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The influence of some varaibles on the consumption of available wheat in Libya

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Abstract

This study aimed to investigate the variables influencing available wheat consumption in Libya using time series data from 1970 to 2023 and applying the ARDL model for this purpose. The results indicated that the variables were stationary at level, except for wheat import, which was stationary at the first difference. The study findings also revealed that there is a cointegrating relationship among the variables. Furthermore, the variables influencing consumption had a positive a significant impact in the short-run. In the long run, the aforementioned variables had a significant positive impact, while the population variable had no significant impact. The study recommended increasing wheat production areas in public projects, which would reduce imports, their high costs, and their impact on the trade balance. It also recommended providing support to private sector farmers to encourage production. Finally, it suggested conducting specialized studies to develop suitable high-yield varieties suited to local environmental conditions.

Keywords

Wheat consumption, Domestic wheat production, Wheat import, Wheat import prices, Population, Ardl Model.

تأثير بعض المتغيرات على استهلاك القمح المتاح في ليبيا

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الملخّص

الدراسة هدفت للتحقيق في المتغيرات المؤثرة استهلاك القمح المتاح في ليبيا باستخدام بيانات السلاسل الزمنية من 1970 إلى 2023 وتطبيق نموذج ARDL لهذا الهدف. النتائج أشارت إلى أن المتغيرات كانت مستقرة في المستوى ماعدا متغير واردات القمح الذي كان مستقر في الفرق الأول. كما كشفت نتائج الدراسة أن هناك علاقة تكامل مشترك بين المتغيرات. علاوة على ذلك، أن المتغيرات المؤثرة في الاستهلاك لها تأثير إيجابي معنوي في المدى القصير. وفي المدى الطويل، المتغيرات المذكورة سابقا لها تأثير ايجابي ومعنوي، بينما متغير السكان ليس له تأثير معنوي. الدراسة أوصت بزيادة مساحة إنتاج القمح في المشاريع العامة، التي تخفض الواردات، تكلفتها العالية، وأثرها على الميزان التجاري. أيضاً أوصت بتوفير الدعم لمزارعين القطاع الخاص لتشجيع الإنتاج. أخيرا، اقترحت إجراء دراسات متخصصة لتطوير استنباط أصناف ذات إنتاجية عالية مناسبة لظروف البيئة المحلية.

الكلمات المفتاحية:

استهلاك القمح، إنتاج القمح المحلي، واردات القمح، أسعار واردات القمح، السكان، نموذج *ARDL*.

Introduction

The scarcity of availability of agricultural food commodities represents one of the obstacles in many countries in the current situation Temesgen and Aweke (2023), whereas the agricultural sector has the responsibility of offering the majority of consumer food goods Fouzi (2024), and it has an effective role in food stability and security and continuously advances the desired development aspirations Viana et al (2022). Taking malnutrition and its underlying conditions into consideration by targeting it in agricultural intervention programs to stabilize food supplies and benefit public health through the purity and diversity of agricultural commodities Huang (2025).

The wheat plant is one of the winter crops, found approximately 10,000 years ago. It belongs to the Gramineae family and is widely spread after corn, feeding 40% of the world's population, with a global production of 771.7 million tons in 2017 Li and Cai (2020). It is considered an increasingly desirable commodity in urbanized areas that have industries, in addition to its importance as a source of protein, vitamins, fiber and provides benefits by using it in providing bread, pastries, and home flour; it is used as animal feed and has health benefits because it contains polyphenols, an antioxidant that fights diabetes and is anti-inflammatory Shewry and Hey (2015). In Libya, wheat is a valuable crop used in many food products, both for human consumption and as animal feed. Based on these benefits, the government has worked to increase its local production Faraj et al (2020), leading to a rise in production from 52,778 tons in 1970 to 293,747 tons in 2023 Food and Agriculture Organization (2025).

Research problem

The problem of the research is that there is a deficiency in the production of the wheat crop in Libya to cover the required needs of the population. Conditions vary according to the seasons from year to year, and the deficiency is compensated for due to the numerous uses of this commodity through imports, which will affect the provision of the population's needs for this strategic commodity, as well as the spending of money in foreign currency to import this material and the evasion of the agricultural trade balance in favor of imports. Therefore, it is necessary to have knowledge of the factors affecting its consumption and the importance of the impact of these variables.

Objectives of Research

This study worked on a set of objectives that can be presented in the following:

1. Descriptive analysis of the study variables.
2. To examine the short-run dynamic effect of variables affecting wheat consumption.
3. To examine the long-run dynamic effect of variables affecting wheat consumption.
4. Develop recommendations related to wheat consumption.

The importance of the study

This study aims to identify the variables that affect the consumption of available wheat in Libya. In doing so, a set of independent variables was selected to examine their dynamic short and long-run relationships. This is of great importance to develop an appropriate production and import system that ensures the provision of wheat sufficient for consumption proportionate to its consumption. The gap in previous literature is based on mostly descriptive analyses in Libya, except for a few. In addition, the decision-making bodies in production and import policy will have some ideas and make the necessary additions to address the shortage of this material by taking appropriate decisions in this regard.

Literature review

There are many studies that address the topic of wheat consumption; thus, the current research is a connected and complementary link to previous studies. A group of studies and research in the field of research has been reviewed, including a study conducted in Libya. One of these is the study in Pakistan, Shaheen et al. (2022) used an autoregressive distributed regression model to estimate wheat consumption covering the period 1975 to 2020. The results of the analysis strongly suggested that wheat is a staple food in Pakistan and the wheat imports directly influence consumption. In another study, Din Palal (2025) uses secondary data to estimate wheat supply and demand in Balochistan. The study revealed that the region needs 1.85 million tons of wheat, with a deficit of 0.33 million tons. The results also indicated that high productivity was found in the Nasirabad and Jafarabad districts, while other areas of Balochistan face irrigation shortages and weather fluctuations. As confirmed by the study of Mottaleb et al (2018), which targeted Bangladesh, India, and Pakistan, which together cover 7 million hectares and experienced wheat crop losses of 0.89–1.77 million tons. These wheat crop losses have serious repercussions for national food security and will lead to increased wheat imports and higher prices.

Alemu (2024) focused on the topics of wheat production and consumption and the chronological development of wheat production and consumption. The results of the analysis, by employing historical data, showed that wheat production increased by 6.2 percent each year compared to the increased wheat consumption, which is estimated at 261,120 tons. This leads to a widening of the gap between them, compensating for it with imports, and necessitating expanding productivity by 1.58 quintals per hectare in the same area currently used by using productive elements leading to this purpose, including increasing the water element, in cooperation with the private sector .On another side, Yemelyanov et al (2023) sought methods to estimate the performance of some countries in sustaining their imports of wheat. This study applies a set of tools to estimate the performance of the level of sustainability of countries that import certain types of agricultural products about the potential reduction in the volume of these imports. This study found a decrease in their ability to reduce these imports is inversely related to these countries accepting a reduction in the import of this commodity, which entails facing steady changes in the continuation of their imports to reflect the reduction in consumption as an automatic result of a decrease in supplies of imports of this commodity .

The study of González-Esteban, (2017) strongly suggested that wheat consumption today has become much greater than seven decades ago globally, with consumption being four times greater than it was previously. This is due to

population growth, the rise in the age percentage of people who depend on wheat consumption for its multiple uses, and also an increase in the per-person share of its consumption. It is noted that population growth had the largest share in global wheat consumption. This can be seen in Asian and African countries, with their dominance in wheat consumption, contrary to what it was before World War II, as a reflection of the steady increase in the population in a greater manner, as well as the increased demand for it .Furthermore, Luo and Tanaka (2021) study indicates that there is a conflict in goals between liberalizing agricultural trade and protecting local markets in countries that are not self-sufficient in wheat, especially in 2008. The study employed the dynamic conditional correlational dynamic conditional correlation (DCC)–generalized autoregressive conditional heteroscedasticity (GARCH) model to examine the correlation between the international wheat price and the retail prices of wheat flour in 10 net importing countries covering the period from 1 month of 2005 to 13 months of 2019 and whether these countries are exposed to shocks as a result of their dependence on supplies imports. The study strongly suggested that there is a correlation between the fluctuation of retail prices in each region and the fluctuation of international prices, which concludes that an improvement in the availability of food locally depends on reducing the import of wheat from abroad and is not at the expense of use.

In addition, Greb at al (2012) study sought to determine the extent to which less developed countries influence the speed with which their local markets are affected by changes in grain prices in global markets. The study found from its analysis that it takes six to seven months for its supporters to reach the local markets on average, equivalent to 0.75 of these changes. Furthermore, the report of OECD and FAO. (2025) pointed to the impact of the population on increasing the consumption of grains, including wheat. The report stated that human consumption of grains represents 40% and 33% of them are used as animal feed, while the remaining percentage will be exploited for other purposes, as well as biofuel. Both India and China are among the most important countries consuming wheat in 2034, as wheat is the main component of their diet. This also applies to North Africa and extending to sub-Saharan Africa, Egypt, Iran, and West Central Asia, which is characterized by a rise in wheat consumption per person. On the other hand, the report revealed that wheat prices are the most international prices that change from time to time due to the lack of supply from Russia and European countries as a result of competition between suppliers. Despite this shortage, both Australia and Argentina tried to compensate for this shortage in supply. Along with this, Ogudi at al (2026) aimed to use a comprehensive multi-methods approach. The study used historical (2000-2024) and forward-looking (2025-2050) cost-benefit analysis to rely on local production to reduce reliance on imports of local wheat flour. The results of the study concluded that the feasibility of the project is sensitive to changes in the international price of wheat and its emphasis on the importance of producing it in Ghana and not importing it from outside the country.

Among the studies conducted in Turkey, Uzunoğuz and Akçay (2009) studied during the period 1984 to 2006 and used the joint logarithmic function to investigate and research the demand for wheat imports in Turkey and the variables affecting it. It was discovered that those who benefit from wheat consumption in Turkey prefer to consume local wheat locally. In addition, their demand for wheat imports depends on or is affected by the local price of it. In another study in Turkey Merdan and comakli (2025) investigate the effect of some variables on the demand for wheat imports during the years 2006-2021 by using the Apparently Unrelated Regressions model. The results of the study found that the delayed value of wheat imports for one year has a significant impact on wheat import demand. The study also indicated that wheat imports will continue.

Research Methodology and Data source

Data source

This research relied on the data obtained from multiple sources, including the Food and Agriculture Organization data (FAOTAST), as well as the bulletins of the Agricultural Development Organization. The study also relied on some previous studies in this field during the study period (1970-2023). This data included the available quantity of wheat consumption as well as domestic production and imports of wheat, the import price of wheat, and the population.

Model specification

The research was based on estimating the consumption of available wheat function by employing the ARDL model methodology to

understand the behavior of the independent variables towards the dependent variable by finding short- and long-term relationships between these variables. The relationship between the dependent variable represented by the consumption of available wheat and some variables affecting it can be visualized, and this relationship can be formulated in the following formula:

$$BC = f(LWP_1, WI_2, WIP_3, \text{and } Pop_4) \quad \ldots..(1)$$

Where, BC = Consumption of available wheat; LWP= domestic wheat production; WI= wheat imports; WIP=wheat import price; Pop= Population.

This is then followed by using ARDL to estimate the relationship between variables as in the equation (2) Mohamed and Faraj (2022).

$$\Delta ln\mathrm{WC} = z_0 + \sum_{i=1}^{n} z_1 \Delta ln\mathrm{LWP}_{t-1} + \sum_{i=0}^{n} \mathrm{z}\, \Delta ln\mathrm{WI}_{t-1} + \sum_{i=0}^{n} z_3 \Delta ln\mathrm{WIP}_{t-1} + \sum_{i=0}^{n} z_4 \Delta ln\mathrm{Pop}_{t-1} + u_t \quad \ldots..(2)$$

Where, WC= Consumption of available wheat; LWP= domestic l wheat production; WI= wheat imports; WIP=wheat import price; P= Population; Δ = Variable in first difference; ln=Natural Logarithmic Transformation; z_0 = Constant; and u_t =White Noise error term.

As for the dynamic error correction model, it can be illustrated by the following equation:

$$\Delta WC_t = \mathrm{z} + \sum_{i=1}^{P} \mathrm{z}_{1i}\Delta \ln Wp_{t-i} + \sum_{i=1}^{P} \mathrm{z}_{2i}\Delta \ln \mathrm{WI}_{t-i} + \sum_{i=1}^{P} \mathrm{z}_{3i}\Delta \ln \mathrm{WIP}_{t-i} + \sum_{i=1}^{P} \mathrm{z}_{4i}\Delta \ln \mathrm{P}_{t-i} + \gamma \mathrm{ECT}_{t-1} + ut \quad \ldots..(3)$$

Where, *ECT*= Error Correction Term; u_t=Disturbance Term.

Research results and Discussion

Descriptive analysis of the study variables

According to data from the Food and Agriculture Organization (FAO), consumption of wheat crops in Libya increased from 52,778 in 1970, with increases and declines until it reached 2,063,526 tons in 2013, then it continued to decrease and increase until it decreased to 293,747 in 2023. Furthermore, consumption of wheat was produced at a minimum of 1,970 tons and a maximum of about 2,063,526 tons in 2013, with an annual average of about 710,685 during the same period. On the other hand, the general trend equation for wheat consumption indicated that it took a significant and positive trend of 0.00668, which is increasing by 0.00668 for each year. From another angle, domestic production increased and decreased from the period extending from 1970 to 2023. It reached approximately 27,159 tons in 1970, then increased to 209,737 tons in 1983, then decreased to 104,000 tons in 2008, then increased to 200,000 tons in 2014, then decreased to 130,000 tons in 2023. Local wheat production also ranged from a minimum of about 17,725 tons in 1971 to a maximum of about 209,737 tons in 1983, with an annual average of 131,157.7 tons. Studying the general trend of wheat production showed that it took a positive and significant general trend at 1%, which means that the rate of change in production increases by 0.005858 per year and slowly.

As for the wheat imports variable, it increased from 25,619 tons in 1970 and increased and decreased until they reached 163,747.49 tons in 2023, with a minimum of 25,619 tons in 1970 and a maximum of 1,863,526 tons in 2013, with an annual average of 579,527.3. The results of the trend equation estimation demonstrated that the sign of the rate of change was statistically significant and positive, indicating that the rate of change in imports per unit of time (annually) changes by an amount of 0.006445. Regarding the data, wheat import prices ranged from 78.14 dollars in 1970 and increased and decreased until they reached 372.83 in 2023. The minimum price of wheat was 74.86 in 1971 and a maximum of about 434.8 dollars in 2022, with an annual average of 212.34 dollars. By estimating its general trend equation, it was concluded that its sign was positive and the significance was 0.002648. Finally, regarding the population variable, it was found that their number in 1970 was 2,082,589 thousand persons. It increased to 2010, then decreased in 2012 and was 6179.330 thousand persons, then increased until their number reached 7305.660 thousand persons in 2023, and the lowest number was about 2082.589 thousand persons in the year 1970, and the maximum census reached 7305.660 thousand persons in 2023, with an annual average of about 4913.806 thousand persons. The result of the general trend equation indicated that its rate of change value was a positive value and statistically significant at 0.004230.

Augmented Dickey Fuller

The augmented Dickey-Fuller test is one of the tests with statistical significance to activate the realism of the results. It is relied upon to eliminate autocorrelation and not fall into spurious regression by examining the presence of a unit root in the variable series. Accordingly, hypothesis H_0 is rejected because it does not contain a unit root, and therefore the variable series is stationary Faraj (2022). The results in Table 1 indicated that the variables of wheat consumption, domestic wheat production, wheat import price, and population remained stationary at the same level, except for wheat imports, which were stationary in the first difference. These results allow for the use of the ARDL model in the estimation process due to the different order.

Table1 ADF Test Result

variable	At Level		At First Difference		The Decision
	t-Stat	Prob	t-Stat	Prob	
WC	-3.015453	0.0400	-		I(0)
DWP	-3.618500	0.0085	-		I(0)
WI	-2.589188	0.1017	-10.14629	0.0000	I(1)
AIP	-3.029430	0.0386	-	-	I(0)
POP	-4.436190	0.0008	-	-	I(0)

Based on the Eviews 12 outputs

Choosing the optimal lag and Model

One of the important things in the autoregressive estimation process is the step of determining the lag length, and one of the most important criteria that has an advantage in this is the Akaike Information Criterion (AIC) because of its effectiveness in series that are less than 60 to be able to reach the highest benefit in obtaining the true lag length to work on the inability to download the estimation during the study period Liew (2004), and this is selected by choosing the smaller value of Akaike Information Criterion (AIC) Fouzi (2026). Based on the analysis results, it was found that the optimal lag was 3, as seen in Table 2, which represents the minimum value of the Akaike Information Criterion (AIC).In terms of choosing the optimal model that expresses the selection and sequence of the last optimum for each time series of variables under study, such that it gives them the lowest value of the Akaike criterion to ensure the reliability of the estimation outputs in the short and long-run. According to the Akaike Information Standard, there were 20 models, the best of which was model 33223, as shown in figure 1.

Table 2 VAR Optimal Lag Choosing

Lag	AIC	SC
0	-0.126146	-0.053772
1	-7.754208	-7.319968
2	-8.463210	-7.667104*
3	-8.726807*	-7.568834

Based on the Eviews 12 outpu

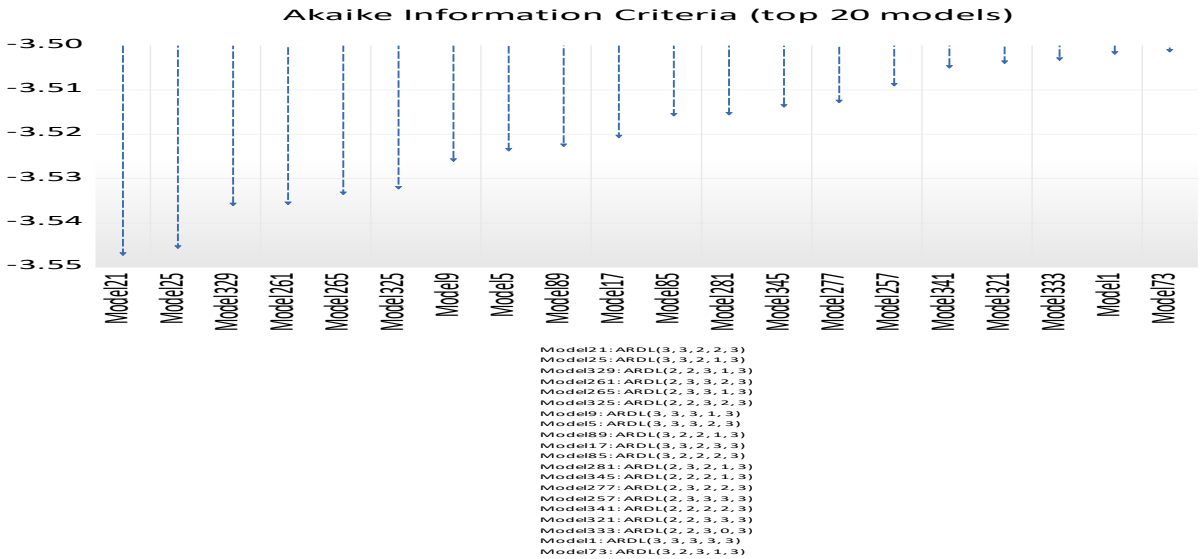

Figure 1 Optimal model

Bound test

To estimate cointegration to find out what the long-run relationships are between the variables included in the study, the bound test was used, which resulted in the estimation results in Table 3. It was observed that the calculated F-statistic value of 5.09 is greater than the upper bound value of 3.49 at the 5% level. This indicates that the F-statistic results are conclusive, suggesting cointegration among the variables.

Table 3 F-Bounds Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
				Asymptotic: n=1000
F-statistic	5.090424	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Based on the Eviews 12 outputs

Short and Long-run Results

The short-run parameters characteristic of the optimal ARDL model are T-consistent with the asymptotically singular covariance matrix. As for the long-run parameters, it has the property of super-consistency and valid inferences, and one of its features that distinguishes it is that it "converges in distribution to normal irrespective of whether explanatory variables are I (0) or I (1) Pesaran and Shin (1995). The results of the analysis in Table 4 summarize that the variables of domestic wheat production, wheat imports, wheat import price, and population have a positive impact on wheat consumption in the short run. These findings mean that a 10% increase in these independent variables leads to an increase in wheat consumption of 2.34% for the domestic wheat production variable, 7.8% for the wheat imports variable, and 0.3% for the wheat import price variable, while the population variable was 20%, which reflects the short-run dynamics in the ARDL model. In term of the previous lag effects, it was found that WP (-1) and WI (-1) had a positive effect on the consumption of available wheat by 0.11 and 0.33, respectively. This means increasing the variables WP and WI by one unit in the lag period t (1-) leads to increasing the dependent variable (consumption of available wheat) by 0.11 and 0.33 units, respectively. Moreover, the results indicate that PIM (-1) and POP (-1) in the period lag (-1) have a negative impact on the consumption of available wheat by -0.03 and -1.25 respectively. This means that increasing the variables WP and WI by one unit in the lag period t (1-) leads to a decrease the dependent variable (consumption of available wheat) in the current period by -0.03 and -1.25 unit respectively. While the effect of previous impact in the period lag (-2), the POP variable lag (-2) has a positive impact on the consumption of wheat 1.75. This means that the increase in the pop variable by one unit in t (-2) leads to an increase in wheat consumption by 1.75. Another point is that the WP variable in lag (-2) has a negative impact on wheat consumption in the current period by (0.04) in the short-run.

As for the long-run estimates of the variables, the independent variables that had a significant positive impact on the study were 0.31 for domestic wheat

production, 0.72 for imports, and 0.15 for wheat import price. Population size had no significant impact. These estimates indicate that a 10% change in these variables increases wheat consumption by 3.1% for domestic wheat production, 7.2% for wheat imports, and 1.5% for import price. All the indicators are consistent with economic logic except for the import price. This may be attributed to increased wheat use or its status as an indispensable strategic commodity, particularly in bread production, as it is a staple food for the majority of the population, especially those with low incomes. With respect to ECT (-1), it represents the extent to which the dependent variable returns to long-run equilibrium after a short-term shock Faraj (2022). An adjustment rate is applied so that the difference between the actual value and the expected value at equilibrium in the subsequent period is minimal Nkoro and Uko (2016). ECT (-1) requires a negative sign and a significance level of less than 0.05. A value that was significant at 1% indicates a 52% correction for the long-run deviation from equilibrium in the period following the dependent variable's return to long-term equilibrium after a short-run shock.

By conducting tests to find out whether the model had problems due to their impact on the effectiveness of the results obtained when estimating, it was found that it did not have any problems regarding the chi-squared probability in the LM test for serial correlation, which is 22%, which is greater than 5%. This indicates no correlation and that the time series of the variables are random. Therefore, the later values do not depend on the previous values. Furthermore, the ARCH test, through its results in detecting the change in the conditional variance of the residuals over time, showed a probability chi-squared value (p-value) of 68%, which is greater than 5%, meaning 68%. This attests to the fact that the variance is constant and the ARDL study model is statistically reliable and effective. According to the normal distribution, the error is normally distributed because the value of the probability percentage of the Jarque-Bera test was above 5%, which is 0.29 and more than 5%. In relation to the stability of the model, its values fall within the borders at the 5% level.as shown in Figure 2.

Table 5: ARDL Model's short-term and long-term estimates (3, 3, 2, 2, and 3)

Variables	Coefficient	t-ratio	p-value
Short-Run Estimates			
Δ DWP	0.2634	11.501	0.000
Δ (DWP(-1))	0.1101	3.561	0.001
Δ (DWP(-2))	- 0.0400	- 1.985	0.055
Δ IM	0.7807	71.425	0.000
Δ (DIM (-1))	0.3355	5.138	0.000
Δ PIM	0.0373	1.735	0.092
Δ (DPIM (-1))	- 0.0312	- 1.568	0.126
Δ POP	2.0333	4.024	0.000
Δ (DPOP (-1))	-1.2591	- 1.804	0.080
Δ (DPOP (-2))	1.7567	3.478	0.001
ECT(-1)	- 0.5237	-5.930	0.000
Long-Run Estimates			
DWP	0.3152	6.4718	0.000
IM	0.7259	23.9085	0.000
PIM	0.1587	2.7938	0.000
POP	0.2445	1.6493	0.108
C	-2.8798	-2.0978	0.045
Model Validity			
Serial Correlation LM test		-	
Normality	4.5255	-	0.2100
Heteroskedasticity ARCH Test:	2.4587	-	0.2924
	1.4839		0.6860

Based on the Eviews 12 outputs.

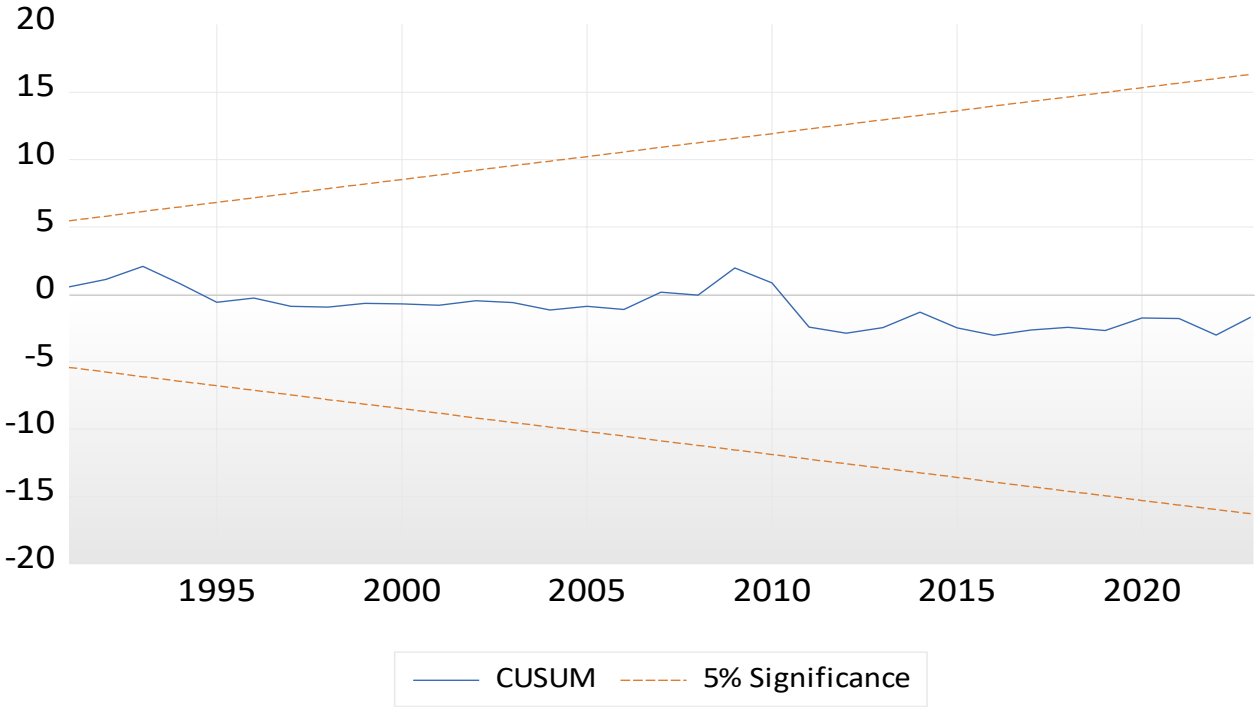

Figure 2 CUSUM stability test Plot

Concerning the predictive and evaluative power of the model, it was high and effective, as evidenced by the value of Theil coefficient, which is less than one and very close to zero (0.0011). Meanwhile, the bias proportion value of 0.00 points to the model being balanced and reliable in predicting values, and its errors are not due to bias in the prediction. Moreover, the ARDL model, with a covariance proportion of 0.078, accurately reflects the natural variability of the data and represents a small fraction of the total error. Therefore, it can be concluded that changes in predicted values closely approximate actual values, allowing for effective and highly reliable prediction of fluctuations.

Conclusion

The study sought to identify the factors affecting wheat consumption in Libya using the ARDL model, covering time series data from 1970 to 2023. The results of the study analysis revealed that the variables were stationary at the level except for the wheat imports variable, which was stationary in the first difference. The study also concluded that there is a cointegration relationship between the variables. It also pointed out that the factors of wheat production, imports, import prices, and population size have a positive impact in the short-run. Similarly, it found that the previous variables had a positive and significant effect, except wheat production in previous lag at t(-2) and population in previous lag at t(-1) variable. In the long-run, the variables have a positive impact except population variable, which was not significant. It also clarified that the model is fully validated and has no standard problems that would hinder its validity or predictive ability.

Recommendations

The study recommends expanding agricultural projects to increase wheat production areas, thereby reducing imports, their high cost, and their impact on the trade balance. Additionally, it recommends providing support to private sector farmers to encourage production through financial assistance and the provision of production inputs. Furthermore, it suggests conducting specialized studies to develop high-yield varieties suitable for local environmental conditions.

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