THE EFFECT OF SOME FACTORS ON WHEAT PRODUCTION IN LIBYA: ARDL MODELING APPROACH

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Abstract:

The study is an attempt to examine the effect of farm price, wheat imports, and flour imports on wheat production empirically in Libya. The ARDL bounds approach was adopted to test the short and long-run among variables under investigation. The results indicated there is co-integration relationship among variables. In a long-run relationship among variables, it found the flour imports variable has effect on wheat production. Also, the findings clarify that the coefficient of the ECM is negative sign and significant (- 0.4788). The study recommends for increasing production of this commodity to exploit all irrigated agricultural lands in the public and private sectors in the production of wheat, and presenting financial support to irrigated farm's to produce wheat, and activating the role of agricultural extension for wheat producers to increase production. Combating the encroachment of urban expansion on agricultural lands. Using industrial river water to cover the deficit and reduce imports.

KEY WORDS: Unit root test, Cointegration, ARDL Model, wheat production, Libya.

المستخلص :-

الدراسة محاولة لفحص تأثير سعر المزرعة وواردات القمح وواردات الدقيق على إنتاج القمح تجريبياً. تم اعتماد نهج حدود ARDLلاختبار المدى القصير والطويل بين المتغيرات قيد التحقيق. أشارت النتائج إلى وجود علاقة تكامل مشترك بين المتغيرات ، مما يعني وجود علاقة طويلة المدى بين المتغيرات ، كما وجدت الدراسة أن متغير واردات الدقيق له تأثير على إنتاج القمح. أيضًا ، توضح النتائج أن معامل ECM هو علامة سالبة ودلالة (- ٠.٤٧٨٨). أوصت الدراسة بزيادة إنتاج هذه السلعة لاستغلال جميع الأراضي الزراعية المروية في القطاعين العام والخاص في إنتاج القمح ، وتقديم الدعم المالي للمزارع المروية، وتفعيل دور الإرشاد الزراعي

لمنتجي لزيادة إنتاجهم. مكافحة زحف التوسع العمراني على الأراضي الزراعية. استخدام مياه الأنهار الصناعي لتغطية العجز وتقليل الواردات.
الكلمات المفتاحية: اختبار جذر الوحدة ، اختبار التكامل المشترك، نموذج الانحدار الذاتي للإبطاء الموزع (ARDL) انتاج القمح. ليبيا

INTRODUCTION

Agriculture plays a critical role in transforming economies to attain this goal, along with achieving other essential development goals like ensuring food security and improving nutrition (Ja'afar-Furo et al , 2018) and improving the availability of food and food security (Pawlak and Kolodziejczak, 2000). It also providing job opportunities and stimulating agriculture-related industries (Drebee and Abdul-Razak, 2020). Apart of that, it is also producing more agricultural commodities and materials have a positive effect in foreign exchange earnings and led growth in least developed countries (Dawson, 2005). In another side, paying attention to the agricultural sector leads to potential to be the industrial and economic springboard from which a country's development can take off (Izuchukwu, 2011) and leads to an increase in farmers' income that is reflected in their purchasing power and consumption of the products of other sectors (Fares, 2005).

The agricultural sector in Libya received a large part of the investment allocations within the strategy of economic transformation during the various economic plans by using the local savings resulting from the high prices and the quantity of exported oil. This target was aimed to reclamation and reconstruction of lands, digging wells, providing agricultural machinery, establishing silos and storage places. In addition, it establishment of many settlement projects to achieving self-sufficiency in agricultural products, including wheat crop, which is one of the most important field crops in Libya and takes the second place after barley in the crop composition (Abdel Razek,

2007), which led to an increase in wheat production from (128.76) thousand tons in 1990 to (144.36) thousand tons in 2015.

RESEARCH PROBLEM

Despite the efforts made by the recovering governments in the Libyan state for the agricultural sector to creating a wide agricultural development in pursuit of diversifying production and reducing dependence on oil as the only source of income. However, despite the agricultural sector's contribution to meeting the required needs of the wheat crop, there is a deficit ratio that was covered from abroad by import, amounting to (263.36) million dollars in 2019 (Aoad, 2022). This situation has created a negative impact on achieving self-sufficiency in this commodity, as well as allocating sums of money from foreign currency to import this material and influencing its trade balance with a deficit in favor of imports. The research question can be summarized as follows: What are the important variables that affect wheat production in the long and short term, which requires research and investigation on these factors.

RESEARCH IMPORTANCE

Due to the economic importance of the wheat crop, which is one of the main sources of food in Libya making efforts to increase production of the commodity and reduce its import. Therefore, the study is of practical importance as the expected results of the research help agricultural decision makers to increase and contribute to achieving food security from the wheat crop. The importance of research from a scientific point of view also comes to use econometrics methods in enriching research and helping researchers to experiment with other methods. Also, this research is an addition to the previous scientific literature in the field of studying grain production (wheat) economically.

OBJECTIVES OF THE STUDY

This study aims to:

1- Detecting the co-integration of study variables.

2- Examine the effect of the farm price of wheat, the quantity of wheat imports, and the quantity of flour imports on wheat production as a dependent variable.

3- Provides recommendations that contribute to improving wheat production.

DATA SOURCE

The study relied on secondary data during 1990-2015 obtained from statistical bulletins issued by the official authorities in Libya, Agricultural Research Center, as well as the Arab Organization for Agricultural Development of the League of Arab States, in addition to some researches and published scientific theses.

RESEARCH METHODOLOGY

The methodology that adopted for this research depended on the purpose and objectives to be achieved. This study relied on quantitative analysis for some variables affecting the wheat production in Libya during the period (1990-2015). The autoregressive distributed lag ARDL used for this purpose. This model differs from the rest of the econometrics models in it does not require that all variables be stationary of the same integrated order. Also, the critical values of the bound test detection of a co-integration relationship are adopted; the long-run coefficients and the error correction model that includes the adjustment speed coefficient.

The function relationship and the detailed specification among of the different variables can be formulated as:

$WP = f (Fp, WIM, FIM)$

$WP = C + \beta_1 Fp + \beta_2 WIM + \beta_3 FIM + \varepsilon_t$

Where:

WP = Wheat production; Fp = farm price; Wim = wheat import; Fim = flour import.

The generalised ARDL (Ᵽ, ٩) model is written with the following formula:

$$W_t = \mathrm{c}_{0i} + \sum_{i=1}^{p} \delta\, W_{t-i} + \sum_{i=0}^{q} \beta'_i\, X_{t-i} + \varepsilon_{it}$$

Where $\mathrm{W_t}$ is a vector; $\mathrm{X'_t}$ are independed variables; δ and β are coefficients; c is the constant; i= 1… k; p, q are optimal lag orders; ε_{it}= is a vector of the error terms.

And it can represent the error correction model (ECM) as following

$$\Delta WP_{\mathrm{t}} = \mathrm{C} + \sum_{\mathrm{i=1}}^{\mathrm{P}} \delta \Delta \ln Wp_{\mathrm{t-i}} + \sum_{\mathrm{i=1}}^{\mathrm{P}} \beta_{1\mathrm{i}} \Delta \ln \mathrm{FP}_{\mathrm{t-i}} + \sum_{\mathrm{i=1}}^{\mathrm{P}} \beta_{2\mathrm{i}} \Delta \ln \mathrm{WIM}_{\mathrm{t-i}} + \sum_{\mathrm{i=1}}^{\mathrm{P}} \beta_{3\mathrm{i}} \Delta \ln \mathrm{FIM}_{\mathrm{t-i}} + \eta \mathrm{ECT}_{\mathrm{t-1}} + \mathrm{et}$$

where:

ECT = Error Correction Term;

e_{t} = Disturbance Term;

WP = Wheat Production;

FP = Farm Price of Wheat;

WIM = the amount of wheat imports;

FIM = the amount of wheat imports;

The term of the error correction represents the long-run relationship and it should be statistically significant of coefficient with a negative sign indicates the presence of long-run causal relationship.

RESULTS AND DISCUSSION

In this part of research we present the results from the ADF and PP tests and ARDL model results described.

Unit Root Tests

There is a need to take some tests in order to test the stationarity of the data, because a time series test is required to be stationary to avoid spurious results due to non-stationarity and the variables are not stationary at the second difference, so this purpose the ADF and PP test have been used.

In another side, the mix of integrated orders of the time series variables allows for the estimation of autoregressive direct lag (ARDL) approach. Both tests' results are presented in Table 1 that indicate that depended variable WP, FP and WIM are nonstationary in level and they stationary at first difference I(1).

Table 1: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test results

Augmented Dickey-Fuller (ADF)			Phillips- Perron(PP)		Order of integration
Variables	Level	First difference	level	First difference	
WP	-2.6829	-3.9136*	-2.2008	-3.8901*	I(1)
FP	-2.9582	-8.1798*	2.2875	-8.3354*	I(1)
WIM	-0.6359	-8.7694*	-1.5736	-8.7694*	I(1)
FIM	-3.3371**	-	-3.2945**	-	I(0)

Note: (*) and (**) denote statistical significance at the 1% and 5% levels, respectively.

As for the flour import variable, it was stationary in the level and with these results; the Ardel Model's methodology can be used.

Lag-order selection criteria

Determine optimum number of lags to be included in the Ardl model comes after the stationary test for study variables. Table 2 reports Akaike and Schwarz information criterion test were chosen for this purpose. Both criterions results indicate the

optimum Lag is two. Therefore, it will proceed by estimating ARDL with lag two.

Table 2: Lag-order selection criteria results

Lag	Aic	Sic
1	-1.4212	-1.0286
2	-1.9583*	-1.4152*

Co-integration Test

The bounds testing procedure is utilized to find out the long-run relationships among the variables, Table 3 shown the calculated F-statistics (12.34481) greather than the lower bound and the upper bound at the 1 percent level. This implies that the null hypothesis of no cointegration cannot be accepted and that there is cointegration between the variables or there is a long-run association among the variables in the model.

Table 3: F-statistics for testing the existence of long-run cointegration

Model	F- statistic	
WP= f (FP, WIM, FIM)	12.34481*	
Narayan (2005)	k=3 , n=26	
Critical Value	Lower	Upper bound
1%	5.333	7.063
5%	3.710	5.018
10%	3.008	4.150

Notes: *, **, and *** denote at 1%, 5 %, 10%, respectively. Critical values are obtained from Narayan (2005) (Table Case III: Unrestricted intercept and no trend).

Results of the ARDL Approach

The optimal model can be selected using the model selection criteria like Schwartz-Bayesian Criteria (SBC) and Akaike Information Criteria (AIC). Following the AIC, and SIC the optimal lag is two. The generated ARDL short and long-run estimation is presented in part 1 and 2 of table 4.

Table 4: Coefficients of Short and Long-run Estimation from ARDL results ((1,0,0,2)

Coefficients of Short-run Estimation			
Regressor	Coefficient	T-ratio value	P- value
dFP	0.10094	{0.299}	[0.768]
dWIM	- 0.06639	{-1.499}	[0.151]
dFIM	0.01382	{0.670}	[0.511]
dFIM1	0.60211	{2.957}	[0.008]
dC	2.81590	{1.428}	[0.170]
ECT_{t-1}	- 0.47885	{- 3.69}*	[0.002]
Coefficients of Long-run Estimation			
Regressor	Coefficient	T-ratio value	P- value
FP	0.21081	{0.305}	[0.764]
WIM	- 0.13866	{-1.40}	[0.179]
FIM	- 0.22405	{-2.58}**	[0.019]
C	5.8806	{1.351}	[0.194]

Note: The figures in {…} and […] refer to the t-statistics and probabilities, respectively. (*), (**) and (***) denote the rejection of the null hypothesis at the 1%, 5% and 10% levels, respectively

The results of long-run estimation in the second part of table 4 showed that farm price of wheat (FP) is positively related with wheat production (0.21081) and non-significant while quantities of wheat imports (WIM) has negative sign (- 0.13866) and non-significant. Meanwhile, the coefficient of quantities of flour imports (FIM) variable is showing a negative sign (- 0.22405) and has significant relationship with the wheat production. Thus, the coefficient of quantities of flour imports (FIM) variable implies that a 1% increase or rise in quantities of flour imports (FIM) results in a decrease of wheat production by 0.22405%.

In short-run side, the results showed that the coefficient of the farm price variable has a positive sign and non-significant, and therefore has no effect on wheat production. As for the

coefficient of the wheat imports, it was a negative sign and insignificant, which imply that it does not affect wheat production. Meanwhile, the results indicated that the coefficient of the flour imports in lag 1 is a positive sign , which contradicts the expectation despite its statistical significance.

Regarding to the estimation of error correction model based on Ardl model which represents the speed of adjustment to equilibrium following shocks. The findings clarify that the coefficient of the ECM is negative sign and significant (-0.4788), suggesting that a deviation from short-run equilibrium between variables and wheat production can be adjusted and recovered each year at 0.47 % in the long-run. In other meaning,

Diagnostic tests

In order to avoid any econometrics problem in model, numerous of diagnostic tests were used as shown in table 5. The estimated value of R^2 is 0.80; this indicates that about 80 % of total change in the system is getting adjusted towards long-run equilibrium at speed of 47.88 percent. wheat production in this study is explained by the selected independent variables. Meanwhile, the value of the F statistic implies that the model had a good fit. The serial correlation test implies that there is no serial correlation in the model. Also, functional form of the estimated model is correct. Besides that, the diagnostic tests findings adverted the residuals are normally distributed and find no heteroscedasticity problem in the model.

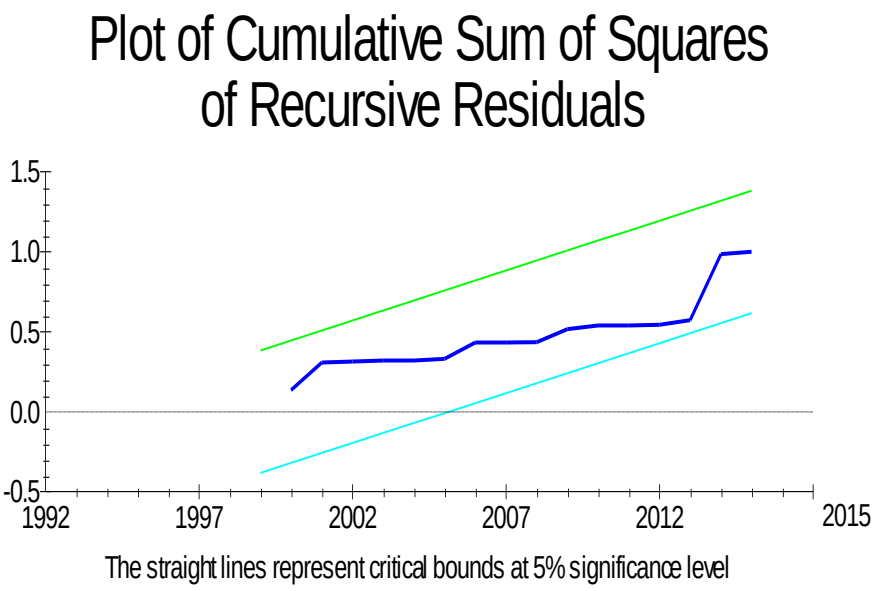
Table 5: Diagnostic test results

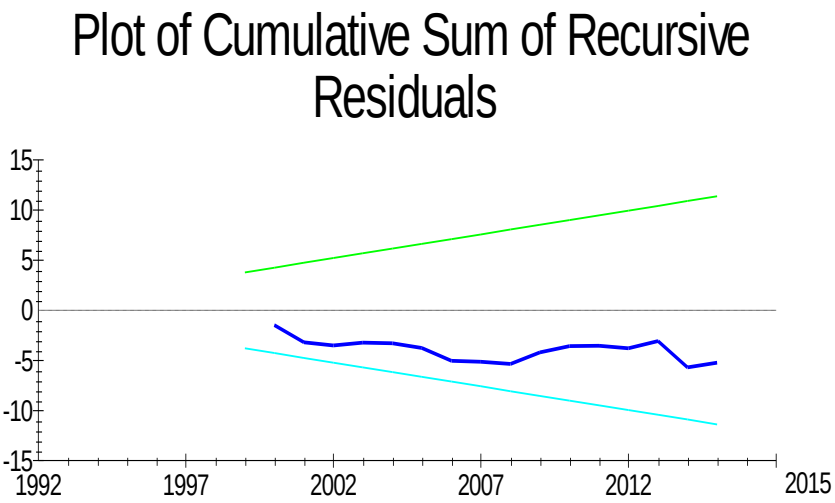
R^2	0.80566
F	11.7460 [0.000]
Serial correlation	2.1670 [0.141]

Functional form	0.42418 [0.515]
Normality	4.6512 [0.098]
Heteroscedasticity	2.0532 [0.152]

Note: The figures in […] refer to the probabilities.

As the stability Figure 1 , 2 showed that the plots of cumulative of sum of recursive residuals and cumulative of sum of squares of recursive residuals within the critical boundaries at 5 % significant level.





CONCLUSION

Completion of the above analysis gives us the possibility to answer of questions, which may be useful for agricultural policy makers. In particular, the study findings found out that during the study period there is co-integration relationship among variables. In a long-run relationship among variables, it found the flour imports variable has effect on wheat production. Also, the findings clarify that the coefficient of the ECM is negative sign and significant (- 0.4788) and the system is getting adjusted towards long-run equilibrium at speed of 47.88 percent.

RECOMMENDATIONS

Based on the results, the study recommends a number of recommendations, including providing financial support to irrigated wheat farms to produce wheat, and activating the role of agricultural extension for wheat producers to increase production. Combating the encroachment of urban expansion on

agricultural lands. Using industrial river water to cover the deficit and reduce imports.

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Appendix: some factors affecting wheat production in Libya during (1990-2015)

year	Wheat Production (Thousand Tons)	Farm Price of wheat (Dinars Per ton)	Imports quantity of wheat (Thousand Tons)	Imports quantity of Flour (Thousand Tons)
1990	128.76	265.20	380.00	591.01
1991	130.00	255.00	614.00	643.39
1992	125.00	260.00	480.00	500.00
1993	126.00	290.00	715.00	615.00
1994	120.00	320.00	300.00	500.00
1995	117.00	278.00	351.95	588.50
1996	124.00	335.00	315.00	637.00
1997	156.40	320.00	352.00	749.00
1998	140.00	335.00	285.00	585.33
1999	130.00	330.00	298.00	674.00
2000	125.00	325.00	427.33	1000.43
2001	125.00	315.00	266.55	901.86
2002	125.00	313.00	490.01	852.20
2003	125.00	310.00	214.84	408.18
2004	125.00	306.50	410.33	958.90
2005	125.00	330.00	580.31	791.49
2006	104.00	312.00	522.20	458.05
2007	104.00	313.00	853.09	571.12
2008	104.00	313.00	809.96	460.55
2009	105.00	313.00	1854.81	155.63
2010	106.00	331.15	1713.19	1.99
2011	166.00	333.46	832.05	265.87

2012	200.00	335.76	1272.62	133.93
2013*	200.00	338.07	1052.34	199.90
2014*	143.35	34.37	1140.70	314.33
2015*	144.36	342.68	1180.66	295.34

Resources:-

- Ministry of agriculture and livestock, Consumer price bulletin for agricultural products.
- Food and Agriculture Organization of the United Nations, Foastat. International information network (Internet)
- Ministry of Libyan Planning, Annual Reports, Ministry of Planning. Various Reports.