UNETHICAL PRICING OF ONIONS AND TOMATOES IN DELHI SABZI MANDI

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ABSTRACT

In general, tomatoes and onions go through an extreme variation of prices in our country. The vegetable price may vary mainly due to change of cost of production and planting structure, transportation method, the variation of fuel prices which has an impact on transportation cost for marketing the produce items, the timing of exports, and perishability factor about the tomato. The objectives of this research work were to find out, if the sudden and extreme variation of prices of onion and tomato in Delhi Sabzi Mandi was ethical or not. The lag-linear model, coefficient of variation, seasonal index, and Cobweb theory were used as the methodology for this research work. The study discloses that in the Delhi market, the variation of prices of onion and tomato were not because of low production and low market arrival but because of the most unethical pricing and marketing of these two commodities. The year 2020 and onwards were not considered as the market did not behave in its usual way because of COVID-19. The detailed analysis and suggestions made in this paper may help the government to control the sudden price hike of onion and tomato in Azadpur mandi in the future.

Keywords: Vegetable prices, price variation, unethical pricing, vegetable production, market arrival, fuel prices.

INTRODUCTION

The biggest wholesale vegetable and fruit market in Delhi is known as Azadpur Mandi. The Azadpur Mandi is operated by about 3664 Wholesalers/Commission Agents under the regulation of ensuring orderly marketing by elimination of various malpractices and to create better infrastructural, economic, and legal conditions which are conducive for most competitive marketing. The most authoritative and prevalent intermediaries in Azadpur Sabji(Vegetable) Mandi are Commission Agents-cum-Wholesalers who must have a shop in the Mandi to acquire a license. Two licenses (A-type related to trading and B-type for selling) may be issued only to big shop owners. It has been noted that 6 to 7 truckloads per day are handled by big commission agent-cum-wholesaler. The previous data on the supply of onion shows that the farmers supplied only 5% of the total supply of onion came from Maharastra while 25% to 30% came from wholesalers and rest from trades of Maharastra. The farmers of places such as Jodhpur, Alwar, Sikar, and Kanchmal supplied 20% to 25% of total onion while 30% to 40% were supplied by village commission agents and the rest by wholesalers and traders. To avert evil practices in the Mandi, the commission agents also ask for producing buyer license. The presence of various suppliers, buyers, various firms, and locations leads to the problem in getting inflow and outflow of products in Azadpur Mandi. As far as buyers of onion from the mandi are concerned, organized retailers have 10–15% share; unorganized retailers have 40% share; forwarders-cum-traders have 20–25% share and semi wholesalers have 10–15% share. The farmers are allowed to come directly to the Mandi to sell their agricultural output on paying commission to the Commission Agents. Normally the market fee is paid by the traders. The traders prefer Azadpur Mandi because of its national importance but the farmers have less preference as they need to pay commission and susceptible to declined facilities about infrastructure and storage. On the contrary, big traders do not prefer small mandis as they go with the understanding and perception that the distribution channel is badly impacted by small mandis. The traditional dry storages are in practice in Azadpur mandi but from a different point of time, the price-spike has created an understanding of hoarding and evil practices against traders. The data on the yield of onion and tomato in the country vis-à-vis their prices in the Azadpur Mandi in the last five years suggests that perhaps the farmers were storing onion and tomatoes at different points of time in the expectation that price will increase. But due to economic urgency and fear of rot, the farmers could not store their product for a long time. The statistics over the last five years reveal that in Azadpur mandi 20% of selling is done by traders, 70 percent by CAs, and 10 percent by forwarders-cum-traders. By and large, since 2011 the trend which is found in the mode of dealing in onion is not on a consignment basis but commission basis.

Maharastra, Madhya Pradesh, Rajasthan, Karnataka, Bihar, Gujarat, West Bengal, Andhra Pradesh, Uttar Pradesh, Haryana, and Chattisgarh produce onion in higher quantities which account for 90% of entire onion production in India. The onion arrives at Azadpur Mandi from Alwar (Rajasthan), Nashik (Maharastra), Nalanda (Bihar), Dewas (M.P), Indore(M.P), Jodhpur (Rajasthan) across the calendar year.

The total production of tomatoes in India in 2019-20 has touched 19.33 million tons as against 19.01million tons in 2018-19 while the total global production of tomatoes is approximately 1279.93 lakh tons. The tomato is produced in bulk quantity in

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the states of Orissa, West Bengal, Bihar, Andhra Pradesh, Karnataka, Madhya Pradesh, Gujarat, Maharastra, Chattisgarh, Tamil Nadu, Punjab, Himachal Pradesh, and Haryana. The tomato arrives at Azadpur Mandi from Shivpuri (M.P), Chhindwara (M.P), Solan (H.P), Karnal (Haryana), Amroha (U.P) across the calendar year.

The objective of the study

(a) To detect the variation of prices of onion and tomato in Delhi Sabzi Mandi and the cause of this variation.
(b) To determine the degree of interconnection between prices and market arrivals of onion and tomato in Delhi Azadpur mandi.
(c) To study the trend of produce arrivals and prices of onion and tomato in the Delhi market.
(d) To find out the effect of fuel prices on produce prices.

Scope of the study

The study was confined to Azadpur Sabzi Mandi in Delhi based on the data collected for the year 2015-2019. The year 2020 was not considered as the market did not behave in its usual way because of COVID-19.

Methods used for data collection and data analysis

(a) Methods used for data collection: The data of arrival and prices of tomatoes and onion in Azadpur Sabzi Mandi, Delhi for the last five years(2015-2019) were collected from different websites.
(b) Methods for data analysis: Time series has been used to process and analyze the data collected by using statistical concepts for the computation of the following and at the same time the Cobweb theory has been used to analyze the undulation of the market prices :

(i) Computation of vegetable growth rate and prices

The annual trend of the arrival volumes and the prices of the onion and tomato in Azadpur Mandi was determined which showed following similar equation :

$$Y_t = \beta_0 + \beta_t + e_i \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where,
Y_t = Monthly volume/price
t = Time period
β_0 = Intercept
β_t = Regression coefficient in time 't'
e_i = Random error

Using equation (1), the Linear Growth Rate(LGR) was found out applying following formula :

$$LGR=(\beta_t/\text{y-bar})x100 \quad \ldots\ldots\ldots\ldots(2)$$

Where,
β_t = Regression coefficient in time 't'
y-bar = Arithmetic mean

(ii) Lag-linear model

The Lag-linear model was used to study and analyze the interrelation between the advent of onion/tomato in the market and corresponding prices of onion/tomato. The model can be explained using the notations given below :

$$CP_t = f\,(LP_{t-1}, Y_t)$$

Where,
CP_t = Current price
LP_{t-1} = Lagged price
Y_t = Current arrival of tomato/onion

The data for the last five years (2015-2019) were collected from Azadpur mandi and were subjected to multiple regression analysis to explain the seasonal relationship between market volume and corresponding prices of onion and tomato. This model is better expressed by the formula written below :

$$P_t=\beta_0+\beta_1.P_{t-1}+\beta_2.Y_t+e_t \quad \ldots\ldots\ldots\ldots(3)$$

Where,
P_t = Price of onion/tomato in $(t)^{th}$ month
P_{t-1} = Price of onion/tomato in $(t-1)^{th}$ month
Y_t = Present market volume of onion/tomato
e_t = Random error

(iii) Karl Pearson Correlation Coefficient

The strength of the interrelation between agricultural produce came to the market and its prices was determined by finding out the Karl Pearson Correlation Coefficient (r) while the variability of two or more than two series is computed by finding out the coefficient of variation (CV) as follows :

$$r = \frac{[\sum(x_i - \text{x-bar})(y_i - \text{y-bar})]}{/\,[\sqrt{\sum(x_i - \text{x-bar})^2}.\sqrt{\sum(y_i - \text{y-bar})^2}],}$$

$$i = 1 \text{ to } n \quad \ldots\ldots\ldots\ldots(4)$$

Where,
n = Number of observations
x_i = Market volume of tomato/onion
y_i = Current market price of tomato/onion

Coefficient of variation or C.V.

$$= [6/\bar{X}\,] \,.\, [100\,] \quad \ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Where 6 is the standard deviation and $\bar{X}$ = Mean

(iv) Study of seasonality

The seasonality for agricultural produce came to the market and its prices were estimated using the following equation while the method of ratio to moving average decomposition was used to derive the seasonal indices :

$$S_i=[(HVSI - LVSI)/LVSI]x[100] \quad \ldots\ldots(6)$$

Where,
HVSI = Highest value of seasonal index
LVSI = Lowest value of seasonal index

(v) Cobweb's theory
The cobweb's theory explains how prices might follow the periodic undulation in certain types of markets. Generally, based on the time lag between supply and demand decisions, the cobweb theory stands. The cobweb's theory might apply in agricultural markets as there is a lag between planting and harvesting. The cobweb's theory assumes the following:

(i) In an agricultural market, before the farmers come to know the would-be market price the farmers decide a year in advance the quantity to be produced.
(ii) The price from the previous year will be the main determinant of supply.
(iii) The very good harvest leads to more supply than expected and this will cause a price reduction.
(iv) If supply is decreased, then this will push the price to go up.

LITERATURE REVIEW

The production volumes of vegetables are very important which is the most vital factor in determining the vegetable prices in the market. Mauro and Jonas(2019) explained that the firm's production costs and the allocation of resources are influenced by the adoption of risk management strategies.

The researchers conducted many studies to detect the reasons for losses during harvest and post-harvest stages. The losses at both these stages have an impact on the production volumes of vegetables. Verma and Singh(2004) carried out an exercise to detect the post-harvest losses of vegetables produced at the firm level and observed that losses occurred due to inadequate means of harvesting while Kedar(2005) pointed out that post-harvest losses are caused by inadequate information which is one of the socioeconomic factors. Rehman *et al.*(2007) stated that losses mainly took place during picking the crop. The author went on to add that improper care at harvest and post-harvest stages are primary factors that are responsible for post-harvest losses in the tomato crop. Ozcan(2007) argued that inappropriate for a specific crop, both early and late harvest, use of improper machines and tools by farmers in harvesting their farm-fresh produce lead to marketing losses. Murthy *et al.* (2009) and Singh *et al.*(2008) have also expressed their view that the wrong method of harvesting is responsible for losses in production. Jain (2007) found that the prime reason for post-harvest losses is the rough handling of agricultural produce. Rasi and Sheron(2015) stated that an efficient marketing channel must be developed through which farmers could sustain any loss. According to the authors, the post-harvest losses could be reduced by an efficient marketing system which in turn would reduce the consumer price and induce demand-driven production and facilitate export. According to Viswanadham, (2007), unawareness of demand in the market is a vital reason for waste. The post-harvest losses of agricultural produce, as pointed out by Ozcan (2007), are a lack of training and experience of workers. Baba *et al*. (2015) explained the requirement of technology mission for vegetable cultivation for better production of vegetables.

The supply chain also is one of the factors of prices of agricultural produce as well as industrial produce. Different authors have offered their observations for managing the efficient supply chain. The consequences of unalike coordination mechanisms on incorporation or debarring of farmers in the supply chains were analyzed by Faure *et al.* (2007) and the authors found that in case of low practical requirement and adequate selling mechanisms, the farmers can be integrated into the supply chain by efficient market coordination. Bailey (2001) pointed out that demand and supply forecast has equal importance in the agricultural supply chain and the supply chain members have limited ability to control the supply. Moreover, he also added that the weather and seasonal patterns of production are beyond the ability of chain members to control the supply.

A study on price spread behaviour of vegetables in Delhi was done by Gupta and Ram(1981) and reported that only 37.6% of consumers price of all vegetables was acquired by the producers and 10.7%, 24.3%, and 2.6% were received by wholesalers, retailers and commissioning agents respectively. This indicated widespread and gross profit sharing by the intermediaries. According to Vasudeva(2018), the prices of onion in India vary extremely. Though the production of onion in the country is rising every year the country experienced sharp price spikes virtually every other year.

The researchers tried to determine the reason for the price fluctuation of different vegetables. Zhang(1997) through his study found out that planting structure and production cost are two important factors for the rise in vegetable prices. Shao (2011) pointed out that when the local supply of vegetables is not adequate and the cost of production goes up the vegetable prices also go up. Many researchers determine the relationship between

the supply of vegetables and the corresponding price. Li and Wang(2006) observed that in China the vegetable prices of the previous year have an impact on deciding the volume of production of the current year and by and large the supply of vegetables to the market becomes the significant determinant of vegetable price. McCalla(2009) believes that the farmers are not authorized to determine the prices on their own and the prices are determined by the phenomena of supply and demand in the market. Many researchers felt the requirement for a genuine and strong marketing intelligence system at different points of time (Kelloo and Pandey,2002; Rai and Pandey,2004; Singh *et al*., 2004).

According to Siddique,(2019), the factors which are responsible for the increase in the cost of the vegetables are (a)less production of vegetables, (b)increase in the cost of production, (c)increase in cost of diesel, (d)increase in demand of particular vegetable in the market, (e)hoarding, (f)many mediators and (g)global inflation. The author argued that the agricultural produce prices are impacted significantly by fuel prices, the distance from sources of produce to the market, and the transportation methods. Siddique opined that wholesale produce prices increase as fuel prices increase.

The researchers studied different types of market operation to ascertain the benefit of the farmers. Reddy and Mehjabeen (2019) reported that by 2018, 585 markets controlled by Agricultural Produce Market Committee (APMC) were linked to Electronic National Agricultural Market (eNAM) in 14 states in India. The authors felt the need for convincing the traders and commission agents for using eNAM and linking warehouses and rural markets to eNAM which they felt would increase the scale and efficiency of market operations.

DATA PRESENTATION

Arrival and prices of tomato and onion in Delhi market

The arrival and prices of tomato and onion in Delhi market in months of last five years is furnished in Table 1.

Table 1 : The arrival of tomato and onion in Delhi market in months of last five years(2015-2019)

	Tomato									
	Arrival (In MT)	Price (Rs./ Quintal)	Arrival (In MT)	Price (Rs./ Quintal	Arrival (In MT)	Price (Rs./ Quintal)	Arrival (In MT)	Price (Rs./ Quintal)	Arrival (In MT)	Price (Rs./ Quintal)
Month	2015		2016		2017		2018		2019	
January	604	3285	511	3638	524	2250	493	2000	478	2912
February	654	3135	600	2764	622	2304	551	2078	571	2708
March	575	2913	609	2008	566	2000	543	2300	559	4840
April	652	3283	611	1779	506	1957	512	2491	519	3261
May	389	3772	421	1924	378	1593	423	1862	403	3096
June	365	3212	401	4469	410	2800	475	3168	379	3438
July	358	4012	323	5380	426	4423	411	6796	445	4944
August	472	3420	525	3420	301	4063	518	7192	456	5083
September	409	3504	459	3076	387	3674	453	4813	482	4563
October	459	4113	500	3338	391	3280	523	5063	466	6000
November	432	5091	503	3140	371	3346	469	6500	491	5140
December	478	3440	467	2469	458	2692	524	4167	693	2760
	Onion									
January	802	2723	860	2196	849	1872	760	4885	1027	2050
February	867	2900	1030	1968	1029	1670	823	3891	953	2000
March	1019	2554	918	1908	1089	1681	865	3021	1057	2324
April	972	2426	882	1617	1073	1696	877	3748	781	2522
May	1016	2280	888	1424	886	1585	904	1963	1004	2523
June	1064	2450	1143	1627	1036	1864	947	2938	962	2938
July	942	3285	966	1972	983	2126	830	2592	829	2767
August	828	6128	946	1888	1069	3127	844	2500	862	3338
September	829	6278	912	1676	961	3117	975	2470	744	5167
October	831	5058	984	1700	1059	3621	885	2560	757	5625
November	1000	4064	1024	2108	954	4580	881	2754	849	7080
December	1032	2300	933	2100	782	4938	945	2108	756	10760

[Source : Agricultural marketing information network]

Variation of prices of onion and tomato in each of last five years (2015-2019)

The variation of prices (difference between maximum and minimum prices) of onion and tomato

in Delhi market in each of last five years has been computed from available data and shown below in Block-I and Block-II respectively :

	Block-I	**Block-II**
In 2014-15	Rs.3998/Quintal.	Rs.2098/Quintal
In 2015-16	Rs.772/Quintal	Rs.3601/Quintal
In 2016-17	Rs.3353/Quintal	Rs.2830/Quintal
In 2017-18	Rs.2922/Quintal	Rs.5330/Quintal
In 2018-19	Rs.8760/Quintal	Rs.3292/Quintal

ANALYSIS OF DATA

Trend and pattern analysis

The trend of market arrival volumes and prices of tomato and onion was carried out using linear growth analysis and the results are furnished in Tables 2 and 3. The result shows that there is a positive beta which indicates that the market volume increased over time in the case of tomato and onion. Both tomato and onion showed a generally positive trend for price over the last five years as the beta is between 0 and 1.

The result implied that the onion is the higher priced as compared to the tomato in the market over the last five years but the higher increase in price was noted for tomato which is approximately Rs.22.11 per year. As regards tomato, the market arrival on average per year had an increasing trend over the last five years but in the year 2017 the average market arrival suddenly dropped to 445 MT and thereafter again went on increasing. Regarding onion, the average market arrival per year followed an increasing trend during the year 2015 - 2017 but in the year 2018 the average market arrival dropped to 878 MT and in the year 2019 it increased to 881.75 MT. The reason for this decreasing trend could be due to rising prices.

The degree of interconnection between prices and market arrivals of onion and tomato in Delhi Azadpur mandi

The market arrivals and price pattern of onion and tomato for the period 2015-2019 was conducted using mean value and coefficient of variation (CV) for each of twelve months and the result is furnished in Table 3. The onion and tomato have a lower CV in market volume but higher CV in price that means the market arrival of both onion and tomato fluctuates less but the prices fluctuate more.

Impact of seasonality on arrivals and prices of onion and tomato: It has been found from the analysis that the onion has a lower seasonal variation in market volume (53.62%) as compared to tomato while tomato has the lower price variation (326.61%) as compared to an onion. Moreover, it is found that onion had a high seasonal market volume in May/June while the price went up during August, September, and October. In the case of tomatoes, the seasonal market volume was found to be high from January to April and the price went up mostly in July and August.

Table 2 : Prices and volumes trend and pattern

Vegetable	Trend for	Coefficient	Constant	R^2	Linear growth rate
Tomato	Price	22.113	.605	0.073	0.057
	S.E	3.498			
	Volume	18.934	.427	0.051	0.0213
	S.E	1.095			
	S.E	3.498			
Onion	Price	17.378	.817	0.0642	0.078
	S.E	2.546			
	Volume	11.174	.315	0.038	0.0417
	S.E	0.983			

[Source : Generated by Authors]

Table 3 : Variation as measured with respect to volumes and prices

Veg.	Variation measured in volumes				Variation measured in prices			
	Max.	Min	Mean	CV	Max.	Min	Mean	CV
Tomato	693	301	482.56	17.66	7192	1593	3535	36.35
Onion	1143	744	926.25	10.51	10760	1424	3017.18	54.71

[Source : Generated by Authors]

Relationship between prices and market arrivals: For analyzing the relationship between price and the market arrival of tomato and onion, a model of multiple regression was used. The result of the regression indicates that the lagged price for both tomato and onion maintained a positive and significant relationship with present prices and market arrivals. It is evident from the results furnished in Table 4 that tomato and onion had the R^2 of 0.072 and 0.067 respectively which indicates that 72% and 67% of the variations in current prices of tomato and onion were explained by lag price and the volume of the said crop.

Table 4 : Relationship between prices and arrival volumes

	Coefficients			
	Lag price	Volume	Constant	R^2
Tomato	17.008	60	.625	0.072
Onion	23.554	60	.784	0.067

[Source : Generated by Authors]

EFFECT OF FUEL PRICES ON PRODUCE PRICES

The impact of fuel prices on produce prices was studied by analyzing a series of relevant data for truck rates and prices across different produce sources of tomato and onion.

Trucking rates

A series of data on transportation costs for full truckload from different produce sources of onion and tomato to Delhi were collected for 2015-2019 from websites. The onion arrives at Azadpur Mandi from Alwar (Rajasthan), Nashik (Maharastra), Nalanda (Bihar), Dewas (M.P), Indore (M.P), Jodhpur (Rajasthan) while tomato arrives at Azadpur Mandi from Shivpuri(M.P), Chhindwara(M.P), Solan(H.P), Karnal(Haryana), Amroha(U.P) across the calendar year.

It has been estimated how truck rates are impacted by the change in fuel(diesel) prices for different routes with varying distances (distance between sources of produce and Azadpur Mandi). The following regression model was constructed and applied to the different truck route price series to see the relationship of transportation costs with fuel prices:

$$\mathbf{T_{rate\ (i,d)} = \beta_1 + \beta_2\ ln(P_{diesel}) + \beta_{seas}\ (T_{season}) + \beta_{sup}\ (T_{supply}) + \beta_3(Trend) + \beta_4(Trend)^2}$$

Where

$T_{route(i,d)}$ is the median cost of transport from Alwar (Rajasthan), Nashik(Maharastra), Nalanda (Bihar), Dewas (M.P), Indore (M.P), Jodhpur(Rajasthan) to destination city, d (Azadpur Mandi Delhi) in week i;

T_{season} represents a vector of seasonal dummy variable

T_{supply} represents a vector of supply dummy variable k which specifies the quality, size, appearance, color, and condition of the produce being sent to the terminal market.

P_{diesel} represents average diesel prices of the previous five weeks

The above model was applied with the following considerations :

(i) For the seasonal dummy variable, the calendar year was divided into four parts: January to March, April to June, July to September, and October to December.
(ii) Each time series was tested using the Augmented Dicky Fuller test.
(iii) Only coefficients associated with fuel(diesel) price variables were exhibited in the results table because a large number of routes were considered in this study with the main focus on fuel price effects.
(iv) A linear and quadratic time trend was inducted to take care of technological growth as well as other time factors. The outcome of this approach gave birth to several faulty results as these two commodities undergo growing seasons or peak distribution periods that overlap calendar years.

The result of this regression is exhibited in Table 5. where we observe different patterns relating to the transport cost and the distance travelled from different sources of produce. In this study, since a large number of routes have been considered and the main focus lies on fuel price effects, only coefficients

Table 5 : Regression result for the truck rate analysis

	Nshik	Patna	Chindwara	Dewas	Shivpuri	Amroha	Alwar	Karnal
P_{diesel}[1]	0.069***	0.067***	0.064*	0.063***	0.036***	0.014**	0.013**	0.008
Std. error	0.006	0.006	0.005	0.005	0.004	0.012	0.012	0.010
R^2	65.28	63.82	68.55	64.52	69.20	58.96	27.58	26.33
N	240	239	234	238	240	239	238	240
Avg. T_{rate}	0.149	0.147	0.148	0.147	0.112	0.103	0.088	0.079
Distance[2]	1264 km	1142 km	927 km	881 km	451 km	152 km	150 km	131 km
%increase in T_{rate}[3]	46.30	45.57	43.24	42.85	32.14	13.59	14.77	10.12

[Source : Generated by Authors]

** Indicates significance at least at the 10-percent level,

*** Indicates significance at least at the 1-percent level.

[1]Coefficient for the main variable of interest, P_{diesel}. The remaining independent variables considered in this model are T_{season}, T_{supply}, Time trends(linear) and Time trends(quadratic). For the shake of simplicity, the regression result has not been presented with dummy variables that is T_{season}, T_{supply}.

[2]Distance refers to the approximate road distance (in km) from produce sources to the Azadpur mandi, Delhi.

[3]Percentage increase in T_{rate} is the estimated percentage impact on truck rates that would happen while considering a doubling of diesel prices.

for the fuel price variables are shown in the results tables.

It has been noted that diesel prices have a statistically significant effect on transport prices. The diesel prices increased the transportation cost(Rs./MT) as the distance between the source of produce and the destination i.e. the Azadpur Mandi increased but no linear relationship followed between the truck rates and the distance traveled from all the sources of produce to Azadpur Mandi. The nonlinear relationship is perhaps because of different demands for the Azadpur mandi from different sources of produce. For instance, the traveled distance between Alwar and Azadpur mandi is 8.42 times less than that traveled between Nashik and Azadpur, but the average truck rate for the Alwar route is about 59% that of the Nashik route. Moreover, the average truck rate for routes to Amroha and Shivpuri are approximately equal, although the Shivpuri route is 299 km longer.

In determining overall transportation costs, the non-linearity for the relationship between truck rates and distance covered suggests the importance of diesel costs in ascertaining overall transportation costs. Bearing in mind that our regression model is estimated considering truck rates in natural log form in diesel prices, the computed impact that the doubling of diesel prices would have on truck rates would be achievable. In our above-mentioned case, it would be the coefficient on diesel prices divided by the average truck rate for each route. Our results imply that the average truck rates for Nashik, Patna, Chindwara, Dewas, Shivpuri, would all rise by 32 to 46 percent in the event diesel prices happen to be double and for Amroha, and Alwar truck rates would go up by about 14 percent and that for Karnal would increase at least, by about 10 percent. By and large, our analysis leads to indicate that fresh produce prices are affected by fuel prices through transport costs. Moreover, there is a logical pattern of increasing marketing costs as the distance increases from the place of production to the terminal market.

Table 6 : Details of production, market arrivals and other price components in different years

Year	Production in India (In MT)	Arrival in Delhi Market (In MT)	Diesel prices (Rs./Ltr)	Average All India agricultural wages (Rs./day)	Price of fertilizer (Rs./MT)	Export made by India (In MT)	Global inflation	Price differential in the year (Max price – Min price)
FOR ONION								
2014-2015	18927420	11202	47.36	281.32	5360	1788127	2.77%	3998
2015-2016	20931230	11484	45.37	295	5360	3492718	2.77%	772
2016-2017	22409540	11770	59.47	315	5360	1922711	3.20%	3353
2017-2018	23245550	10536	70.80	320.85	3562	2182944	3.62%	2922
2018-2019	23610100	10581	65.84	333	3562	1149054	3.56%	8760
FOR TOMATO								
2014-2015	16368000	5874	47.36	281.32	5360	158505	2.77%	2098
2015-2016	18717000	5930	45.37	295	5360	41045	2.77%	3601
2016-2017	20693000	5340	59.47	315	5360	47446	3.20%	2830
2017-2018	19745000	5895	70.80	320.85	3562	99801	3.62%	5330
2018-2019	20515000	5942	65.84	333	3562	93622	3.56%	3292

[Sources : Generated by Authors based on APEDA,DGCIS Annual report, ICAR, www.faidelhi.org, www.livemint.com]

It may be mentioned that with the increase in distance traveled, the fuel sensitivity generally increases and this relationship holds in almost all the routes – from sources of produce to the terminal market. For the Karnal route, the coefficient of diesel prices is not significant as this estimation has no good explanatory power. As far as Nashik, Patna, Chindwara, and Dewas routes are concerned, these are long routes having statistically identical diesel price coefficients and on top of it, the length of the routes are closely comparable. The diesel price coefficients of these routes increase marginally with the distance. The diesel price coefficient and the length of the route of Shivpuri is about 54% and 39% respectively of that of Patna and deviates from the linear relationship while Alwar and Amroha are found to have a linear relationship.

INTERPRETATION OF DATA

The factors which are mainly responsible for the increase in the cost of the vegetables are (a)less production of vegetables, (b)increase in cost of production, (c)increase in the cost of transportation, (d)hoarding, and (g)global inflation (Siddique,2019). The cost of production has two main components – wages of labor and cost of fertilizer while the transportation cost depends mainly on diesel prices. The study reveals that for the production of one quintal of onion, the labor cost = 55.03%, and fertilizer cost is 14.83% of total production cost (cab.rbi.org.in/docs/special_study). On the other hand, for the production of one metric tonne of tomato, the labor cost is 71.80% and fertilizer cost is 20% of the total production cost (cab.rbi.org.in/docs/special_study). For the

interpretation of data, Table 6 has been generated and shown below.

(a)Prices of onion - The variation of prices has been analyzed based on the inputs from Table 6. In 2014-15, the variation of prices is Rs.3998/quintal when the production of onion was 18927000 tonnes, 9.44% of the total production was exported, the labour wages was the minimum (Rs.281.32) in five years span under consideration, cost of fertilizer was Rs.5360/MT and the global inflation was 2.77%. In 2015-16, the variation of prices dropped to Rs.772/quintal when the production increased by 10.58%, market arrival increased by 2.51%, diesel prices dropped, labour wages marginally increased, prices of fertilizer and global inflation remained the same, the export increased by 95.32%. So, it may be mentioned that in 2014-15, the variation of price (Rs.3998) within the year does not appear to be justified. In 2016-17, the variation of prices suddenly increased to Rs.3353/quintal i.e. three and half times as compared to that of the previous year when the production increased by 7%, market arrival increased by 2.49%, export decreased by 44.95% but diesel prices increased by 31%, labour wages increased by 6.77%, global inflation increased by 15.52% and fertilizer price remained same. So, in 2016-17, the price hike is justified but the quantum jump does not appear to be reasonable. In 2017-18, the variation of prices dropped to Rs.2922/quintal when the production increased by 3.73%, market arrival decreased by 10.48%, diesel prices increased by 19%, labour wages increased marginally, fertilizer prices decreased heavily by 33.54% and export increased by 13.53%. So, with all these combined effects, the price difference experienced in this year appears to be reasonable. In the year 2018-19, the price difference increased drastically to Rs.8760 (i.e. more than eight and half times) if we compare this with the previous year despite an increase in production and market arrival, decrease in diesel prices, export, and global inflation, marginal increase in labour wages and fertilizer prices remain same. Therefore, undoubtedly the price hike is exorbitant.

(b) Prices of tomato – In 2014-15, the variation of prices in the Delhi market was found to be Rs.2098/quintal when the tomato production in the country was 16368000 tonnes and the export was 0.97% of total production. In 2015-16, the price difference increased to Rs.3601 when the tomato production in the country increased by 14.35%, market arrival increased marginally, diesel prices and export decreased, fertilizer prices and global inflation remained the same but the labor wages increased by 4.86%. So, 71.63% in price difference for the year as compared to that of 2014-15 appears to be unjustified. In 2017-18, it has been noted that the price difference in the year dropped to Rs.2830/quintal as the production increased to 20693000 tonnes and this was recorded as the highest in the five years considered in this study. In 2017-18, the maximum price difference of Rs.5330/quintal was recorded for the year when the production of tomato in the country marginally dropped by 948 tonnes, market arrival increased by 10.39% irrespective of export getting increased to double, diesel prices increased by 19.05%, fertilizer prices drastically decreased by 33.54% and labor wages increased marginally. So, 88% of the price difference in the year as compared to that of 2016-17 appears not to be reasonable. Ultimately, in 2018-19, the price differential was reduced to Rs.3292/quintal as compared to that of 2017-18 although the tomato production in the country was increased to 20515000 tonnes.

Analysis as per Cobweb's theory:

The average market arrival(In MT) and market price(In Rs./Quintal) of tomato and onion in Delhi market as computed from above are shown in Block-I and Block-II respectively:

	Block-I		**Block-II**	
Year	Arrival	Price	Arrival	Price
2014-15	487.25	3593,30	933.50	3537.16
2015-16	494.16	3117.08	957	1848.66
2016-17	445	2865.16	980.83	2656.41
2017-18	491.25	4035.83	878	2952.50
2018-19	495.16	4062.08	881	4091.16

For tomato, we see that in 2015, the average price of tomatoes in the Delhi market was Rs.2913/quintal when the average arrival of tomatoes was 575 MT. In 2016, the average arrival slightly increased and the average price came down which conforms with Cobweb theory. But in 2017, the prices came down instead of going up when the average arrival was less as compared to the previous year which contradicts Cobweb's theory. In 2018, the average arrival increased and average prices also increased remarkably as compared to the previous year. In 2019, the average arrival further increased but the average prices also increased. So, we observe the contradiction of Cobweb's theory also in the year 2018 and 2019.

For onion, it is observed that in 2016, with a 2.51% increase in arrival as compared to the previous year, the price has gone up by 47.73% which is unexpected though it obeys the basic principle of Cobweb theory. In 2017, the average market price increased with the increase in average market arrival which contradicts Cobweb's theory. Again in 2019, the market arrival increased by 0.34% when the average price increased by 38.56%. which neither in conformity with Cobweb's theory nor it sounds ethical.

CONCLUSION

The study and analysis have done above expose that in the Delhi market the variation of prices of onion and tomato were not because of low production and

low market arrival but because of most unethical pricing and marketing of these two vegetables.

In general, tomato and onion that go through an extreme variation of prices in our country and the government find it too difficult to satisfy the customers always with reasonable price and to ensure farmers with the prices of their satisfaction and due remuneration. The earlier study in this direction brings to our knowledge that onion was extremely volatile with a 52% coefficient of variation while tomato stood at second place with a 47% coefficient of variation. We found from our present study that the tomato and onion had the lower CV in market volume (17.66% and 10.51% respectively) but higher CV in price(36.35% and 54.71% respectively). That means the market arrival of both tomato and onion fluctuated less but the prices fluctuated more. The trend of the price of onion showed that high prices prevailed only for few months. In October 2018 onion prices went up in some parts of the country because of inadequate supply as there was a drought-like situation in the key onion growing state, Maharastra. Looking at the variation of prices in Delhi Azadpur Mandi in each time frame (2014-15, 2015-16, 2016-17, 2017-18, and 2018-19) for different factors presented in Table 6, it is very difficult to establish a constant logic for variation of prices in the mandi. The real scenario presents that there was a price hike in Azadpur mandi both in case of marginal drop as also in case of increase in market arrival. The same thing has been experienced in the case of fluctuation of diesel prices and labor wages. This indicates that pricing of both the items in Delhi Azadpur mandi did not follow any logical pattern and Cobweb's theory but the prices were built by marketers in the most unethical way as per their desire.

On analyzing the variation of prices of onion and tomato in the Delhi market the government may try to improve the circulation system of seeds, fertilizer, farm machinery, and other consumables related to the production as also to develop modern logistics infrastructure to create stable price and production of onion and tomato in the country. The agricultural products circulation must be improved backed up with modern logistics such as transport machines, perfect warehousing, distribution facilitation along advanced information network platform. The buffer stock of onion and tomato must be maintained and for this, enough storage capacity will have to be developed in Delhi. To encourage, invite and support private investments in this area the essential commodities act is to be removed. Imposing stocking limits or banning exports do not lead to a proper solution. The objective of the government should be to process and export at least 15% of onion and tomato produced in the country but at present India exports about 12% of fresh produce of onion in dehydrated form and about 1% of tomatoes. The analysis and suggestions laid down in this paper may help the government to control the sudden price hike of onion and tomato in the future.

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