An Economic Analysis for Maize Market in Egypt

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ABSTRACT

Maize crop is one of the food crops that have several uses, whether as a food for man or as animal feed. The domestic consumption was increased from about 10.1 million tons in 2000 to about 14.3 million tons in 2013. In the same period, the domestic production was raised from about 5.6 million in 2000 to about 6.9 million tons in 2014. The amount of imports was raised from about 4958.2 million tons in 2000 to about 10805.6 in 2014. The problem of the study is summarized in the continuing rise in the imports of maize despite the increase from the domestic production, which represents more burdens on the Egyptian trade balance under the liberalization of the exchange rate of the Egyptian pound and the decrease in its value before the dollar. The study aims to identify the developments occurred in maize market through studying the aspects of supply, consumption, imports and stock. A standard model is being designed. This model consists of four equations represented in the equation of the national consumption, imports and maize supply and the fourth equation is an identification equation that indicates that the consumed amount of maize crop is equal to the amount produced locally plus the amount of imports and the change in the stock of maize at the end of the year. The method of estimation of two stages least square (2 SLS) has been used. The model has been estimated in the first stage and then the reduced form and the estimates of the reduced form were more logical and identical to the economic logic.

Key words: Maize market, domestic production and consumption, Economic, Egypt.

Introduction

Maize crop is one of the food crops that have several uses, whether as a food for man or as animal feed, due to its high nutrition value. Also, maize enters in the process of manufacturing some important products such as corn oil, fructose and starch. The amount of the Egyptian imports of maize reached to about 4821.2 thousand tons in the average period (2000-2013) at a value reached to about 1032.75 million dollars, as an average for the same period, which represents about 28.1% of the total value of the imports of plant products during the same period .

The Problem of the Study:
The problem of the study is summarized in the continuing rise in the imported quantities of maize, as they were increased from about 4958.2 million tons in 2000, at a value estimated at about 555 million dollars, to about 10805.6 million tons in 2013, at a value estimated at 1809.9 million dollars, i.e., at a proportion of increase reached to about 118%, 226% in quantity and value respectively, as it does not commensurate with the increase in the domestic production from about 5.6 million tons in 2000 to about 6.9 million tons in 2012 at a rate of increase reached to about 23.2%.

The Aim of the Study:
The study aims to identify the developments occurred in maize market in Egypt through studying the aspects of production, consumption, imports and stock and the factors affecting them.

The Method of the Study and Data Sources:
The study has depended on the analytical method from both the theoretical and quantitative sides, as some statistical methods, such as the general time trend and the economic models, have been used and an economic model for maize market in Egypt has been built. The study has depended on the annual data available from the Central Agency for Public Mobilization and Statistics and the Food and Agriculture Organization F.A.O.

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Results and Discussion

The Directions of Maize Production:
The Global Production:

The average of the area cultivated with maize reached to about 161.6 million hectares during the period (2005-2012). In addition, nearly half of the cultivated area is concentrated in two countries which are China and the United States, as they produce about 63.5% of the total global production. The global production reached to about 713.7 million tons in 2005 and then it rose to about 872.1 million tons in 2012 at a rate of increase reached to about 22.2%. The United States is the first country producing maize crop in the world, as its production represents about 37.5% of the total global production, while its cultivated area represented about 20.2% of the total cultivated area at the level of the world during the period (2005-2012). However, the production of the Arab Republic of Egypt reached to about 1% of the total global production during the same period, while Egypt represents the third place at the level of the African continent.

The Domestic Production:

Two kinds of maize (white – yellow) are planted in the Arab Republic of Egypt in both of summer seasons (mid-May – mid-June) and in the Nile flood during (July – August). The cultivation of the two kinds of maize is concentrated in Lower Egypt, as the total cultivated area reached to about 1053.6 thousand fadden producing about 27.1 million Ardebs, i.e., at a proportion of 48.8%, 52.62% respectively, in 2013, of the total area and production at the level of the Republic. However, the total production of Middle Egypt reached to about 1.39 million Ardebs at a proportion reached to about 27% of the same year.

In addition, Beheira governorate is the first governorate in Lower Egypt to produce maize, as its production reached to about 218.4 thousand Ardebs at a proportion of 22.6%. Beheira governorate is followed by Sharqia governorate at a proportion of 22.5% in 2013.

Table No (1) shows the equations of the general time trend for the area, the total production and the productivity of the summer season and the Nile flood and the total of the two kinds of maize (yellow, white). It has been shown that the total area of the summer season of white maize has taken an increasing general trend that is statistically significant and it reached to about 27.1 thousand fadden at an annual rate estimated at about 1.49% of the average of the crop's area in Egypt, during the study period, that has reached to about 1813.3 thousand fadden. The significance of increase in the total production was not stable during the same period, as the rate of increase has reached to about 44.9 thousand tons annually that represents 0.72% of the average of the total production that reached to about 6233 thousand tons. This is due to the decline in the productivity, as it was shown that it has taken a decreasing general trend that is statistically non-significant and it reached to about 0.015 tons annually. Moreover, by studying the general time trend of white maize, whose area represents about 85.3% of the total cultivated area and produces about 86.2% of the total production of summer season for 2013, (3) it was shown that the area and the total production have taken an increasing general trend by about 6.38 thousand fadden, 6.78 thousand tons at an annual rate reached to about 0.39, 0.12% of their averages that reached to about 1.644 million fadden, 5.631 million tons respectively.

Table 1: The Evolution of the Area and the Total Production of the Two Kinds of Maize in the Arab Republic of Egypt during the Period (2000-2012).

Year	Yellow Maize			White Maize		
	Area	Productivity	Production	Area	Productivity	Production
2000	21.7	2.248	48.9	305.2	2.54	775.2
2001	28.2	2.435	68.6	276.6	2.49	680.2
2002	21.3	2.494	53.1	281.2	2.49	701.4
2003	19.9	2.697	53.82	307.4	2.58	794.8
2004	41.9	2.73	114.3	306.3	2.56	773.8
2005	40.6	2.758	112.1	276.5	0.602	719.4
2006	36.2	2.565	92.9	246	2.708	666.1
2007	45.0	2.609	117.4	242	2.773	671.1
2008	59.9	2.921	175.0	308.9	2.98	920.3
2009	84.8	2.799	237.3	278.3	2.89	804.3
2010	71.8	2.412	173.1	273.1	2.688	734
2011	64.4	2.84	183	292.1	2.766	807.8
2012	70.3	2.991	210.3	252	2.69	677.8

Source calculated from: the Ministry of Agriculture and Land Reclamation – the Central Administration of Agricultural Economics – different issues (2000-2014).

In addition, Table (2) shows that the total area of the summer season production of yellow maize has taken an increasing general trend that is statistically significant and it has reached to about 22.6 thousand acres, 69.6 thousand tons at an annual growth rate reached to about 12.83, 12.57% of their averages that have reached to about 176.2 thousand acres, 553.6 thousand tons. As for the total Nile maize as shown in table (2), the total area

and total production have taken an increasing general trend that is statistically non-significant at an annual growth rate estimated at about 0.77, 2.19% of the total average that has reached to about 326 thousand acres, 867.7 thousand tons respectively. Also, it is shown that the area of Nile white maize has taken a decreasing general trend that is non-significant at an annual growth rate reached to 0.76%, however, the total production of it has taken an increasing general trend that is non-significant at a growth rate reached to 0.33% of the average that has reached 280.5 thousand acres, 748.2 thousand tons respectively. Moreover, the general trend of the area and the total production of yellow maize has taken an increasing general trend that is statistically significant at an annual growth rate reached to about 15.79, 11.74% of the average that has reached to 31.6 thousand acres, 126.1 thousand tons respectively.

Table 2: the Equations of the General Time Trend of the Area and Production of Maize Crop during the Period (2000-2013)

Items	Equations	R^2	$\bar{x}$	Significance	The Annual Rate of Growth %
The total of summer maize:					
Area	$\acute{y}_1 = 1614.8 + 27.1\ x$	0.52	1813.3	*	1.49
Total production	$\acute{y}_2 = 5918.6 + 44.9\ x$	0.28	6233	-	0.72
Summer white maize:					
Area	$\acute{y}_3 = 1599.4 + 6.38\ x$	0.05	1644.1	-	0.39
Total production	$\acute{y}_4 = 5584.1 + 6.78\ x$	0.006	5631.5	-	0.12
Summer yellow maize:					
Area	$\acute{y}_5 = 17.49 + 22.6x$	0.93	176.2	**	12.83
Total production	$\acute{y}_6 = 66.42 + 69.6\ x$	0.93	553.6	**	12.57
The total maize in the Nile flood:					
Area	$\acute{y}_7 = 308.5 + 2.53x$	0.13	326	-	0.77
production	$\acute{y}_8 = 762.2 + 15.1\ x$	0.31	867.7	-	2.19
The Nile white maize:					
Area	$\acute{y}_9 = 295.4 + 2.12x$	0.12	280.5	-	0.76
Total production	$\acute{y}_{10} = 730.6 + 2.51\ x$	0.01	748.2	-	0.33
The Nile yellow maize:					
Area	$\acute{y}_{11} = 11.7 + 4.99x$	0.80	31.6	*	15.79
Total production	$\acute{y}_{12} = 22.4 + 14.8x$	0.82	126.1	**	11.74

As = the estimated value of the dependent variable in the n year.
= time variable as n = 1, 2, ……………, 15.
*: significant, - non-significant.
Source: collected and calculated from the data of table No (1).

Maize Consumption:

The average of the global consumption of maize during the period (2001-2009) reached to about 702 million tons and it was raised to reach to about 926 million tons as an average for the period (2010-2013). The proportion of the United States' consumption represented about 30.2% of the total global consumption, followed by China at a proportion of 20.5% as an average for the period (2000-2013). The Arab Republic of Egypt is the largest country consuming maize at the level of the African continent. The aspects of consuming maize are several, as maize flour is used in baking bread in the rural areas as it is mixed with wheat flour and some other grains with fenugreek and the proportion of the consumption of it in this field reached to about 20% of the total domestic production for 2012. In addition, maize grains enter in poultry and animal feed industry, as well as they are used in the mail of several industries and the most important of these industries are extracting starch, sugar and glucose and oils industry. The cobs of green maize are used in manufacturing silage and the proportion of what enters in its industry is estimated at 10% of the total domestic production. The equation of the general time trend of the domestic consumption of maize shows the increase in the domestic consumption at an annual rate reached to about 113.6 thousand tons that represent 1% of the average of the amount of the annual consumption that reached to about 11207.2 thousand tons during the period (2000-2013).

$Y_1 = 10411.9 + 113.6\ x_1$

where : Y_1 = total domestic consumption of maize in Egypt 1,....,10

$r^2 = 0.09$

The International Trade of Maize:

Maize represents about 11.7% of the commodities of the international trade for 2012, and this proportion is not characterized by stability as it differs according to the climatic conditions experienced by the countries that plant maize, in addition to the famines that drives some countries to consume all their production of maize.

The United States is the first country exporting maize, as the amount of its exports of maize in 2011 reached to 45.109 million metric tons whose value was estimated at about 12.882 billion dollars, and it was raised to about 50.565 million metric tons in 2014 at a value estimated at about 11.11 billion dollars. This is due to the decline in the prices of exporting maize, as it is expected that the United States' exports of grains and feed would reach to more than 29.9 billion dollars, down 2.1 billion dollars less than the previous year, due to the decline in the prices of wheat, maize and some feed products. Also, it is expected that the United States' exports of coarse grains would reach to about 9.5 billion dollars, down about 400 million dollars less than the previous year.

Moreover, Japan is the first country importing maize from the United States, as the average of the imported amount reached to about 9.5 million tons as an average during (2013-2014) an average of a value estimated at 2.27 billion dollars during the same period at a proportion reached to about 26.3% of the total amount of exports and about 25.4% of the total value as an average for the period (2013-2015). In addition, Egypt has occupied the fifth rank at the level of the countries importing from America, as the imported amount reached to about 2.91 million tons estimated at about 59.8 million dollar for the same period.

Table 3: The Domestic Production and Consumption, the Egyptian Imports of Maize and the Price of the Importation per Ton during (2000-2013).

Year	Production per thousand tons	The available for consumption per thousand tons	The amount of imports Million dollars	The value of imports Million dollars	The price Importation
2000	5.6	10.1	4958.2	555	111.9
2001	6.1	11.65	4797.1	552	115.11
2002	6.43	11.1	4721	591.4	125.3
2003	6.23	10.33	4.53	1121.9	277.8
2004	6.73	9.105	2429	360	149.6
2005	7.7	12.8	5098	684.3	136.4
2006	6.91	10.65	3769	541.7	144.1
2007	6.93	11.4	4474	936.7	209.7
2008	7.4	12.5	2553.8	971.5	380
2009	7.4	9.32	1936.7	834.3	430.8
2010	7.7	12.5	5054.2	1268.2	250.9
2011	7.2	14.1	7041.8	2177.4	309.2
2012	6.9	10.1	3284	2054.2	1488.4
2013	8.3	14.3	6167	1809.9	1239.8

Source: Collected and calculated from the data of: the Central Agency for Public Mobilization and Statistics, unpublished data. The annual bulletin of the movement of production and foreign trade and the available from the agricultural commodities for consumption (2011-2013) the issuance of January 2015.

An Economic Standard Model for Studying the Variables of Maize Crop's Market in Egypt:

A standard model, that is commensurate with the aim of the study, has been designed. This model consists of four equations; the first equation is for the national consumption of maize, and the second equation is the equation of the Egyptian imports of maize. The third equation is the equation of supply maize, and the fourth equation is an induction equation that indicates that the consumed amount of maize is equal to the amount produced locally plus the amount of the imports of maize in addition to the change in the stock of maize at the end of the year.

The demand function has been estimated, as it is supposed that the amount of the consumption of maize is a function in the population, the price of consumers, the per capita income and the amount of maize used as animal feed.

The import demand function, also, has been estimated as it is supposed that the amount of the imports of maize is a function in the real price of importation, the real world price, the amount of the domestic production of maize and the dollar exchange rate in Egyptian pounds. As for the function of the domestic supply, it is supposed that the amount of maize supplied domestically is a function in the amount produced domestically, the amount of maize imports and the real farm price of maize per ton in the previous year. In addition, the induction equation shows that the amount of maize consumption is equal to the amount produced domestically plus the amount of imports and plus the change in the stock during the year.

It is shown from the analysis that the equations of the model are distinctive, so the proper method for estimation in this case is the method of least squares in two stages 2SLS The estimates of this method give a more accurate form for the total effects of the independent variables and the elasticities estimated in this method are more efficient. The real values have been used instead of the monetary values in order to reach to the

composition of the best formula of the standard model of maize market in Egypt, to avoid the problems of estimation and to achieve the condition of degree and grade in the model.

The Discussion of the Results of the Model:

Table (4) shows the results of the analysis (LS2S) for the entering and leaving variables in the standard economic model of maize market in Egypt during the period (2000-2013). In addition, table (5) shows the estimated elasticities for the basic variables in the model. The calculated value of F that is significant and estimated at the level of 0.01 has been shown, which shows the efficiency of the estimated relations in the model in expressing the relationship between maize consumption and the factors affecting on them as well as for the two equations of imports and supply. Also, it is shown from the D.W test that there is no self-correlation among the residuals, which shows the possibility of obtaining high-efficient estimates in the model. In the equation of consumption, the estimates has emphasized the positive relation among the consumed amount of maize, population and the consumed amount of animal feed, as the increase in population in million people leads to an increase in the consumption of maize by about 0.57 thousand tons, while the increase in the consumed amount of animal feed by thousand tons leads to an increase in the consumed amount of maize by about 187.6 thousand tons. Moreover, the study has shown the inverse relation among the consumed amount, the real price of consumers and the real price of importation, as the elasticity of the price of maize in Egypt has been estimated at about 0.04-, which means that the rise in the real price of consumers by about 1% leads to a decrease in the consumed amount of maize by about 0.04%. Also, the rise in the real price of importation for one ton of maize in Egypt, by about 1%, leads to a decrease in the consumed amount of maize by about 0.06 %. The estimates of the equation of consumption has emphasized the positive relationship between the consumed amount of maize and the real income, as the increase in the income by 1% leads to an increase in the consumed amount of maize by about 0.025%.

From the estimates of the function of importation, the estimates have shown the inverse relationship between the imported amount of maize and the real price of importation, the real world price and the exchange rate, as the increase in each of them by 1% leads to a decrease in the imported amount of maize by about 0.42%, 2.4%, 0.21% and 0.18% for each of them respectively. In addition, the estimates have shown the inverse relationship between the imported amount of maize and the amount of the domestic production, as the increase in the domestic production by 1% leads to a decrease in the imported amount of maize by 2.4 thousand tons.

From the estimates of the function of supply, the estimates have shown the positive relationship between the supplied amount of maize and both of the produced amount and the amount of imports, as the increase in each of them by thousand tons leads to an increase in the supplied amount by about 0.65, 0.37 thousand tons. Also, the positive relationship between the supplied amount and the real farm price in the previous year is shown from the estimates of the supply function, as the increase in the real farm price by 1% raises the supplied amount by 0.003%.

Table 4: Structural Estimates

Equation	Model	R^2	F	D.W
Import equation	$QI_t = 390.1-0.009_{PET} - 7.07_{wpt} - 0.05IP_t - 1.5_{qpt}$ (-2.5) (5.2) (-9.7) (-2.6)	0.97	125	2.2
Consumption equation	$QC_t= 1182 - 0.09_{IPt} + .21 + 91.7q_{Ft} -.23_{Pct}+0.4_{Put}$ (-3.1) (-.17) (9.9) (-4.5)(4.7)	0.89	19.2	1.6
Supply equation	$Qs_t = 3012.8 + 768.2_{qpt} +1.2_{qit} + .03_{Pft-1}$ (8.9) (8.7) (1.7)			

Source: Collected and calculated from the data of table (3)

Where: QCT= the consumed amount of maize in (2000-2013)

QIT= the consumed amount of maize in thousand tons (2000-2013),QST= the supplied amount of maize in thousand tons (2000-2013)

Qpt= the produced amount of maize in thousand tons (2000-2013),PUT= population in million people (2000-2013)

Qft= the amount of maize used as animal feed in thousand tons (2000-2013),DIT= the real per capita income in pounds (2000-2013)

PCT= the real price for consumers for one ton of maize in pounds (2000-2013),PFt-1= the real farm price for one ton of maize in pounds (2000-2013),PEt= the average of the exchange rate in dollars in pounds (2000-2013),Wpt= the average of the real world price for one ton of maize (2000-2013),IPt= the average of the real price of importing one ton of maize (2000-2013)

Table 5: Elasticities

	Pu	Pc	PI	PI	qp	Wp	Ep	Pf	Qm	Qf
Elasticities QI			-.42		-2.4	-.21	-1.8			
Elasticities QC	.57	-.04	-.06	.025						.38
Elasticities QS					.65			.003	.37	

Conclusion

The rise in the real price of importation for one ton of maize by 10% leads to a decrease in the consumed amount by 0.06%. In addition, the increase in the domestic production by thousand tons leads to a decrease in the imports by about 2.4 thousand tons. The rise in the exchange rate of dollar the Egyptian pound by about 10% leads to a decrease in the imported amount by about 0.42%. The rise in the real farm price for the previous year by 10% leads to an increase in the supplied amount by about 0.65%.

The study recommends the necessity to give an attention to increase the domestic production of maize whether in terms of the cultivated area or planting high production varieties, especially after the rise in the exchange rate from about 3.98 in 2001 to 7.0916 pounds to the dollar in 2014, and thus the rise in the cost of the imports of maize on the Egyptian national economy.

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