Original Research Article

Growth and Instability analysis of groundnut price of Major Markets in Saurashtra Region of Gujarat state

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ABSTRACT

The present study was carried out by using time series data of price from 1998 to 2018, to compare the price variation, to measure the price instability of major domestic groundnut markets of Saurashtra region of Gujarat state *i.e.* Rajkot, Junagadh, Amreli and Gondal. Data were collected from the registers maintained in the respective Agricultural Produce Market Committees (APMCs). The price variation had been compared by using descriptive statistics. Range and standard deviation indicated wide variation in the price level of all the markets. The price instability and price seasonality based on trend model were measured. Estimates of fitted cubic trend model for all the markets were significant. Highest instability was observed for Gondal market.

Key words: CDVI, Instability, Adjusted R-square, AIC, SIC

INTRODUCTION

Gujarat ranks first in the area and production of groundnut among all the states of country accounting for 34 and 43 per cent respectively. It is annually grown on an area about 16.5 lakh ha. producing 30.5 lakh tonnes with an average productivity of 1879 kg/ha in 2017-18 (Anon., 2018). Saurashtra region consisting of groundnut growing districts is leading in the Gujarat state. So, it is significant to study the performance of groundnut markets in these districts and price fluctuation occurring in these markets

The instability in the price of agricultural commodities are influenced by number of factors such as annual variation in production and low-price elasticity of agricultural production (Kahlon and Tyagi, 1989). The information about behavior of the price in terms of price level, trend and fluctuations are the most important factors in determining

competitiveness of the commodity in the domestic and international level to draw influence for future prices and to formulate the long-term strategy on trade. The past trend in area, production and market arrivals of commodities are also useful in understanding the present and to forecast the future. Prices of farm products fluctuate more than that of industrial goods due to heavy dependence on natural factor.

Rakesh (2014) studied growth and instability in agricultural production in Haryana by using Cuddy Della Valley Index (CDVI) and reported that rice and wheat were more stable (15) but the coarse cereals and pulses were found to be highly instable (> 30) in area and production in Haryana.

MATERIALS AND METHODS

❖ Data

The monthly time series data on prices of groundnut for 20 years (April-1998 to March-2018) were collected from the registers maintained in the Agricultural Produce Market Committees (APMCs).

❖ Selection of Markets

Rajkot, Junagadh, Amreli and Gondal markets of Saurashtra region were selected on the basis of maximum arrival of groundnut.

- **STATISTICAL ANALYSIS**

❖ Regression analysis:

Regression analysis was carried out to ascertain the response of the prices on the arrivals. The econometric models used for the purpose are as follows:

- **Growth Models**

Different regression equations such as Linear, Quadratic, Cubic, Logarithmic and Power were fitted for major groundnut markets of the Saurashtra region. The best fitted model was selected for estimating the growth pattern on the basis of the R^2 and adjusted R^2 ($\overline{R}^2$) values obtained. The model with highest values of R^2 and $\overline{R}^2$ was considered as the best model.

Linear function	$Y_t = a + bt$
Quadratic function	$Y_t = a + bt + ct^2$
Cubic function	$Y_t = a + bt + ct^2 + dt^3$
Logarithmic function	$Y_t = a + b \ln (t)$
Power function	$Y_t = at^b$ (or) $\ln (Y_t) = \ln (a) + b \ln(t)$

❖ **Cuddy Della Valle Index**

Cuddy Della Valle Instability index (Cuddy and Della, 1978) is a modification of coefficient of variation to accommodate trend present in the data, which is commonly present in economic time series data. This method is superior over the scale dependent measures such as standard deviation. The Cuddy Della Valle Index (CDVI) was calculated as follows:

$CDVI = CV\sqrt{X}$

Where, $X = 1 - \bar{R}^2$,

CV is coefficient of variation and $\bar{R}^2$ is adjusted coefficient of determination. The ranges of CDVI (Rakesh, 2014) are given as follows:

- Low instability = 0 to 15
- Medium instability = greater than 15 and less than 30
- High instability = 30 and above

RESULTS AND DISCUSSION

Polynomial models were fitted to price levels of four major domestic groundnut markets of Saurashtra region *viz.*, Rajkot, Junagadh, Amreli and Gondal to measure the instability.

Trend Model

To measure price instability, it is necessary to fit trend model to the price series. The instability index is calculated based on the fitted trend. The result of fitted trend model for three markets is given as under.

Fitting trend model for Rajkot market

Trend is one of the components of time series data which means changes in the value of a variable in accordance with time. Fitting of trend model is done by regressing the variable under consideration on chronological time period.

The cubic model was found to be best fitted as it is having high $\bar{R}^2$ (0.85) with lower AIC (15.05) and SIC (15.11) values as compared to another models. Thus, the fitted model was adequate to describe trend in the data as per Table 1.

In addition to this, the actual and fitted data are depicted graphically in Fig.1. The residuals from the fitted model resembles white noise because they were almost within the two standard error limits. It is clear that the fitted cubic trend model was appropriate for Rajkot market in measuring instability and seasonal factor.

Fitting trend model for Junagadh market

The results of trend model for Junagadh market are presented in Table 2. It revealed that cubic trend model was best fitted model on the basis of $\overline{R}^2$, AIC and SIC value which having high $\overline{R}^2$ (0.86) with lower AIC (14.91) and SIC (14.97) values as compared to another model. Thus, the fitted model was adequate to describe trend in the data.

The actual, fitted and residual of the fitted model are depicted in the Fig.2. It shows that the residuals obtained from the fitted cubic model are within the two standard error limits. So, this model was appropriate for Junagadh market to measure instability and seasonality.

Fitting trend model for Amreli market

The results of trend model for Amreli market are presented in Table 3. The different types of trend equations were fitted depending upon its $\overline{R}^2$, AIC and SIC values to assess the trend in market prices. Among them, the cubic model was found to be better fit due to high $\overline{R}^2$ (0.85) with the lower AIC (15.03) and SIC (15.09) values. Thus, the fitted model was adequate to describe trend in the data.

In addition to this, the actual and fitted data are depicted graphically in Fig.3. It is clear that the actual data reverting to its mean value (fitted value) was maximum and much of the residuals were within the standard error limits. So, this model was appropriate for Amreli market to measure instability and volatility.

Table 1. Estimates of fitted cubic trend model for Rajkot market

Model	Adjusted R Square	Constant ($\hat{\alpha}$)	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	AIC	SIC
Linear	0.80	849.13**	14.70**	-	-	15.33	15.36
Logarithmic	0.54	-1,307.55**	873.75**	-	-	16.16	16.19
Quadratic	0.80	996.42**	11.05**	0.02	-	15.31	15.35
Cubic	0.85	1,670.14**	-22.15**	0.36*	-0.01	15.05	15.11
Power	0.63	464.13**	0.36*	-	-	15.89	15.93

*, ** indicates significant at 5% and 1% levels, respectively.

Table 2. Estimates of fitted cubic trend model for Junagadh market

Model	Adjusted R Square	Constant ($\hat{\alpha}$)	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	AIC	SIC
Linear	0.81	785.69**	14.35**	-	-	15.18	15.22
Logarithmic	0.55	-1,327.61**	854.62**	-	-	16.07	16.10
Quadratic	0.82	919.33**	11.04**	0.01	-	15.19	15.23
Cubic	0.86	1,561.17**	-20.60**	0.34*	-0.01	14.91	14.97
Power	0.64	424.87**	0.37*	-	-	15.72	15.75

*, ** indicates significant at 5% and 1% levels, respectively.

Table 3. Estimates of fitted cubic trend model for Amreli market

Model	Adjust R Square	Constant ($\hat{\alpha}$)	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	AIC	SIC
Linear	0.79	953.86**	14.25**	-	-	15.33	15.36
Logarithmic	0.54	-1,169.20**	854.23**	-	-	16.10	16.13
Quadratic	0.79	1,052.64**	11.80**	0.01	-	15.31	15.35
Cubic	0.85	1,752.35**	-22.68**	0.37*	-0.01	15.03	15.09
Power	0.63	512.98**	0.35*	-	-	15.89	15.93

*, ** indicates significant at 5% and 1% levels, respectively.

Table 4. Estimates of fitted cubic trend model for Gondal market

Model	Adjusted R Square	Constant ($\hat{\alpha}$)	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	AIC	SIC
Linear	0.77	900.78**	14.59**	-	-	15.47	15.50
Logarithmic	0.52	-1,230.77**	865.10**	-	-	16.22	16.25
Quadratic	0.78	1,050.37**	10.88**	0.02	-	15.46	15.51
Cubic	0.83	1,771.29**	-24.65**	0.38*	-0.01	15.20	15.26
Power	0.61	501.01**	0.35*	-	-	15.97	16.01

*, ** indicates significant at 5% and 1% levels, respectively.

Fitting trend model for Gondal market

The results of trend model for Gondal market are presented in Table 4. It revealed that cubic trend coefficient was highly significant and the adjusted R-squared (0.83) value was also high. The AIC (15.20) and SIC (15.26) values were also comparatively low. Thus, the fitted model was adequate to describe trend in the data.

The actual and fitted data are also depicted graphically in Fig.4. It is clear from the graph that the actual data reverting to its mean value (fitted value) was maximum and much of the residuals were within the standard error limits. So, this model was appropriate for Gondal market to measure instability and volatility.

Cuddy Della Valle Index (CDVI)

In time series analysis, instability in the data is measured by Cuddy Della Valle Instability index because this index accommodates trend present in the data which is not done by the commonly used instability measure *i.e.* Coefficient of Variation (CV%). The latter measures instability around mean but the former measures instability around the trend. Since, time series data contain trend, it should be detrended in order to measure instability in a statistically sound manner. So CDVI was utilized to measure instability in all the four markets and the results are presented in Table 5. It revealed that instability for all the four markets was quite moderate (above 15).

In four markets, the instability of Gondal market (18.04) was quite higher than others which indicated that the persistence of volatility may be higher in Gondal market than other three markets.

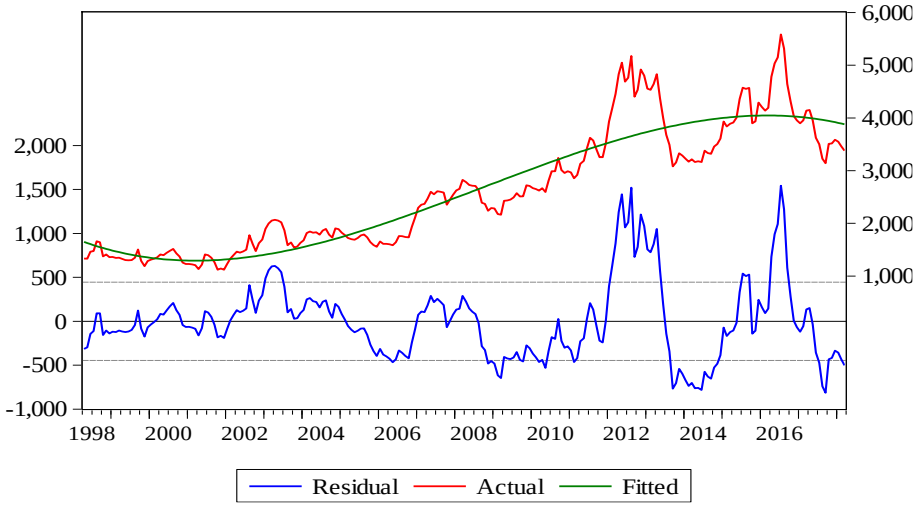

Fig.1. Fitted cubic trend model for Rajkot market

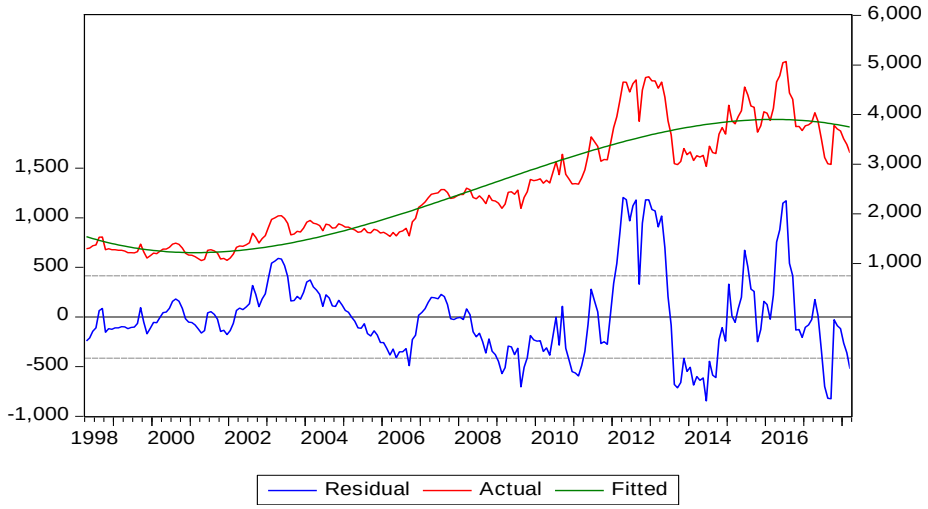

Fig.2. Fitted cubic trend model for Junagadh market

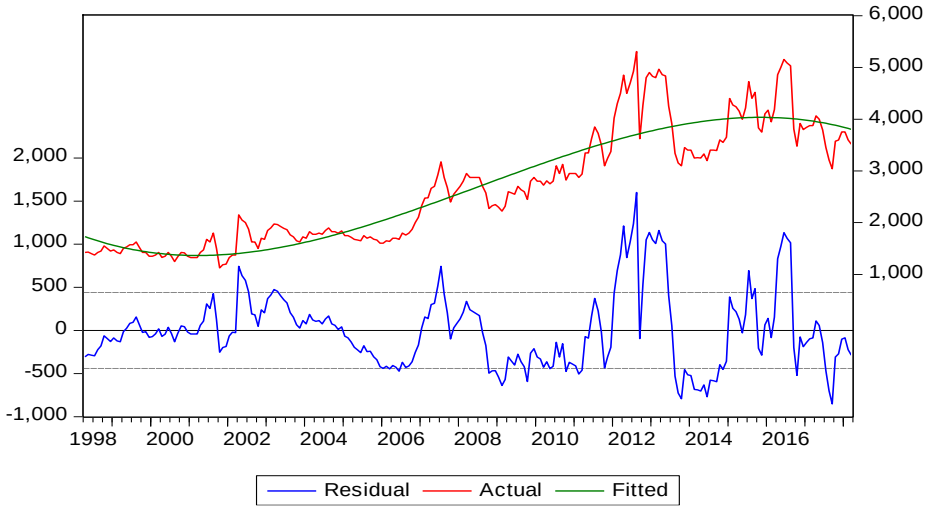

Fig.3. Fitted cubic trend model for Amreli market

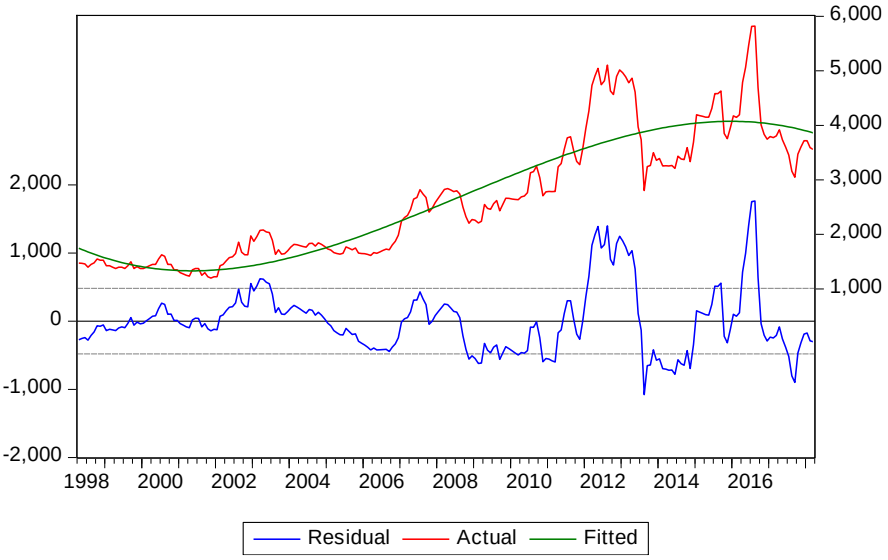

Fig.4. Fitted cubic trend model for Gondal market

Table 5. Instability of the major domestic markets

Market	Adjusted-R square	CV%	CDVI	Range
Rajkot	0.85	43.48	16.96	Medium
Junagadh	0.86	43.86	16.45	Medium
Amreli	0.85	41.60	16.48	Medium
Gondal	0.83	43.27	18.04	Medium

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