Economic Affairs, Vol. 61, No. 4, pp. 627-631, December 2016
DOI: 10.5958/0976-4666.2016.00077.2

Effect of Price of Other Seasonal Fruits on Mango Price in Uttar Pradesh

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Abstract

The study analyzed the effect of prices of seasonal fruits available as substitutes of mango in highest producing state of India. Market infrastructures being internal factor, prices of other fruits too affects externally to the major fruit of the state. It depends on the transaction behavior of buyers in the existing market conditions. Lucknow and Varanasi markets in Uttar Pradesh were selected purposively on the basis of maximum arrivals of mango. Monthly time series data for 22 years from 1993-94 to 2014-15 was collected of major arriving fruits from both the selected markets. Data was analysed using Multiple Regression technique for the available dataset. Study revealed that in both markets pomegranate price and sweet orange price found to be significant and affected positively to mango price. But the price of apple in Lucknow market and prices of banana in Varanasi market was found non-significant. It was also confirmed from the correction coefficients of corresponding fruit in a particular market was found to be non significant. Study suggested that efforts should be made to make available theses substitutes in order to check the volatility of mango prices in the market, which will benefit producers and consumers both.

Keywords: Multiple regressions, substitutes, volatility

Demand pattern of agricultural commodities both at consumer and industry level has been shifting towards high quality and processed products (Chand 2012 and Panagariya and Rao 2014; Patnaik 2011). Currently, India grows fruits and vegetables on less than 10 per cent of the area under all crops. CSO data on the value of output for year 2013-14 reveal that fruits and vegetable crops on average generate ₹ 3.30 lakh worth of output per hectare compared with ₹ 37.5 thousand in the case of cereals and ₹ 29 thousand and ₹ 48.7 thousand in the cases of pulses and oilseeds, respectively. These variations in value productivity suggest a very large scope for raising the value of agricultural output through a shift from cereals, pulses and oilseeds into fruits and vegetables (NITI, 2015). Mango is recognized as the king of fruits because of its nutritive value, taste and attractive fragrance and high volume of production (Dadhich, 2012). Uttar Pradesh is one of major mango producing state in India, as the state continuously accounting an increasing production of mango from last three years and ranks first in terms of production. The problems regarding the price fluctuations arise due to seasonality in arrival and perishable nature. There are many factors which affect the prices like arrival, income, supply chain efficiency and prices of substitutes etc. Market infrastructure being considered the internal factor which directly affects the prices of mango and prices of other fruits are considered to be the external factor which indirectly affects the prices of mango, which are mainly depends on the attitude of buyers toward transaction in the existing market conditions (Bhatia, 1984; Rajagopal, 1986; Krishnan, 1988). In order to facilitate productivity growth, it is important to ensure that farmers receive lucrative prices for their produce.

The present study was conducted to examine effect of the prices of other fruits available during same season, on the prices of mango in the largest producing state Uttar Pradesh.

Methodology

The study conducted in Uttar Pradesh as the state ranks first position in the production of mango. In the state there were five major markets of mango, out of five two major markets *viz.* Lucknow and Varanasi markets were selected on the basis of highest arrivals of mango. The data regarding prices of mango and prices other fruits collected from the particular APMC markets. Being seasonal nature of mango the arrival of fruit in the markets of Uttar Pradesh was in the months from March to August. So, the secondary data for 22 years from 1993-94 to 2014-15 were collected only for the six months of peak season of mango. Also the data for observing the effect of prices of other fruits collected for the same period. There were many more fruits in the market but only four fruits were selected on the basis of their arrivals in the particular peak season of mango. The data were analysed by using the multiple linear regression model.

Multiple Linear Regression (MLR) Model

Regression analysis is a statistical technique for investigating and modeling the relationship between independent and dependent variables. In case of multiple linear regression model more than one regressor or independent variable is involved.

The model is expressed as:

$$Y = \beta_0 + \sum_{i=1}^{k} \beta_i X_i + e_i$$

Where, i = 1……..k

Y: Price of Mango
X1: Price of Banana,
X2: Price of Apple,
X3: Price of Pomegranate,
X4: Price of Sweet Orange
β: Parameter of the model
k: Number of observations
e_i: Random errors with E (e_i)=0, V(e_i) = σ_i^2 and components 'e_i' are uncorrelated.

Multiple linear regressions (MLR) are widely used for short or intermediate term forecasting. These models are of immense use to assess "which factors to include and which to exclude".

By using the regression ANOVA an attempt is made in testing the null hypothesis that β=0 against the alternative hypothesis β≠0. Reject null hypothesis if calculated F-value. If the model was significant, applying individual t-test the null hypothesis was that β≠0 against the alternative hypothesis, i= 1,2,3,……..,p.

The formula for individual t-test was given by:

$$t_{cal} = \frac{|\hat{\beta}_i|}{SE(\hat{\beta}_i)} \sim t_{(\alpha, n-p-1df)}$$

Where, $SE(\hat{\beta}_i)$ was the square root if ith diagonal element of the matrix V (β). Reject the null hypothesis if calculated t-value is greater than table t-value or accept null hypothesis if calculated t-value is less than table t-value the with (n-p-1) error degrees of freedom. (Rathod, *et al.*, 2012)

Model adequacy is tested by using coefficient of determination (R^2) and adjusted R^2

Coefficient of determination (R^2) was computed as:

$$R^2 = \frac{\text{Regression } SS}{\text{Total } SS}$$

Coefficient of determination (R^2) explains the variation in the prediction variable (Y) by regressors through the fitted regression equation.

Stepwise Regression

An important issue that precedess fitting of regression model is selection of explanatory variables which really influence on Y. There are many methods used for selection of explanatory variables. The one that is frequently used is the stepwise regression algorithm. This is a combination of the forward selection and backward elimination procedures.

This is a modification of forward selection in which at each step all regressors entered into the model previously are reassessed via their partial F-statistics (Narayanswamy, *et. al.*, 2012). A regressors added at an earlier step may now be redundant because of the relationships between it and regressors added at an earlier step may now be redundant because of the relationships between it and regressors now in the equation (Montgomery, *et al.*, 2003). The predictor

variables selected by the stepwise procedures were included in the final model.

Correlation

Given pair of related measures (X and Y) on each of a set of items, the correlation coefficient (r) provides an index of the degree to which the paired measures co-vary in a linear fashion. In general r will be positive when items with large values of X also tend to have a large values of Y whereas items with small values of X tend to have small values of Y. Correspondingly, r will be negative when items with large values of X tend to have small values of Y whereas items with small values of X tend to have large values of Y. The values of r is calculated by first converting the Xs and Ys into their respective Z scores and, keeping track of which Z score goes with which item, determining the value of the mean Z score product. Numerically, r can assume any value between -1 and +1 depending upon the degree of the linear relationship. Plus and minus one indicate perfect positive and negative relationships whereas zero indicates that the X and Y values do not co-vary in any linear fashion (Sharma V. K. and R. Prasad).

This is also called as Pearson-product-moment correlation coefficient. The values of the correlation coefficient have no units. While scatter plot provides a picture of the relation, the value of the correlation is the same if you switch the Y (vertical) and (horizontal) measures.

Let (x_i , y_i), i = 1,2,3,…. N denotes a random sample of n observations from a bivariate population. The sample correlation r is estimated by the formula:

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - \left(\sum_{i=1}^{n} x_i\right)\left(\sum_{i=1}^{n} y_i\right)}{\sqrt{n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)}\sqrt{n\sum_{i=1}^{n} y_i^2 - \left(\sum_{i=1}^{n} y_i\right)}}$$

Test of significance of correlation coefficient

Case 1: $H_0 : \rho = 1$

The variables X, Y follow a bivariate normal distribution. If the population correlation coefficient of X and Y is denoted by ρ, then it is often of interest to test whether ρ is zero or different from zero, on the basis of observed correlation coefficient, r. Thus, if *r* is the sample correlation coefficient based on a sample of n observations, then the appropriate test statistic for testing the null hypothesis $H_0 : \rho = 1$ against the alternative $H_0 : \rho \neq 1$ is : $t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$

Comparison of the computed value of $|t|$, with the table value of t-distribution (n-2) degrees of freedom, and at a given level of significance, say 5% will indicate the existence or non-existence of correlation. If the computed value of $|t|$ exceeds the table value, then $H_0 : \rho = 1$ is rejected against the alternative $H_0 : \rho \neq 1$.

Results and Discussion

Factors influencing the prices of mango in Lucknow market

The results of multiple regression analysis of the banana price, apple price, pomegranate price and sweet orange price (Independent variable) to the mango price (Dependent variable) of Lucknow market are presented in Table 1.

Table 1: Factors affecting prices of mango in Lucknow market

Factors	Coefficients	Standard Error	t Stat	P value
Intercept	909.22*	223.57	4.07	0.000
Banana prices (X_1)	1.62*	0.20	8.13	0.032
Apple prices (X_2)	- 2.89^{NS}	3.17	- 0.91	0.085
Pomegranate prices (X_3)	3.18*	1.41	2.25	0.019
Sweet orange prices (X_4)	1.18*	0.18	6.55	0.029
R square = 0.624				

** indicates significance at 5% level of probability, NS- Non Significant*

It is revealed from table 1 that about 62% of the variation in mango price was explained by the independent variables those are incorporated in the model. The R square was found to be low due to the lack of number of independent variables considered for the study. It shows the effect of other variables too on the mango prices. The results clearly indicated that there was significant positive effect on mango prices with the other fruit prices except apple prices. The prices of banana, pomegranate and sweet orange indicates the positive effect on the mango prices which shows,

as the increase in one unit of corresponding prices of banana, pomegranate and sweet orange there was a increase in 1.62, 3.18 and 1.18 unit of mango prices respectively (Bates and Flordeliza, 2010). It was found to be the prices of mango were remaining constant at ₹ 909.22 indicates the consistency of price in the peak period of mango irrespective of change in the prices of its substitutes. Though there was a increase in the prices of mango due to change in the prices of other fruits, the peoples were prefer to purchase it at current market price due to seasonal nature of fruit. It may be concluded that, despite of the availability of other fruits like banana, pomegranate and sweet orange during mango season, mango has its own demand and the price of mango is not negatively effected due to other substitutes.

Table 2: Correlation between the various substitute in Lucknow market

	Mango	Banana	Apple	Pome-granate	Sweet orange
Mango	1.00	0.274*	0.234 ^{NS}	0.399*	0.335*
Banana	0.274*	1.00	0.707*	0.714*	0.714*
Apple	0.234^{NS}	0.707*	1.00	0.830*	0.800*
Pomegranate	0.399*	0.714*	0.830*	1.00	0.782*
Sweet orange	0.335*	0.714*	0.800*	0.782*	1.00

** indicates significance at 5% level of probability, NS-Correlation is Non Significant*

The non significant effect of correlation coefficient between mango prices and apple prices in the market can also be observed from Table 2 (Krishnankutty, 2002). Since the market prices of mango were affected by prices of banana, pomegranate and sweet orange, the null hypothesis 'the market prices of mango are affected by prices of other substitute fruit crops' was accepted.

Factors influencing the prices of mango in Varanasi market

The factors affecting prices of mango in Varanasi market are shown in Table 3. The R square value obtained from the analysis was 0.59. This indicates that around 59 per cent of the variation in dependent variable (Mango prices) was explained by selected independent variables.

Table 3: Factors affecting prices of mango in Varanasi market

Factors	Coefficients	Standard Error	t Stat	P value
Intercept	828.705*	323.721	2.560	0.013
Banana prices (X_1)	- 0.644^{NS}	0.941	- 0.684	0.077
Apple prices (X_2)	1.425*	1.289	1.106	0.049
Pomegranate prices (X_3)	0.161*	0.072	2.230	0.030
Sweet orange prices (X_4)	2.68*	1.75	1.531	0.028
R square = 0.59				

** indicates significance at 5% level of probability, NS- Non Significant*

It is evident from table 3 that the regression coefficients of the apple price, pomegranate price and sweet orange price were found to be statistically significant at 5% level of probability (Kumar, *et al.*, 2000). One unit change in the price of apple, pomegranate and sweet orange will increase the price of mango by 1.42, 0.16 and 2.68 unit respectively. The pomegranate prices found to be negligible effect on the prices of mango.

Table 4: Correlation between the variables in Varanasi market

	Mango	Banana	Apple	Pome-granate	Sweet orange
Mango	1.00	0.185^{NS}	0.272*	0.329*	0.210*
Banana	0.185 ^{NS}	1.00	0.798*	0.851*	0.761*
Apple	0.272*	0.798*	1.00	0.778*	0.764*
Pomegranate	0.329*	0.851*	0.778*	1.00	0.744*
Sweet orange	0.210*	0.761*	0764*	0.744*	1.00

** Correlation is significant at the 0.05 level, NS-Correlation is Non Significant.*

In Table 4, the negative slope of the prices of banana could be due to the fact that correlation coefficient between the mango price and banana price in the Varanasi market was not significant. It indicates the price of banana is not affecting the prices of mango in the market.

Conclusion

The demand pattern of consumers and production pattern of producers are shifting towards fruits and

vegetables. Production of horticultural commodities is more than the production of foodgrain. Study concluded that the price of mango was affected by the other seasonal fruits in both the major markets of Uttar Pradesh. In both the markets pomegranate price and sweet orange price found to be significant and affected positively. But the price of apple in Lucknow market and prices of banana in Varanasi market was found n to mango price. The results of correction coefficients of corresponding fruit in a particular market also confirmed it. In Varanasi market the prices of mango were affected by higher nutritive and relatively more expensive than other fruits i.e. apple, pomegranate and sweet orange.

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