futures | 4.33** | 0.010 | 99.40 |
| Post-futures | 12.43** | 0.021 | 53.62 |

**Significant at 1% level

Table 2: Indian export of castor oil

| Year | Volume (thousand t) | Value (₹ Crore) | Price (₹/t) |
|---|---|---|---|
| 2002-03 | 163.86 | 520.85 | 31786 |
| 2003-04 | 161.62 | 603.27 | 37327 |
| 2004-05 | 208.18 | 788.56 | 37879 |
| 2005-06 | 182.16 | 627.43 | 34444 |
| 2006-07 | 195.61 | 653.05 | 34995 |
| 2007-08 | 176.18 | 757.29 | 42985 |
| 2008-09 | 308.62 | 1821.57 | 59022 |
| 2009-10 | 345.33 | 1780.31 | 51554 |
| 2010-11 | 343.25 | 2362.46 | 68826 |
| 2011-12 | 404.49 | 3804.78 | 94063 |

Source: ITI, Investor Services Limited (2012)

be held only responsible for the increase in the growth rate because the period during which futures markets have been in operation is much too short to discriminate adequately between the effect of opening up futures markets and what might simply be normal cyclical adjustments. This was in confirmation with the findings of Sen (2008).

*3.2. Coefficient of variation of monthly wholesale price index*

The year- wise information regarding Coefficient of variation of monthly Wholesale price index of castor for the period pre-futures (1994-2003) and post-futures (2004-2013) is given in (Table 3). Average percentage of CV is slightly less in post-futures period (6.63%) as compared to pre-futures (6.77%) as well as the range of percentage of CV is also less in post-futures period (3.35% to 12.06%) as compared to pre-futures (2.74% to 15.95%).

*3.3. Price trend in spot and futures prices of castor*

Table 3: Coefficient of variation of monthly WPI of castor in India

| Pre-futures | CV% | Post-futures | CV% |
|---|---|---|---|
| 1994 | 15.95 | 2004 | 5.80 |
| 1995 | 4.59 | 2005 | 6.62 |
| 1996 | 3.24 | 2006 | 7.10 |
| 1997 | 2.74 | 2007 | 3.35 |
| 1998 | 11.80 | 2008 | 6.67 |
| 1999 | 4.46 | 2009 | 3.99 |
| 2000 | 4.43 | 2010 | 12.06 |
| 2001 | 5.63 | 2011 | 8.07 |
| 2002 | 5.04 | 2012 | 7.99 |
| 2003 | 9.79 | 2013 | 4.65 |
| Average | 6.77 | Average | 6.63 |

Price trend in spot and futures prices of castor during the year 2004 to 2013 is depicted in (Figure 1). which indicates that Castor seed prices which were almost stagnant during the year 2004-2007, have witnessed a rising trend since then. Although India is the largest producer of castor seed and thereby castor oil, the prices are largely driven by the demand from the overseas market. Higher export and sturdy demand of castor in domestic market have led castor seed prices rising trend in the last few years but in year 2011-12 prices were highest due to export coupled with weaknesses in Indian rupee that attracted exporters. The prices of castor show fluctuation during the recent times. The average daily futures price in NCDEX was ₹ 18770 $t^{-1}$ in 2004, which rose to ₹ 47000 in 2011 but again reduced to ₹ 36360 in 2013. The spot price has also increased from ₹ 18420 in 2004 to ₹ 46500 in 2011 and reduced to ₹ 36400 in 2013 $t^{-1}$. Due to increase in prices of castor during the year 2011, there was a bumper harvest in year 2012 and spot and futures prices declined sharply up to ₹ 36270 and ₹ 35800 $t^{-1}$. In India during the year 2010-11, castor production was 13.50 lakh t, area was 8.80 lakh ha and productivity was 1534 Kg $ha^{-1}$. The area and production is almost double i.e. 14.69 lakh ha and 23.39 lakh tonnes during the year 2011-12 as compared to previous year.

*3.4. Price volatility*

Generally, volatility refers to the fluctuation in prices of commodities/goods. It can be measured by using the univariate ARCH-type models for spot and futures prices of castor crop and the results of volatility analysis have been given in (Table 4) to (Table 5).

The univariate GARCH (1, 1) parameters for the mean and variance equations or sum of the coefficient of ARCH (α) and GARCH (β) terms for spot and futures series were 1.00 and 0.91 respectively and both were estimated closer to one, indicating the persistence of volatility in spot and future prices for a longer period of time, which further infers the usefulness of futures trading. The result of GARCH model also indicates that the volatility in the current day prices depends on the volatility in preceding day prices. None of the series showed an explosive pattern as the value of (α+β) had not exceeded


Figure 1: Price trend in spot and futures prices of castor (2004-2013)

Table 4: Auto regressive conditional heteroskedasticity (ARCH) with spot price as dependent for castor

| GARCH=C(2)+C(3)*RESID(-1)$^2$+C(4)*GARCH(-1) | | | | |
|---|---|---|---|---|
| Particulars | Co efficient | Std. error | Z-statistics | Prob. |
| Mean equation | | | | |
| C | 2866.08 | 2.5623 | 1118.55 | 0.0000 |
| Variance equation | | | | |
| C | 1125.086 | 202.6925 | 5.5507 | 0.0000 |
| α: RESID (-1)$^2$ | 1.0814 | 0.1983 | 5.4534 | 0.0000 |
| β: GARCH (-1) | -0.0721 | 0.0255 | -2.8263 | 0.0047 |
| Mean dependent var | 2892.31 | | | 1049.81 |
| S.E. of regression | 1050.13 | S.D. dependent var | | 15.9368 |
| Sum squared resid | 2.70E+09 | Akaike info criterion | | 15.9462 |
| Log likelihood | -19494.63 | Schwarz criterion | | 0.00370 |
| R-squared | -0.0006 | Durbin-Watson stat | | 15.9402 |
| | | Hannan-Quinn criteria | | |

Table 5: Auto regressive conditional heteroskedasticity (ARCH) with futures price as dependent for castor

| GARCH=C(2)+C(3)*RESID(-1)$^2$+C(4)*GARCH(-1) | | | | |
|---|---|---|---|---|
| Particulars | Co efficient | Std. error | Z-statistics | Prob. |
| Mean equation | | | | |
| C | 2786.006 | 7.4659 | 373.165 | 0.0000 |
| Variance equation | | | | |
| C | 31241.59 | 6690.992 | 4.6692 | 0.0000 |
| α: RESID (-1)$^2$ | 1.4820 | 0.3882 | 3.8171 | 0.0001 |
| β: GARCH (-1) | -0.5732 | 0.0698 | -8.2110 | 0.0000 |
| Mean dependen var | 2914.54 | | | 1062.15 |
| S.E. of regression | 1069.91 | S.D. dependent var | | 16.0138 |
| Sum squared resid | 2.80E+09 | Akaike info criterion | | 16.0233 |
| Log likelihood | -19588.90 | Schwarz criterion | | 0.00255 |
| R-squared | -0.01465 | Durbin-Watson stat | | 16.0173 |
| | | Hannan-Quinn criteria | | |

one. The reason for persistence of volatility in prices of castor could be due to the nascent stage of futures market. Sendhil et al. (2013) obtained similar results while studying price volatility in wheat, barley, chickpea and maize. This further indicates that futures price series of castor were fairly stable and led to efficient price discovery which helped the farmers in better decision making. So, the government must encourage the futures trading for better decision making and price information for farmers.

## 4. Conclusion

The average CGR of wholesale prices was higher in post-futures period, which shows that after evolution of futures trading the prices of castor increased and it may be due to the several other factors like - export pattern, government policies etc. The persistence of volatility in spot and future prices for a longer period of time infers the usefulness and nascent stage of futures trading.

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