

An Economic Analysis of Vegetables Volume and Price Behaviour in Trinidad and Tobago

**Brandon Murphy¹, Kathiravan Gopalan²
and Wayne Ganpat³**

Department of Agricultural Economics and
Extension,
Faculty of Food and Agriculture,
The University of the West Indies,
St. Augustine, Republic of Trinidad and
Tobago, WI.

The prices of vegetable and the volumes of their arrival are the major determinants of consumer food choices and, in turn, dietary quality. Vegetable prices and volume vary across Trinidad and Tobago, but until now, an analysis that provides a consistent and statistically detailed measure of prices and volumes did not exist. Consequently, this study was planned to examine the behaviour and pattern of fluctuations in prices and arrivals of 22 major vegetables consumed in Trinidad and Tobago, using monthly data for a period of 10 years from 2006 to 2015 obtained from the National Agricultural Marketing and Development

Corporation (NAMDEVCO). The seasonal indices were worked out by using ratio to moving average decomposition method which was followed by the evaluation of seasonality. Besides, the nature of relationship between market arrivals and prices was analysed using lag-linear model. The results revealed that the seasonality was high (38.71 per cent) in the arrival of large melonegene and the low (11.79 per cent) in medium sweet peppers arrival to the market. However, the seasonality in price was more (53.68 per cent) in christophene arrival, while it was less (11.96 per cent) in green plantains. The results of lagged linear models indicated that past prices and volumes were important factors that determine the current prices and the marketed volumes in many vegetables.

Key words: Vegetables, Price Index, Volume Index, Seasonality, Growth Rate, Trinidad and Tobago

¹ Presenting Author; PG Scholar;

brandonmurphyc@gmail.com

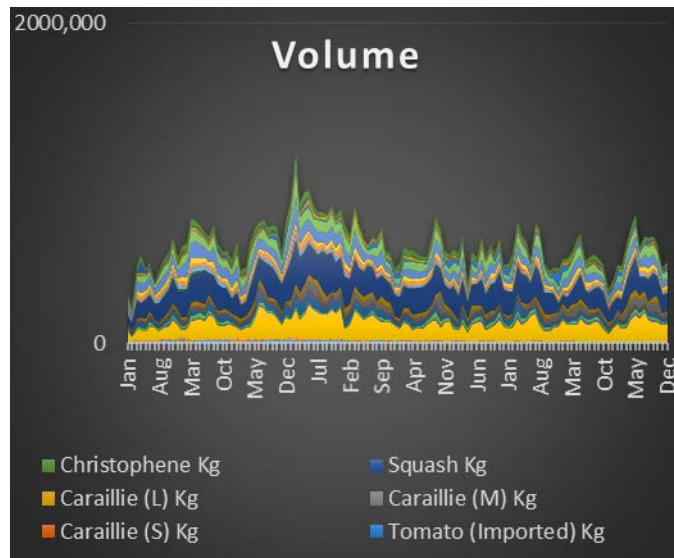
² Senior Lecturer, Kathiravan.Gopalan@sta.uwi.edu

³ Senior Lecturer and HOD,
Wayne.Ganpat@sta.uwi.edu

Introduction

Trinidad and Tobago's agriculture sector is considered economically small, but socially imperial. Although the domestic consumption exceeds domestic production and only a few essential commodities are produced in any significant quantity, the sector's contribution to the country's GDP has been minute over the last decade. In Trinidad and Tobago vegetables are very essential for the nutrition security of the people, as it can be considered a staple in the country's daily dietary cuisines. "Vegetables and fruits was the second highest commodity to be imported by T&T, and the highest in terms of proportion of total food import values, according to data from the Central Statistical Office (CSO) for 2011." (Clyne 2016) Thus, the

prices of vegetables and the volumes of their arrival are the major determinants of consumer food choices and, in turn, dietary quality. This study is based on market arrivals and wholesale prices of different vegetable crops collected from the National Agricultural Marketing and Development Corporation (NAMDEVCO). As summarized below, the data from NAMDEVCO shows the cumulated totals of each vegetables throughout the ten year span. It can be deduced that, during the period 2006-2015, there were vacillations in the market arrivals of vegetables traded which may influence variations in the respective prices. The variations in the volume of these crops lead to wild fluctuations in their prices thus exposing the vegetable producers to more risk.



This study was done to gain insights into the behaviour and pattern of fluctuations of market arrivals and prices of a selected array of vegetable crops in Trinidad and Tobago.

More specifically, the study had two objectives:

- (i) to examine the pattern of market arrivals and prices of selected vegetable crops in terms of the degree of variability market of Trinidad and Tobago, and

- (ii) to analyse relationships between market arrivals and prices, both over the years and across months

Methodology

The study analyses the behaviour and pattern of fluctuations in prices and arrivals of 22 major vegetables consumed in Trinidad and Tobago, using monthly data for a period of 10 years from 2006 to 2015 obtained from the National Agricultural Marketing and Development Corporation (NAMDEVCO). After compilation of data, functional analysis such as seasonal indices, standard deviation (S.D.), co-efficient variation (C.V.), minimum and maximum values, and regression were computed for precision in conclusion. The computation procedure, of these analytical tools is given in the following section. From this equation, the linear growth rate was derived using the following procedure;

$$\text{Linear growth rate (LGR)} = \frac{\beta_t}{\bar{y}} \times 100$$

where,
b = Regression coefficient
 \bar{y} = Arithmetic mean

Seasonality

The seasonal indices were worked out by using ratio to moving average decomposition method. Seasonality in prices and market arrivals was estimated as follows.

$$S_i = \left[\frac{(Ih - Il)}{Il} \right] * 100$$

Where Ih = highest value of seasonal index, Il = lowest value of seasonal index

Lag-linear model

The nature of relationship between market arrivals and prices was analysed using lag-linear model. This can be further explain using the following notation;

$$P_t = f(P_{t-1}, Y_t)$$

Where P_t = current price,

Growth rate:

This was computed using the annual trend in the arrivals volumes and prices of commodities.

A linear trend line was used, and will have similar equations as follows:

$$Y = \beta_0 + \beta_t + U_i$$

where,
Y = Monthly volumes / price
t = Time period
U_i = Random errors

P_{t-1} = lagged price; and
 Y_t = current arrivals of selected vegetables markets

Karl Pearson correlation coefficient

The Karl Pearson correlation coefficient was computed to find the degree of relationship between market arrivals and prices. This is a measure of the linear correlation between two variables, X_i(market volume) and Y(current vegetable price), giving a value between +1 and -1 inclusive, where 1 is total positive correlation, 0 is no correlation, and -1 is total negative correlation. This can be calculated using the following formula;

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}}$$

where:

n = number of observations

X_i = market volume data for vegetables

y_i = current market price

RESULTS AND DISCUSSION

Trends in arrivals and prices of vegetables

A trend analysis was done to examine the market market volumes and prices of selected vegetables as is presented in Table 1 and Table 2. The results indicate that although Ochro is the highest priced vegetable in the market over the past ten years, the highest increased price is Seim Beans of approximately \$0.0929 per year. Also, in spite of having the largest increase in market arrivals of 226.26kg per year, the study found that green plantains has the least increased price with an average of \$0.008. Likewise, pumpkin volume has the lowest increase in the market arrivals, but the lowest increase of an estimate -235kg. Thus, this

suggest that the pattern of market arrivals and price behaviour of vegetable crops both over the years and across the months which have significant importance.

The pattern of market arrivals and price behaviour of the selected vegetable crops over the period 2006-2015 was examined using the mean value and the coefficient of variation for each of the twelve months. Table 2 explains that, small tomatoes and green plantains have the lowest CV market arrival and price respectively, which implies that there is low dispersion. Conversely, the highest CV market volume and price were squash and christophene.

Table :1

Name of Crop	Trend for	Coefficient	Constant	R2	Linear Growth Rate	Column 1	Name of Crop2	Trend for2	Coefficient3	Constant	R2	Linear Growth Rate6	
Bodi beans	Price	0.0903	19.3685	0.2493	0.3636		Melongene (M)	Price	0.0587	3.9922	0.4647	0.7781	
	S.E	0.0144	1.0053					S.E	0.0058	0.4046			
	Volume	-70.8567	14046.9374	0.3747	-0.7260			Volume	18.5916	14249.573	2	0.0123	0.1209
	S.E	8.4262	587.4313					S.E	15.3550	1070.4740			
Seim beans	Price	0.0929	8.0558	0.5580	0.6794		Melongene (L)	Price	0.0732	5.0701	0.5222	0.7709	
	S.E	0.0076	0.5305					S.E	0.0064	0.4496			
	Volume	-29.9196	6693.5374	0.2617	-0.6127			Volume	-126.2898	39876.888	1	0.0764	-0.3918
	S.E	4.6268	322.5579					S.E	40.4122	2817.3332			
Cucumber	Price	0.0260	4.0326	0.1450	0.4639		Ochro	Price	0.0752	17.1927	0.1468	0.3457	
	S.E	0.0058	0.4055					S.E	0.0167	1.1629			
	Volume	58.1810	108987.4910	0.0028	0.0517			Volume	-18.8293	9261.5037	0.0630	-0.2318	
	S.E	101.7541	7093.7780					S.E	6.6841	465.9823			

Melongene (S)	Price	0.0428	2.8739	0.3988	0.7838	Plantain (Green)	Price	0.0078	8.3599	0.0267	0.0879	
	S.E	0.0048	0.3372				S.E	0.0043	0.3008			
	Volume	48.5796	4303.7498	0.1379	0.6707		Volume	226.2618	10315.4237	0.1756	0.9426	
	S.E	11.1832	779.6346				S.E	45.1303	3146.2509			
Name of Crop	Trend for	Coefficient	Constant	R2	Linear Growth Rate	1	Name of Crop2	Trend for2	Coefficient	Constant4	R2	Linear Growth Rate6
Plantain (Ripe)	Price	0.0149	8.1495	0.0837	0.1652	Sweet Pepper (L)	Price	0.0718	10.7807	0.2409	0.4747	
	S.E	0.0046	0.3173				S.E	0.0117	0.8182			
	Volume	20.8717	21389.7733	0.0055	0.0921		Volume	-88.6243	24872.8751	0.1999	-0.4542	
	S.E	25.8102	1799.3526				S.E	16.3233	1137.9743			
Pumpkin	Price	0.0152	2.1898	0.1576	0.4885	Tomato (S)	Price	0.0509	7.3487	0.1519	0.4875	
	S.E	0.0032	0.2254				S.E	0.0111	0.7711			
	Volume	-235.7001	157739.3939	0.0375	-0.1643		Volume	-10.3370	27248.3676	0.0022	-0.0388	
	S.E	109.8849	7660.6135				S.E	20.0459	1397.4947			
Sweet Pepper (S)	Price	0.0509	6.9032	0.2146	0.5096	Tomato (M)	Price	0.0647	9.1940	0.1936	0.4933	
	S.E	0.0090	0.6244				S.E	0.0122	0.8471			
	Volume	-14.6647	7420.3007	0.0375	-0.2245		Volume	-207.0088	70228.9013	0.1235	-0.3587	
	S.E	5.5573	387.4242				S.E	50.7680	3539.2856			
Sweet Pepper (M)	Price	0.0632	8.7541	0.2336	0.5024	Tomato (L)	Price	0.0769	11.0889	0.2211	0.4883	
	S.E	0.0105	0.7346				S.E	0.0133	0.9258			
	Volume	-68.9416	19059.3521	0.1944	-0.4631		Volume	-42.7921	54659.2394	0.0055	-0.0822	
	S.E	12.9209	900.7795				S.E	52.7648	3678.4904			

Table 2

Measures of variations in volumes					Measures of variations in Price				
Vegetables	Max	Min	Mean/ Average	CV		Max	Min	Mean/ Average	CV
Bodi beans	20662.0000	3666.0000	9760.1080	0.5795		41.0300	9.9600	24.8301	0.5320
Seim beans	12487.5600	1483.3100	4883.4001	0.5809		23.2800	6.2900	13.6749	0.5485
Pigeon Peas	8083.5700	36.2900	1364.4075	0.7080		35.2700	9.5500	19.1093	0.4392
Cucumber	215659.2100	34308.0000	112507.4437	0.5562		16.6800	1.9900	5.6070	0.5836
Melongene (S)	34107.1200	576.0700	7242.8147	0.6691		12.6700	1.6500	5.4629	0.5863
Melongene (M)	41392.3500	4613.1000	15374.3633	0.5682		16.1000	2.4100	7.5463	0.5741
Melongene (L)	87677.5700	9597.7100	32236.3528	0.6099		19.8900	3.3000	9.5008	0.5653
Ochro	19080.0000	3942.0000	8134.8709	0.5491		42.6700	9.9800	21.7398	0.5478
Plantain (Green)	135485.1100	2236.2400	24004.2642	0.7456		12.2350	5.0300	8.8295	0.5182
Plantain (Ripe)	50093.1500	2968.8200	22652.5104	0.5864		14.0633	4.2100	9.0538	0.5202
Pumpkin	268348.2400	47809.1400	143479.5363	0.5426		9.6400	1.2900	3.1090	0.5851
Sweet Pepper (S)	15023.2400	2041.2000	6533.0855	0.5527		19.9200	3.1900	9.9799	0.5692
Sweet Pepper (M)	30469.6300	5588.3500	14888.3853	0.5635		24.4500	4.8400	12.5776	0.5623
Sweet Pepper (L)	44216.4100	6506.9000	19511.1020	0.5597		28.2400	6.3000	15.1262	0.5545
Tomato (S)	51034.0500	12346.5400	26622.9793	0.5399		24.6600	3.9200	10.4252	0.5877
Tomato (M)	148756.4900	24716.6400	57704.8661	0.5602		28.9900	5.3300	13.1070	0.5717
Tomato (L)	160228.7500	19180.4800	52070.3178	0.5696		32.8400	6.9600	15.7391	0.5622
Carailie (S)	5223.2200	217.7300	2446.1208	0.6098		14.9700	1.6500	5.4959	0.5555
Carailie (M)	9176.3700	485.3500	4702.0416	0.5780		18.2800	3.6700	7.3301	0.5423
Carailie (L)	29933.4800	1508.2200	11447.5870	0.5931		22.3000	3.6300	9.1847	0.5390
Squash	70503.8400	136.0800	5908.0154	0.9790		16.4300	2.3000	7.5983	0.5622
Christophene	78835.1400	5617.8400	26875.7523	0.5796		33.8300	3.1600	12.6630	0.6163

Seasonality in arrivals and prices of vegetables

Seasonal indices of price and market volumes were estimated using ratio to moving average method and results are presented in Table 3. The study observed that seasonal fluctuations exist both in market arrivals as well as prices of tomato across the selected markets. The results show that christophene has the highest seasonal price of 53.68%, where the prices in latter seven months of the year have the greatest seasonal influence. Green plantains, per contra, is the least with 11.96%, as seasonality only impacts price in the first and last quarter of the year. Similarly, the

vegetable with the highest seasonality of market volume is melongene of 38.71%. The study revealed that seasonal market volume is highest within the months of March and April, but at its lowest in the month of December. On the other hand the vegetable with least seasonal variation in market volume is medium sweet pepper with 11.79%. This indicates that seasonality factors influences little on medium sweet peppers as compared to the other selected vegetables.

Table 3
Seasonal Indices

Vegetables	Price Index	Volume Index
Bodi beans	23.0382	17.7794
Seim beans	18.6846	25.2795
Cucumber	35.0941	26.1074
Melongene (S)	25.1968	25.0104
Melongene (M)	20.3739	14.2471
Melongene (L)	18.4894	38.7107
Ochro	27.0312	18.9092
Plantain (Green)	11.9759	35.0109
Plantain (Ripe)	15.7890	34.8711
Pumpkin	20.0982	16.5247
Sweet Pepper (S)	21.0383	18.3169
Sweet Pepper (M)	20.1124	11.7930
Sweet Pepper (L)	15.0887	15.7659
Tomato (S)	50.3687	35.8028
Tomato (M)	37.7452	24.8223
Tomato (L)	34.5421	22.4660
Carailie (S)	19.0515	18.7050
Carailie (M)	15.4010	19.2505
Carailie (L)	13.2853	21.0467
Squash	14.0156	33.6643
Christophene	53.6826	33.3714
	Christophene	Melongene (L)
Max	53.6826	38.7107
Min	11.9759	11.7930
	Plantain (Green)	Sweet Pepper (M)

Relationship between prices and market arrivals selected vegetables.

To understand the relationship that exist between market arrivals volume and price, regression equations were estimated and the results are summarized in Table 4. In general, the regression analysis indicates that the lagged price for each vegetable had a positive and significant correlation with current prices, and negative, but mostly significant with market arrivals. Also, the results connote that the lagged price of all the vegetables explained higher variations when compared to current market market volumes, thus indicating that the lagged price of the selected vegetables is an important factor in determining the current price than the market arrivals.

For example, Table 4 explains that Seim beans have the largest R^2 (0.811), indicating that 81.10% of the variations in current prices of seim beans is explained by lag price and volume of the said crop. Furthermore, the regression outlines, assuming everything else is constant, that a one dollar increase in the previous months price (lag price) may result in an average \$0.047 change in current price of seim beans. Thus indicating a positive relationship between the two variables. Likewise, ceterus paribus, a one unit increase in current market market volume may result in an average \$-0.314 change in current price of seim beans. Hence, signifying a negative relationship between the two variables.

Table 4
The Relationship Between Prices and Arrivals Volume of Selected Vegetables

Vegetables	Coefficients				R2
	Lag Price	Volume	Constant		
Bodi beans	0.0467	-0.314	18.109	0.413	
Seim beans	0.66	-0.351	8.412	0.811	
Cucumber	0.275*	-0.438	7158	0.298	
Melongene (S)	0.657	-0.32	2.047	0.432	
Melongene (M)	0.71	-0.111	3.131	0.51	
Melongene (L)	0.632	-0.304	5.76	0.606	
Ochro	0.637	-0.27	13.757	0.539	
Plantain (Green)	0.807	-0.98	1.9252	0.646	
Plantain (Ripe)	0.77	-0.173	2.845	0.627	
Pumpkin	0.664	-0.281	2.347	0.551	
Sweet Pepper (S)	0.54	-0.228	7.292	0.412	
Sweet Pepper (M)	0.506	-0.367	10.855	0.521	
Sweet Pepper (L)	0.539	-0.382	12.592	0.54	
Tomato (S)	0.527	-0.434	11.97	0.61	
Tomato (M)	0.48	-0.457	13.489	0.602	
Tomato (L)	0.598	-0.328	11.226	0.553	
Caraille (S)	0.505	-0.028	2.858	0.255	
Caraille (M)	0.544	-0.231	4.615	0.36	
Caraille (L)	0.535	-0.331	6.253	0.446	
Squash	0.34	-0.171	5.269	0.166	
Christophene	0.492	-0.446	13.496	0.65	

Conclusion

To conclude, the study found that there is significant importance to trend in market arrivals and price behaviour of vegetable crops both over the years and across the months, as the crop with the highest price increased was seim beans, while green plantains had the lowest price increase but the highest increase in market arrivals.

Following this, pumpkin showed to have the lowest increase in market arrivals. Likewise, small tomatoes and green plantains had the lowest CV market arrival and price respectively, implying that there is low dispersion.

The study observed that seasonal fluctuations, as christophene had the highest seasonal price of 53.68%, and green plantains with the least with of 11.96%. Similarly, the vegetable with the highest seasonality of market volume is melongene of 38.71% while the least seasonal variation in market volume is medium sweet pepper with 11.79%.

Finally, lag regression models were used to understand the relationship between prices and market arrivals. In synopsis, the lagged price for each vegetable had a positive and significant correlation with current prices, and negative, but mostly significant with market arrivals. Also, the study has confirmed the negative relationship between market arrivals and prices over the years.

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