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Analytical Study on Factors Affecting Food Security Coefficient for Egyptian Wheat

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Abstract: The issue of food security is considered as a national security issue, that's why the government is making continuous efforts to raise the rate of food security. Wheat is one of the most important cereal crops in which the Egyptian people depend for their food, despite the recent efforts to reduce the wheat gap, by working to increase wheat production either by vertical expansion or horizontal expansion. However, the increasing demand as a result of the steady increase in the population and the diversification of the consumption pattern, has exacerbated the gap between production and consumption, forcing the country to rely on imports, exacerbating the deficit in the balance of payments and slowing the process of economic development. Therefore, the research aims to study the most important economic factors affecting the food security coefficient of wheat during the period (1996-2020) through the Tobit Censored regression model, which is concerned with studying the most important indirect factors affecting the food security coefficient.

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Key words: food security indicators, food security coefficient, strategic stock, Unit Root Test, Co-integration Test, Tobit Censored regression model.

Introduction:

The issue of food security is a national security, and that is why the government is making continuous efforts and working to raise the rate of food security as much as possible by increasing local production rates and reducing the volume of imports, especially in light of the current conditions and the suffering of the whole world from the Covid 19 pandemic, which causes some Risks from economic and political fluctuations, and that's why the country direct its agricultural policy to provide strategic food commodities from local sources. Several tracks are followed, most notably the development of the agricultural sector, increasing livestock, fish resources and poultry resources, increasing food support, especially for the most needy categories, reducing food loss and waste, raising awareness of the importance of proper nutrition, and improving food quality through strengthening food safety control. The report of the high Commissioner for Human Rights indicated that in 2019, Egypt advanced six places in the global food security index, ranked the 55th place globally, after it was in the 61st place during 2018. Egypt also ranked 23rd in the world in the food availability index, after it was the 39th during 2018, and ranked the 50th place in the food quality and security index, after it was in the 57th place.

Wheat is the most important cereal crop in which the Egyptian people depend for their food, whether directly in the production of bread and pastries, or in indirect form, where animal breeders use it as a basic food for animals. Despite the efforts made recently to reduce the wheat gap and raise food security rates, by working to increase wheat production, either by vertical expansion by raising productivity rates. Or the horizontal expansion by increasing the cultivated areas, where the area of wheat reached about 3.39 million acres in 2020, an estimated increase of 14% over 2005. However, the increasing demand as a result of the steady increase in the population and the diversification of the consumption pattern, exacerbated the gap between production and consumption, and then The burdens on the country budget increased with the increase in the imports bill.

Research problem:

The research problem is the increasing wheat gap in a way that negatively affects food security, forcing the country to rely on imports to reduce this gap and meet the needs of the population, as the amount of wheat imports in 2020 was estimated at about 12.5 million tons, equivalent to about 60% of the volume of consumption. At a value of about 2.7 billion dollars, representing about 18.9% of the total value of agricultural imports for the same year. While the value of wheat imports during 2010 amounted to

2.2 billion dollars, an increase of 23% over 2020.Which leads to an exacerbation of the deficit in the balance of payments and a slowdown in the process of economic development.

Research objective:

The research aims mainly to study the economic factors affecting the food security coefficient for wheat during the period (1996-2020), and to achieve this goal, some sub-objectives were studied:

1) Studying the current situation of production and consumption and the self-sufficiency rate of wheat for the same period.
2) Estimation of food security indicators of wheat during the same period.
3) Standard analysis of the most important factors affecting the food security coefficient for wheat.

Research method and data sources:

In achieving it's objectives, the research depends on the use of both descriptive and quantitative statistical analysis methods to explain the economic phenomena related to the subject of the research, and some statistical tools were used to estimate food security indicators, and standard model to estimate the food security coefficient for wheat was applied , To determine the most important factors that affect the coefficient of food security indirectly. The research depends on the published and unpublished secondary data issued by the official authorities, including the Ministry of Agriculture and Land Reclamation, the Central Agency for Public Mobilization& Statistics, and the General Authority for Supply Commodities, in addition to the results of previous research and studies related to the subject of the research.

Theoretical framework of the concepts used in the research:

1. The concept of food security:

There are many concepts of food security, as the Food and Agriculture Organization (FAO) explained that the concept of food security means "providing food for all individuals of the society in terms of quantity and quality which necessary to meet their needs on ongoing basis for a healthy and active life." This definition differs from the traditional concept of food security, which is linked to achieving self-improvement by the country's dependence on its resources and capabilities to produce its food needs locally. The World Bank defines it as the access of all individuals, at any time, to an adequate amount of adequate food for an active healthy life. The concept of food security includes four sub-axes: The first axis relates to availability, which is the availability of an adequate supply of food, and this axis relates to the provision of food, whether from local sources, imports or aid. While the second axis includes the ease of access to food by enabling different categories within the community to reach their food needs. The third axis relates to stability by achieving a stable level of food security, in the presence of a stock of important food commodities, especially grains. The fourth axis includes food safety in terms of the quality and safety of food, where the World Health Organization defines as all the necessary conditions and standards during the production, manufacturing, storage, distribution and preparation of food necessary to ensure that food is safe, reliable and healthy for human consumption.

2. Strategic Stock:

The strategic stock of a commodity is defined as the quantities maintained by the government and the private sector to meet the expected domestic or export demand for this commodity during a future period of time. The strategic stock during a certain period of time is the sum of the surplus directed to the development of the strategic stock in some years and the amount of the deficit that is withdrawn from that stock during other years in which a deficit appears in domestic consumption, and there are many factors affecting the organization and management of the strategic stock, including two adequacy periods Production and import coverage for domestic consumption, consumption differences in time and space, and global market conditions for the commodity.

3. Estimation of the food security coefficient:

The food security coefficient is one of the important indicators to measure the food security of a particular commodity, and its value ranges between zero and the correct one. The closer its value to zero, this indicates a decrease in the state of food security of the commodity, but if its value approaches the correct one, this indicates a high state of food security. Of this commodity in the country, the food security coefficient can be estimated using the following economic equations:

1. **Daily domestic consumption**= Total domestic consumption ÷ 365 days.
2. **Production adequacy period for consumption** = total production ÷ total daily consumption.
3. **Import coverage period for consumption** = Total Quantity of imports ÷ Total daily consumption.
4. **The amount of surplus consumption** = (the sum of the two periods of production sufficiency and imports coverage for consumption – 365) x total daily consumption.
5. **The period of sufficiency of the surplus for consumption** = the amount of surplus consumption ÷ total daily consumption.
6. **The amount of Deficit consumption** = (365 - the sum of the two periods of production

sufficiency and imports coverage for consumption) x total daily consumption.

7. **The period of the deficit sufficiency for consumption** = the amount of the deficit in consumption ÷ total daily consumption.
8. **Quantity of strategic stock** = Quantity of surplus consumption - Quantity of deficit consumption.
9. **Food security coeffecient** = annual change in the size of the strategic stock ÷ annual consumption, Or = the result of the change in the size of the strategic stock ÷ annual domestic consumption.

4. Estimating the Tobit Model:

The research is concerned with estimating the impact of the most important indirect factors on the dependent variable (the coefficient of food security), through the unconventional regression model, which is known as Tobit Censored, named after James Tobin. To estimate the standard model, several tests must first be conducted, namely, unit root test, co-integration test, and causality test.

1) Unit Root Test:

The unit root test is concerned with determining the stability of time series, and determining the degree of integration of these series to reach sound results and to avoid the phenomenon of spurious regression. That's why a stability test is performed. Among the most important methods used is the extended Dicke-Fuller test (ADF). The unit root test assumes that the series is unstable if the estimated absolute value t < of the critical absolute value t, and here accepts the null hypothesis H0:B = 0, which requires retesting again but after taking the differences. While accepting the alternative hypothesis H1: B<0, which indicates the stability of the series, if the estimated absolute value t > the absolute value t the tabular critical, and when the original series is found to be stationary at the level, it is said to be integral of degree zero (0), Taking the variances d(1), or d(2) to make them stable we say they are integrals of degree I(1), or I(2).

2) Co-Integration Test

After verifying the integrity of the time series of the same degree according to the stationary test, the co-integration method is used, and this test is concerned with determining the presence or absence of co-integration between variables, and there are many tests that are used to verify the existence of co-integration between the time series variables. Johansson is better if the model contains more than two variables, and the test assumes the presence of P of economic variables in the regression vector of degree K. To determine the number of co-integration relationships between variables, Johansen and Jusellius suggest two tests: Trace & Eigenvalue Max . It is assumed that the calculated value of the two tests is greater than the critical values at the 0.05 level of significance.where, there is a vector of co-integration between the variables, and the existence of an integrative relationship, and therefore the null hypothesis is rejected and the alternative hypothesis is accepted.

3) Causality Test:

The Granger model is used to measure the causal relationship between variables, and it is called the causal relationship between economic variables where, the change in the present and past values of one variable causes the change in another variable, and this test is used to test the null hypothesis that there is no causal relationship between the variables. Granger assumes the absence of a causal relationship between the variables, and each of the internal research variables was tested as an exogenous variable.

4) Tobit Censored Regression Model:

The parameters of the regression function with a finite dependent variable are estimated (where the value of the food security coefficient ranges between zero and one with zero or negative observations replaced by zero), and this method is used instead of using the traditional method of analysis (OLS method) which assumes that there are no limits for the dependent variable (+∞, -∞). Using Tobit analysis, which requires setting limits for the dependent variable to address bias in OLS estimates. There are two ways to estimate the model, the first method is Truncated Tobit, where the null and negative observations are removed from the dependent variable and the corresponding independent variables, and then the model is estimated for the rest of the observations. The second method is Tobit Censored, where the whole model is estimated by entering all observations and replacing the zero and negative observations in the dependent variable only with zero, and to estimate the regression coefficients in this case the Likelihood Estimator (MLE) method is applied (Akerolf 1980, Olsen 1978).

Discussing the research results:

1. The track situation of the production and consumption situation of wheat during the period (1996-2020).

This part is concerned with clarifying the current situation of production and consumption, the size of the gap, the self-sufficiency ratio and the quantity of wheat imports during the period (1996-2020), in addition to estimating the directional values and growth rates of the variables under study, through the data provided in tables (1, 2).

1) Domestic Production of Wheat:

The data in Table (1) indicate that the local production of wheat ranges between a minimum of about 4.4 million tons in 1996, and a maximum of about 9.6 million tons in 2015. The average local production of wheat reached about 8.06 million tons during the mentioned period.,and by studying the directional relationship between time and the quantity of production of wheat, it turns out that the quantity of production is increasing at a statistically significant annual rate estimated about 176 thousand tons, and the growth rate in production is estimated about 2.2% annually, and this is indicated by Table (2). The coefficient of determination is estimated at 0.75, which means that 75% of the changes occurring in wheat production go back to time.

The decline in production has been observed during the last five years (2016-2020) due to the decrease in the average productivity of feddans as a result of climatic fluctuations. Where the average productivity was about 2.67 tons / feddan in 2020, compared to about 2.77 tons / feddan in 2015. The average cultivated area in 2020 was about 3.39 million feddans, compared to about 3.35 million feddans in 2016, with increase rate of about 1.2% annually.

2) Imports of Wheat:

The data in Table (1) showed that the average quantity of wheat imports during the mentioned period ranged between a minimum of about 4.09 million tons in 2003, and a maximum of about 12.7 million tons in 2020. The average quantity of imports was about 7.8 million tons, and the table (2) shows Equation of the general trend of the quantity of imports, which increased at a statistically significant annual rate estimated about 341.2 thousand tons, with a growth rate of about 4.4% annually.

3) Wheat Consumption:

The data also indicates that the volume of consumption of wheat ranges between a minimum of about 9.3 million tons in 1996, and a maximum of about 21.2 million tons in 2020. The average consumption estimated about 15.6 million tons during the mentioned period. as indicated by the general trend equation , the amount of consumption is increasing at a statistically significant rate estimated about 504 thousand tons annually, and the rate of growth in consumption is estimated about 3.23% annually.

4) Nutritional Gap:

Table (1) indicated that the size of the food gap of wheat ranges between a minimum of about 3.56 million tons in 2001, and a maximum of about 12.6 million tons in 2020. The average size of the gap was about 7.57 million tons during the mentioned period, while Table (2) showed that the general temporal trend of the size of the gap is increasing at a statistically significant annual rate estimated about 328 thousand tons, with a growth rate of about 4.3% annually.

Table (1) The current situation of production and consumption and the self-sufficiency rate of wheat during the period (1996-2020) Quantity: thousand tons

years	production quantity	import quantity	Consumption amount	Gap size	Self- % sufficiency	per capita
1996	5729	4958	10832	5103	%52.9	135.1
1997	5792	4842	10407	4615	%55.7	132.7
1998	5971	5431	11188	5217	%53.4	141.2
1999	6220	4103	9629	3409	%64.6	114.4
2000	6564	4570	11114	4550	%59.1	129.6
2001	6255	4840	9819	3564	%63.7	111.9
2002	6440	4531	11625	5185	%55.4	128.0
2003	6845	4090	10936	4091	%62.6	121.4
2004	7178	4363	11753	4575	%61.1	127.3
2005	8141	5688	13352	5211	%61.0	135.0
2006	8274	5811	14257	5983	%58.0	141.2
2007	7379	5911	13771	6393	%53.6	132.9
2008	7977	4078	14545	6568	%54.8	136.6
2009	8523	4060	14593	6070	%58.4	135.4
2010	7169	9774	14980	7811	%47.9	133.9
2011	8371	9800	16878	8507	%49.6	135.0
2012	8795	6538	15659	6863	%56.2	121.7
2013	9460	7870	17210	7750	%55.0	132.3
2014	9280	8126	17025	7745	%54.5	127.5
2015	9608	9001	18411	8803	%52.2	128.8

2016	9345	10820	19410	10065	%48.1	133.0
2017	8421	12061	19707	11286	%42.7	148.6
2018	8346	12390	19714	11368	%42.3	145.7
2019	8559	12493	20847	12288	%41.1	149.5
2020	8580	12747	21780	13200	%39.4	148.8
average	**7729**	**7156**	**14778**	**7049**	**%53.7**	**133.1**

Source: Compiled and calculated from the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Food Balance Bulletin.

5) Self-Sufficiency Ratios:

The average rate of self-sufficiency of wheat for the mentioned period estimated about 53%. It is noted that self-sufficiency rates declined despite the increase in the volume of production, due to the population increase, whose growth rate is estimated about 2.2% annually during the same period. The maximum self-sufficiency rate was estimated in 2003 at 62.3%, while the lowest rate in 2020 was estimated at 40.4%. The data in Table (2) indicates a decrease in wheat self-sufficiency rates at a statistically significant annual rate of 1%, and the rate of decline is estimated about 2.3% annually.

6) Average Per Capita:

The data indicate that the average per capita share of wheat estimated about 133.5 kg/year for the same period, and ranges between a minimum of about 111.9 kg/year in 2001, and a maximum of 149.5 kg/year in 2019. The trend equation showed the average per capita consumption of wheat whose per capita share increased at a statistically significant annual rate estimated at about 0.66 kg, and the growth rate was estimated at 0.5% annually.

Table (2)Equations of general trend of the quantity of production and consumption of wheat in thousand tons during the period (1996-2020)

Statement	ą	b	Growth rate	T	R^2	F
Amount of domestic production	5827	146	%1.9	8.6	0.76	74.8
import quantity	2500	358	%5.0	8	0.73	63.7
Consumption amount	8368	493	%3.3	19.7	0.94	388.1
The size of the food gap	2541	347	%4.9	10.8	0.84	117.3
% Self-sufficiency	0.6	0.01	%1.3	5.2	0.54	26.5
average per capita	124	0.7	%0.5	2.8	0.25	7.8

Source: calculated from Table (1).

2. Estimating the indicators of the food security coefficient of wheat during the period (1996-2020).

1) Evolution of the production adequacy periods and import coverage for domestic consumption of wheat:

The length of the production adequacy period for domestic consumption indicates the extent to which local production is able to meet the needs of consumption during a certain period of time. In order to estimate the production adequacy and import coverage periods, the daily consumption rate is calculated.

- Daily consumption rate: It is evident from Table (3) that the average daily consumption of wheat ranged between a minimum of 25.5 thousand tons in 1996, and a maximum of 58.2 thousand tons in 2020. The average daily consumption was estimated about 40.5 thousand tons during the period (1996-2020). By estimating the directional relationship between daily consumption and time, Table (4) showed that the daily consumption is increasing at a statistically significant annual rate estimated about 1.38 thousand tons, with an annual growth rate of about 3.4%.
- Production adequacy period for consumption: Table (3) indicates that the production sufficiency period fluctuated between increase and decrease during the study period, where the longest sufficiency period was in 2001 with about 232.5 days, or about 7.8 months, while the lowest sufficiency period in 2020 was about 147.5 days, i. About 4.9 months. The average production sufficiency period during the mentioned period was about 190.6 days, or about 6.4 months. Table (4) indicates that the adequacy of production for domestic consumption is decreasing at a statistically significant annual rate of about 1.65 days, and the annual decline rate has reached 0.9%. The coefficient of determination showed that about 23% of the change in the production sufficiency period is due to the time component.
- Import coverage period for consumption: The same table indicates that the import coverage

period for wheat consumption ranged from a minimum of 136.5 days in 2003 that led to about 4.6 months, and a maximum of about 229.4 days in 2018, or about 7.6 months. With an average period of about 179.5 days, or about 6 months, during the same period. By examining the directional relationship of the import coverage period for wheat consumption, the annual statistically significant increase was found by about 1.8 days, and the growth rate for the coverage period was about 1%.

2) Amount of surplus and deficit in wheat consumption:

To estimate the size of the strategic stock of wheat, the size of the surplus and deficit allocated for consumption is estimated. The surplus means the quantity added from the crop to the strategic stock, and the deficit represents the quantity withdrawn from the stock to cover the needs of local consumption of wheat.

Table (3) Indicators of food security of wheat in thousand tons during the period (1996-2020)

years	daily consumption	The period of sufficient production for consumption	Import Coverage period for consumption	sum of the two periods	surplus consumption		Deficit in consumption		Amount of strategic stock	Food Security coefficient
					Quantity	sufficiency period	Quantity	sufficiency period		
1996	30	193	167	360			145	5	30	0.013-
1997	29	203	170	373	227	8			29	0.022
1998	31	167	177	344			638	21	31	0.057-
1999	26	236	156	391	694	26			26	0.072
2000	30	216	150	366	20	1			30	0.002
2001	27	233	180	412	1276	47			27	0.13
2002	32	202	142	345			654	21	32	0.056-
2003	30	228	137	365			1	0	30	0.0001-
2004	32	223	136	358			212	7	32	0.018-
2005	37	223	156	378	477	13			37	0.036
2006	39	212	149	361			172	4	39	0.012-
2007	38	196	157	352			482	13	38	0.035-
2008	40	200	102	303			2491	63	40	0.171-
2009	40	213	102	315			2010	50	40	0.138-
2010	41	175	238	413	1963	48			41	0.131
2011	46	181	212	393	1293	28			46	0.077
2012	43	205	152	357			325	8	43	0.021-
2013	47	201	167	368	120	3			47	0.007
2014	47	199	174	373	381	8			47	0.022
2015	50	191	178	369	198	4			50	0.011
2016	53	176	204	379	755	14			53	0.039
2017	54	156	223	379	775	14			54	0.039
2018	54	155	229	384	1022	19			54	0.052
2019	57	150	219	369	205	4			57	0.01
2020	60	144	214	357			453	8	60	0.021-
average	**40.5**	**195**	**171.6**	**366.6**						
				Total	**9406**	**237**	**7582**	**198**		
The quantity of strategic stock is 1823.4 tons							**Food Security coefficient 0.12**			

Source: Compiled and calculated from the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Food Balance Bulletin.

Table (4) Equations of the general trend of food security indicators of wheat in thousand tons during the period (1996-2020)

Statement	ą	b	Growth rate	T	R^2	F
Average daily consumption	22.9	1.4	3.30%	19.7	0.94	388.1
The period of sufficient production for consumption	225.4	-2.3	-1.20%	-4.1	0.43	17.2
Import coverage period for consumption	138.1	2.6	1.50%	2.9	0.27	8.3

Source: compiled and calculated from Table (3).

- Amount of surplus for consumption: By reviewing the data of Table (3), it turns out that there is a surplus of wheat over domestic consumption, as the total volume of the surplus estimated about 7569.8 thousand tons, and the period of sufficiency of the surplus for

consumption is estimated about 182.7 days, or 6.1 months. This surplus is directed to the development of the strategic stock of wheat, which is withdrawn in the case of a deficit.

- The amount of the deficit in consumption: The table also indicates the years of deficit in wheat consumption. The total volume of the deficit was estimated about 2378,8 thousand tons, which is sufficient to consume about 56.8 days, or about 1.9 months. coverage is done from strategic stock or import.

3) The size of the strategic stock and the food security coefficient for wheat:

The size of the strategic stock: It is defined as the sum of both the surplus and the deficit during the period (1996-2020). The strategic stock of wheat was estimated at about 1823,4 thousand tons, and this stock is sufficient to cover domestic consumption for about 45 days, which requires the need to provide a strategic stock to achieve rates higher than food security.

Food security coefficient: It is calculated as a ratio between the size of the strategic stock to the average annual consumption, and the food security coefficient for wheat was estimated about 0.12 during the mentioned period. This coefficient indicates that the coefficient of food security is poor because it is close to zero. It is always advised to work on increasing the value of the food security coefficient until it reaches about 0.5, which is sufficient for domestic consumption for at least six months, according to food security considerations.

1. Standard Model Estimate for Unconventional Regression:

Most studies have adopted the standard estimation of the most important factors affecting the food security coefficient directly, which are the quantity of production, the quantity of imports, and the quantity of consumption. And owing to , these variables are directly included in the estimation of the food security factor, The research is concerned with estimating the impact of the most important indirect factors on the dependent variable (the coefficient of food security), and these variables are represented in each of the population number in million people (x1), the exchange rate (x2), the value of bread subsidy in billion dollars (x3), the average import price for wheat In dollars per ton (x4), agricultural investment in billion dollars (x5), Amount of wheat loss in thousand tons (x6).

Despite the importance of the wheat loss variable, the percentage of loss during the period (1996-2020) is estimated about 15%. With an average production quantity of 1.7 million tons. While the loss in 2020 amounted to about 25%, which is equivalent to about 2.1 million tons, with a cash value of about 615 million dollars.

The variable was excluded because the parameter was statistically illogical, while the function agrees in economic terms, as the function indicates an inverse relationship between the food security factor and the amount of wheat loss.

1) The Unit Root Test:

By estimating the unit root of the study variables according to the Augmented Dickey - Fuller methodologies, the results of Table (5) indicated the acceptance of the null hypothesis that all the variables under study are not static at the Level, as the estimated values are less than the tabular values at different levels of significance. To get rid of the chain's inactivity, the first difference was taken, and the unit root was eliminated. Therefore, the alternative hypothesis was accepted that the variables are stable of the first degree I(1). Thus, the chain is settled at the first difference.

Table (5) Results of the unit root test (Dickey-Fuller Extended)

Model		Level			1nd difference (1)					
Critical		intercept	Trend & intercept	None	intercept		trend & intercept		None	
					1%	5%	1%	5%	1%	5%
Value					-4.2	-3.2	-5.1	-3.9	-2.8	-1.9
Food Security Coefficient	Y	-4.24	-4.15	-4.32	-5.14		-4.99		-5.30	
population	X1	2.76	-1.43	6.24	-5.71		-7.35		0.44	
exchange rate	X2	-0.12	-1.50	1.21	-3.87		-3.86		-3.66	
bread subsidy value	X3	2.04	-0.21	3.26	-6.83		-8.21		-2.07	
Average import price of wheat	X4	-1.34	-2.05	0.06	-4.91		-4.79		-4.80	
agricultural investments	X5	0.30	0.51	1.25	-4.67		1.28		-4.37	

The slowdown period is estimated automatically with a maximum of 4 periods according to the Schwartz Info Criterion.

Source: Results of model estimates using Eviews software

2. **Co-integration Test:**

After series is settled, the co-integration test is conducted, as Table (6) shows the results of the test between the food security coefficient of wheat as a dependent variable and the independent variables affecting it. , and therefore we reject the null hypothesis that there is no vector of co-integration and accept the alternative hypothesis, as it is clear from the test that there are 5 vectors of co-integration between the model variables when testing the effect. As for the test of the greatest value, the calculated value reached 68.6 at the 5% level, and therefore we accept the null hypothesis that there is no vector of co-integration in the test of the greatest value, and it turns out that there are two vectors of co-integration. Thus, we reject the null hypothesis that there is no vector of co-integration between the variables.

Table (6) Co-integration test results according to Johansen and Jusellius' methodology

Test Trace					Max Eigenvalue Test				
No. of CE(s)	Eigenvalue	Trace	0.05 Critical Value	Prob	No. of CE(s)	Eigenvalue	Max-Eigen	0.05 Critical Value	Prob
None *	0.96	145.3	95.75	0	None *	0.96	68.6	40.08	0
At most 1 *	0.67	76.7	69.82	0.013	At most 1	0.67	24.5	33.88	0.419
At most 2 *	0.63	52.2	47.86	0.019	At most 2	0.63	21.9	27.58	0.225
At most 3 *	0.52	30.3	29.8	0.044	At most 3	0.52	16	21.13	0.228
At most 4	0.36	14.3	15.49	0.075	At most 4	0.36	9.9	14.26	0.216
At most 5 *	0.18	4.3	3.84	0.037	At most 5 *	0.18	4.3	3.84	0.037

Source: Model results using Eviews

3. **The Granger Causality Test**

Table (7) shows the existence of a causal relationship between the dependent variable and the independent variables using the Granger Causality Test, and the results indicate the significance of the relationship between the variables at the 5%, 10% level. Which means accepting the alternative hypothesis and rejecting the null hypothesis that there is no causal relationship between the independent variables and the dependent variable. We accept the alternative hypothesis that changes in the food security coefficient variable are due to the change in the independent variables. The test was performed automatically at two slower intervals.

Table (7) Causality Test Results According to Granger Causality

null hypothesis	**Direction of causal**	**Obs**	F-Statistic	Prob.
DX1 does not Granger Cause DY	**X1 → Y**	23	2.089	0.154
DY does not Granger Cause DX1	**Y → X1**		0.245	0.085
DX2 does not Granger Cause DY	**X2 → Y**	23	0.141	0.170
DY does not Granger Cause DX2	**Y → X2**		0.137	0.173
DX3 does not Granger Cause DY	**X3 → Y**	23	0.284	0.075
DY does not Granger Cause DX3	**Y → X3**		5.341	0.016
DX4 does not Granger Cause DY	**X4 → Y**	23	4.336	0.030
DY does not Granger Cause DX4	**Y → X4**		1.405	0.273
DX5 does not Granger Cause DY	**X5 → Y**	23	0.333	0.021
DY does not Granger Cause DX5	**Y → X5**		6.365	0.009

Source: Model results using Eviews

4. Tobit Censored Regression Model:

Table (8) indicates the results of the multiple regression analysis using the Tobit Censored model, and the following becomes clear:

1. Population:

The economic logic indicates that there is an inverse relationship between the food security coefficient and the population number, that is, by increasing the population, the food security coefficient decreases. The data indicate that the average population reached about 77.3 million during the period (1996-2020). The population has increased from about 59.3 million people in 1996, to about 100.7 million in 2020, with a statistically significant

annual increase of about 1.74 million people, and an annual growth rate estimated at 2.2%. The results of the Tobit Censored model indicate that the regression coefficient agrees with the economic logic in terms of negative sign, where the regression coefficient shows that increasing the population by one million people leads to a decrease in the food security coefficient by about 0.008 units. The value of the elasticity was estimated at (-0.03), which means that an increase in the population by about 10% leads to a decrease in the food security coefficient by about 0.3%.

2. Exchange rate:

The economic theory shows that there is an inverse relationship between the exchange rate and the food security coefficient, meaning that the lower of the exchange rate, the higher the value of the security coefficient . food. The data indicate that the average exchange rate estimated about 7.4 pounds during the period (1996-2020). The value of the exchange rate increased from about 3.39 in 1996, to about 15.8 in 2020, with a statistically significant annual increase of about 0.52 pounds, and the annual growth rate of the exchange rate was estimated at 6.9%. The regression coefficient shows that an increase in the exchange rate by one unit leads to a decrease in the food security coefficient by about 0.003 units. The value of the elasticity was estimated at (-0.04), which means that an increase in the exchange rate by about 10% leads to a decrease in the food security coefficient by about 0.4%.

3. The value of bread subsidy:

The country seeks to raise the rates of food security for individuals, by directing subsidies to some food commodities, as the bread subsidy accounts for about 60% of the total subsidies for food commodities. The economic theory indicates that there is a positive relationship between the value of the subsidy and the coefficient of food security. since, by increasing the value of the subsidy, the food security coefficient increases. The data shows that the average value of subsidies for wheat and bread estimated about 1.7 billion dollars during the same period. The value of the subsidy increased from about 649 Million dollars in 1996, to about 2.18 Billion dollars in 2020, with a statistically significant annual increase estimated at 96 Million dollars, and the growth rate of the subsidy was estimated at about 6% annually. The regression coefficient indicates that an increase in the value of the subsidy by about one billion dollars leads to an increase in the food security coefficient by about 0.03 units. The value of the elasticity was estimated at (0.02), which means that an increase in the value of the subsidy by 10% leads to an increase in the food security coefficient by about 0.20%.

4. Average Import Price of Wheat:

There is no doubt that the increase in the average import price affects the national economy, especially in light of the aggravation of the wheat gap and the dependence on about 60% of consumption abroad. The economic theory indicates that there is an inverse relationship between the average import price and the food security coefficient . The data shows that the average import price estimated about 209 dollars / ton during the study period. The average import price of a ton of wheat increased from about 205 dollars in 1996, to about 230 in 2020. The regression coefficient shows that an increase in the average import price in dollars / ton leads to a decrease in the food security coefficient by about 0.38 units. The value of the elasticity was estimated at (-0.24), which means that an increase in the average import price by about 10% leads to a decrease in the food security coefficient by about 2.4%.

5. Agricultural Investments:

Agricultural investment is the main and effective driver of agricultural development process, and by increasing the volume of investments, the dwarf economy activates, and thus leads to raising food security rates. Therefore, relationship between agricultural investments and the food security coefficient is a positive relationship. In other words, the increase in the value of agricultural investments increases the food security coefficient. The data shows that the average value of agricultural investments estimated about 1.6 billion dollars during the same period. The value of agricultural investments increased from about 1.3 billion dollars in 1996, to about 1.98 billion dollars in 2020. The regression coefficient shows that an increase in the value of agricultural investments by about one billion dollars leads to a decrease in the food security coefficient by 0.05 units. The value of the elasticity was estimated about (-3.39), which means that an increase in agricultural investments by about 10% leads to a decrease in the food security coefficient by about 33.9%.

The results indicate that the estimated model is efficient, as the mean values of the error distribution of the dependent variable S.D. dependent var of 0.093, Schwarz criterion value of -1.17.

Table (8) Results of the Tobit Censored Regression Model

Method: ML - Censored Normal (TOBIT) (Newton-Raphson / Marquardt						
Variable		Coefficient	Elastics	Std. Error	z-Statistic	Prob.
Constant	C	0.006	-	0.038	0.17	0.865
population	DX1	-0.008	-0.03	0.023	-0.347	0.073
exchange rate	DX2	-0.003	-0.04	0.014	-0.215	0.53
bread subsidy value	DX3	0.03	0.02	0.004	0.657	0.005
Average import price of wheat	DX4	-0.386	-0.24	0.511	-0.754	0.451
agricultural investments	DX5	0.053	3.39	0.053	1.004	0.032
SCALE:C(7)		0.085	-	0.012	6.928	0
Mean dependent var		-0.0003	-	S.D. dependent var		0.093
Akaike info criterion		-1.51	-	Schwarz criterion		-1.17
Log likelihood		25.11	-	Hannan-Quinn criter.		-1.42
Avg. log likelihood		1.05	-			

Source: Model results using Eviews

Summary and recommendations:

Wheat is the most important cereal crop in which the Egyptian people depend for their food, growth rate of the food gap Increasing 4.3% annually, The self-sufficiency rates decreased annual rate of 1%. By estimating the indicators of the wheat food security factor during the period (1996-2020), it was found that the daily consumption rate is increasing at 1.38 thousand tons, While the production adequacy period for consumption is decreasing by 1.65 days, . By estimating the size of the strategic stock of wheat, the size of the surplus and the deficit allocated for consumption is estimated, as the total surplus estimated about7569.8 thousand tons, and the period of sufficiency of the surplus for consumption is estimated about 182.7 days, or 6.1 months. This surplus is directed to the development of the strategic stock of wheat, which is withdrawn in the case of a deficit. While the total volume of the deficit was estimated about 2378.8 thousand tons, which is sufficient for consumption of about 56.8 days, or about 1.9 months. Coverage is done from strategic stock or import. The size of the strategic stock of wheat reached about 1823.4 thousand tons, and this stock is sufficient to cover domestic consumption for about 45 days, which requires the necessity of providing a strategic stock to achieve higher rates of food security. The food security coefficient for wheat was estimated about 0.12 during the period (1996-2020), and this coefficient indicates the weakness of the food security coefficient index as it is close to zero. It is always advised to work on increasing the value of the food security factor until it reaches about 0.5, which is sufficient for domestic consumption for at least six months, according to food security considerations.

The results of the Tobit Censored analysis showed the logicality of the relationship between the independent variables and the dependent variable in economic and statistical terms, where the regression relationship between each of the food security coefficient as a dependent variable and each of the independent variables represented in the population in one million people, the exchange rate in dollars, the value of support Bread in billion dollars, average import price of a ton of wheat in dollars/ton, agricultural investments in billion dollars. The results of the Tobit Censored model indicate that the regression coefficient agrees with the economic logic of the relationship between the population and the food security coefficient, which is an inverse relationship, and the regression coefficient shows that an increase in the population by one million people leads to a decrease in the food security coefficient by about 0.008 units. The value of the elasticity was estimated at (-0.03), which means that an increase in the population by about 10% leads to a decrease in the food security coefficient by about 0.3%. As for the exchange rate, the relationship is also inverse, and the regression coefficient shows that an increase in the exchange rate by one unit leads to a decrease in the food security coefficient by about 0.003 units. The value of the elasticity was estimated at (-0.04), which means that an increase in the exchange rate by about 10% leads to a decrease in the food security coefficient by about 0.4%. The economic theory indicates that there is a direct relationship between the value of the subsidy and the coefficient of food security. The regression coefficient indicates that an increase in the value of the subsidy by about one billion dollars leads to an increase in the food security coefficient by about 0.03 units. The value of

the elasticity was estimated at (0.02), which means that an increase in the value of the subsidy by 10% leads to an increase in the food security factor by about 0.20%. The regression coefficient shows the existence of an inverse relationship between the average import price and the food security coefficient, which is consistent with the economic logic, as it was found that an increase in the average import price in dollars/ton leads to a decrease in the food security coefficient by about 0.38 units. The value of the elasticity was estimated at (-0.24), which means that an increase in the average import price by about 10% leads to a decrease in the food security coefficient by about 2.4%. The relationship between agricultural investments and the food security coefficient is a positive relationship. The regression coefficient shows that an increase in the value of agricultural investments by about one billion dollars leads to a decrease in the food security coefficient by about 0.05 units. The value of the elasticity was estimated at (-3.39), which means that an increase in agricultural investments by about 10% leads to a decrease in the food security coefficient by about 33.9%.

Recommendations:

1. The necessity of expanding wheat production, either by vertical expansion by increasing the cultivated area, by reducing the area of green fodder, or by expanding wheat cultivation in newly reclaimed lands. Or horizontal expansion by devising high-yield varieties or continuously updating the varietal map to achieve higher productivity.
2. Finding feasible solutions to the problem of loss, using modern technology in the systems of cultivation, harvesting and storage methods. The wasted area of wheat is estimated about 680,000 feddans in 2020.
3. Finding alternatives for the production of bread to receive consumer acceptance, by mixing wheat with (barley, corn, rice crackers, potatoes). This is to reduce the average per capita consumption of about 149 kg/year, which is higher than the global average per capita consumption of wheat of 95 kg/year.
4. Directing subsidies to those eligible to rationalize consumption and raise food security rates, given the existence of a direct relationship between the value of bread subsidy and the food security factor. With the control of the bakery system, the loss of the produced loaves is estimated at 33%, which represents 2.9 million tons of flour 82%.
5. Increasing investments in the agricultural sector, as it is noted that the percentage of agricultural investments decreased during the year 2020 compared to 1960. The percentage of agricultural investments out of the total investments represented about 17% in 1960, while it estimated about 6% in 2020.

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