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Estimating Agricultural Production Function in Syria using Autoregressive Distributed Lag Approach (ARDL)

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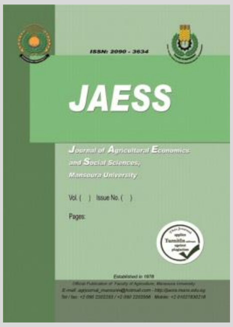

ABSTRACT

Agricultural production is one of the main pillars of the of the Syrian economy development, and despite this importance it suffers from many difficulties, the most important of which is the poor investment of economic resources in agriculture .Therefore, this study aims to estimate the agricultural production function in Syria for the period between 1987 and 2017, using the Cobb-Douglas function, and applying the Autoregressive Distributed lag (ARDL) approach to estimate the responding of agricultural production in real value to changes in agricultural production factors (fixed capital - requirements - employment), to reach a set of results that can help increasing agricultural productivity to achieve the required level of production can support Syrian economy development within the optimal use of limited resources, and the most important results: There is cointegration between agriculture production and its factors, fixed capital is the most productive factor, while productivity of equipment and labor are close and less than fixed capital, agriculture productivity function in Syria follows the law of increasing yield in the long-term which means each increase in production factors causes a higher increase in the real value of agricultural production in the estimated model.

Keywords: agriculture production; Agricultural Production factors; Production function; cointegration.

INTRODUCTION

The agricultural sector plays an important role in the economies of developed and developing countries, as it is considered one of the vital sectors and the main pillars of development in its various branches. This importance flows from providing job opportunities for a wide segment of labor, seeking to achieve self-sufficiency of for growing demand of food with the increasing population growth, provision raw materials for many industries, encouraging activities of other sectors related to agricultural activity, contributing to export promotion, and limiting imports to save foreign exchange (Naeem & Houary, 2015). Agriculture in Syria is recognized by availability of natural and human resources, which are necessary to enhance agricultural production and increase its contribution to the economic development process. However, due to its poor performance agricultural production has not achieve the desired goals. Considering that production is the vital tool for the agricultural sector, which is seeking to maximize it to achieve its goals, our study analysis agricultural production and its influencing by changes in the available production factors, as a result of the depending on the urgent need of achieving vertical expansion due to the limited area of arable land, which confirms the need to increase the productivity of production factors to achieve the agricultural objectives required for economic development process, by the estimation of the agricultural production function in Syria between 1987 and 2017, to find out the following questions:

- What is the effect of the changes in agricultural production factors on the real value of production?
- What is the most influencing factor in the real value of agricultural production?

Therefore, the function of agricultural production will be estimate for Syrian agricultural production during the period between 1987 and 2017, through applying the cointegration approach and the Cobb-Douglas production function, to analyze the response of the real value of agricultural production to the changes in agricultural production factors (capital, requirements, labors), and reaching results that would help in increasing the productivity of the agricultural sector in Syria, and reaching the required level of production within the framework of the optimal use of available resources. Hence the importance of analyzing and measuring the influencing of production factors on the real value of agricultural production in Syria for the period between 1987 and 2017, is represented in determining the influence of each studied factors, and the stage of return of scale, by applying cointegration approach and the Cobb-Douglas function. The literary survey of several previous studies depicts that most researchers have been interested in estimating the agricultural production function by using Cobb-Douglas function to evaluate inputs productivity, and to investigate return to scale in agricultural production. Also, they have been interested with econometric analysis methods in analyzing time series, such as: unit root test and cointegration to reach more accurate results. (HAFIZA&HEJYRA, 2019) estimated agricultural production function in Algeria for the period between 2003 and 2014 applying ARDL to estimate Cobb-Douglas function, they reached a cointegration between agricultural production factors (land, labor, irrigation, fertilizers) and agricultural production, the agricultural production function in Algeria follows decreasing return of scale law (HAFEZA & HEGYRA, 30-10-2019). A study by (YEGO et la., 2018) sough to identify the effects of

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agricultural inputs on agricultural productivity in Kenya for a period between 2001 and 2016, using Johansen Cointegration approach to estimate Cobb-Douglas function for agricultural productivity with (agricultural credit, inflation, rainfall, temperature, agricultural capital formation), and the agricultural productivity, the most important results are revealed that there are a positively effects of independent variables on agricultural productivity, and that agriculture in Kenya follows the increasing returns to scale (YEGO, KEROR, BARTILOL, SAMOEL, & ROTICH, 2018). In research of (SALLEMM, ELSHAIB,2017), they explained conditions for obtaining correct estimation of production elasticities by applying The Cobb-Douglas function therefor, they chose wheat crop production value in Gharbia Governorate to proof research objectives using (cultivated area, labor, capital, farmer age, farmer education level) as explanatory variables for period between 2013 and 2015, and The most important results, the Cobb-Douglas function can be used to calculate the amount of resources maximizing profit in the case of decreasing returns to scale only, the values and signs of the coefficients of the estimated explanatory variables of the Cobb-Douglas function correspond to the economic logic after making sure that the main assumptions of Gauss-Markov theory are fulfilled, marginal productivity is more accurate in representing the productivity of resources than average productivity, as it takes into account the relative effect of these resources on production through elasticity (SALLEM & ELSHAIB, 2017).

MATERIALS AND METHODS

Data for this research cover Syrian agriculture production derived from The year book issued by the Central Bureau Statistics in Syria for period between 1988 and 2018, and the Arab Organization for Arab Development for period between 1987 and 2017 covered agricultural production, agricultural fixed capital, agricultural requirements in real value, and agricultural labor to describe and analyze reality of agriculture production in Syria through estimating Cobb-Douglas function by Cointegration approach.

Agricultural production in Syria

Agricultural production is characterized by a set of features that distinguish it from the production of other sectors, the most important of these characteristics is the high ratio of fixed capital to the capital circulating in the production process unlike other sectors' production, length of the production cycle, seasonality of production, high risk, the sensitivity of logistic operations from farm to market, and the prevalence of traditional agriculture process and the low adoption of modern technical process (BASMA, 2017).

In Syria, agricultural production recorded many fluctuations between 1987 and 2017, as a result of its suffering from several crises of drought, sequential climate changes, natural resources misuse, insufficient investment, and recently the war trouble and destruction that Syria has suffered since 2011 (ESCWA, 2018). Table 1. shows that in despite of these difficulties the real value of agricultural production increased from 156128 million SYP to 329720 million SYP, with 3.17% an average annual growth rate between 1987 and 2017. There are many factors contributing to agricultural production process which are commonly classified into: nature factors such as: land, livestock, Irrigation. Economic factor such as: fixed capital, equipment, force labor. In this study analyses focused on economic factors productivity.

Table 1. Real agriculture production value (million Syrian pound)

Year	Real agriculture production	Year	Real agriculture production	Year	Real agriculture production
1987	156128	1998	349526	2009	398006
1988	200960	1999	307863	2010	365527
1989	177175	2000	337098	2011	415289
1990	207150	2001	359947	2012	425070
1991	217033	2002	384005	2013	320143
1992	241743	2003	371442	2014	302388
1993	244837	2004	377281	2015	316223
1994	256271	2005	401921	2016	318647
1995	273974	2006	437933	2017	329720
1996	313518	2007	382941	Average annual growth rate	3.17%
1997	290275	2008	360506		

Source: yearbook of Syrian Central Bureau Statistics for period between 1988 and 2018

Agricultural Fixed Capital in Syria

Fixed capital is an important aspect to enhance agricultural production and promote long-term agricultural growth which affects in economic development. Fixed capital consist of durable assets like improvements of land and capital invested in livestock, furthermore fixed capital reflects the technical foundation needed for production capacity to improve agricultural competitiveness (LOSOSOVA, ZDENEK, & SVOBODA, 2020).

Table 2. shows increasing in real fixed capital value invested in Syrian agricultural sector from 11357 million SYP in 1987 to 35801 million SYP in 2017 with 7.17% an average annual rate. Nevertheless, agricultural investment suffers from weakness compared to other economic sector investment with high return, because of the high risk, weak infrastructure, small agricultural holdings, and inefficiency of agricultural credit programs.

Table 2. Real fixed agricultural capital value (million Syrian pound)

Year	Real Fixed agricultural value	Year	Real Fixed agricultural value	Year	Real Fixed agricultural value
1987	11357	1998	24296	2009	26911
1988	14071	1999	22204	2010	34552
1989	19783	2000	24431	2011	31368
1990	22713	2001	18866	2012	11614
1991	22014	2002	32279	2013	23573
1992	24385	2003	30173	2014	11248
1993	22425	2004	37218	2015	20477
1994	23078	2005	40571	2016	18608
1995	25132	2006	34634	2017	35801
1996	24922	2007	26260	Average annual growth rate	7.17%
1997	24987	2008	21879		

Source: yearbook of Syrian Central Bureau Statistics for period between 1988 and 2018

Agricultural production requirements in Syria

Farmer always care of access modern agricultural requirements to improve productivity by providing the subsequent inputs, such as: seeds, electricity power, mechanization, fertilizers, and pesticides etc. (GANESA &

PUSHPAVALLY, 2017) So production requirements are considered as a means to resist to negatives caused by the limited arable land, decline in pasture, soil degradation and in addition to compensate for the missed opportunities of insufficient agricultural fixed capital, to intensify agricultural production and improve the quality as necessary for the development of the agricultural sector and increase its contribution to economic development.

Table 3. shows the increased dependence of requirements by farmers in Syria. The real requirements value increased from 41,570 million SYP in 1987 to 218,346 million SYP in 2017, with an average annual growth rate of 14.17%, which is a high rate compared to real agricultural fixed capital, But agricultural requirements using is still low compared to the global level for many reasons, the most important of which is the weakness of domestic requirements, depending on imported requirements and their high prices, in addition to poor of technical knowledge and experience of most farmers in modern requirements and the importance of how rational use, especially fertilizers, medicines and improved seeds, as well as the limited financing capacity for farmers (BAHBOUH, 2018).

Table 3. Real agricultural production requirements value (million Syrian pound)

Year	Real agricultural requirements value	Year	Real agricultural requirements value	Year	Real agricultural requirements value
1987	41570	1998	107365	2009	131684
1988	49783	1999	106504	2010	125152
1989	72400	2000	116821	2011	137178
1990	79745	2001	120051	2012	218884
1991	80828	2002	122997	2013	130568
1992	80461	2003	117364	2014	199005
1993	84092	2004	128883	2015	205580
1994	85499	2005	136512	2016	209917
1995	96599	2006	144177	2017	218346
1996	110123	2007	128928	Average annual growth rate	14.17%
1997	92521	2008	123647		

Source: yearbook of Syrian Central Bureau Statistics for period between 1988 and 2018

Agricultural Labors in Syria

The labor factor is distinguished from other production factors by a set of characteristics that are derived from human characteristics, such as: need, motivation, and satisfaction acquired from work. The agricultural labor also derives its importance from its role in blending other production factors up to achieve the desired level of production. This makes work in agriculture recognized with a special character from other economic activities due to the distinctive nature of agriculture which makes the agricultural sector unattractive to work due to the difficult nature of intensive work and its seasonality according to the season of agricultural production and weak wages compared to other economic sectors (PETRESCU, 2014).

Agricultural labor in developing countries is affected by the prevailing economic situation in periods of economic recovery, labors move from the unstable agricultural sector to other economic sectors that achieve a higher return for them, at the forefront of which is the services sector, in periods of economic crises the agricultural sector is considered the reserve sector for labors and the proportion of labors in it rises (ESCWA, 2011), This explains the fluctuation in the volume of agricultural labor in Syria between 1987 and 2018.

As shown in Table 4. Agricultural labors registered an increase between 1987 and 2003 to reach 1599000 labor after which it began to decline and reaching the lowest number 767580 labor in 2012 the period which observed the start of the acceleration of economic development and the shift of labors from agricultural sector to other economic sectors that provide them with better livelihood opportunities from agriculture, then the number has increased to 1287620 labor in 2017 with returning of labors to agriculture due to the damage of economic sectors and the decline in production of all of them in recent years because of political and economic situations in Syria. So agricultural labors achieve between 1987 and 2017 average annual growth rate 2.60%, and it is the lowest rate between studied factors.

Table 4. Volume of agricultural labors in Syria

Year	Agricultural labors	Year	Agricultural labors	Year	Agricultural labors
1987	723000	1998	1117000	2009	814000
1988	730000	1999	1306000	2010	758000
1989	738000	2000	1493000	2011	721000
1990	746000	2001	1528000	2012	767580
1991	743000	2002	1563000	2013	872300
1992	756000	2003	1599000	2014	872300
1993	784000	2004	813000	2015	1352000
1994	813000	2005	953000	2016	1297630
1995	835130	2006	945000	2017	1287620
1996	924000	2007	947000	Average annual growth rate	2.60%
1997	924000	2008	963000		

Source: yearbook of The Arab Organization for Arab Development for period between 1987 and 2017

The Cobb – Douglas Production Function

The importance of estimating the production function coms from the economic indicators derived from it, such as production elasticities to know the extent of achieving economic efficiency of the production input. The Cobb-Douglas functions is commonly used in estimating agricultural production function and extracting economic indicators to determine the quantity or value of inputs needed to maximize production or profit (SALLEM & ELSHAIB, 2017). The Cobb-Douglas function has the following mathematical form:

$$\gamma = A\, L^{\beta_1}\, K^{\beta_2} e^{\varepsilon} \qquad (1)$$

Where:

γ is output, A is efficiency parameter, L is labor input, K is capita input, β_1: partial elasticity of labor input, β_2: partial elasticity of capital input, ε: error term.

Frequently The Cobb-Douglas function include two main factors labor and fixed capital, but regarding on the analytical need it is possible to extend factors (PAVELESCU, 2014). So, in this study we will add requirement variable because it is considered working capital transferred its value to production output.

The Cobb-Douglas Function is distinguish as a Homogeneous Production Function of degree (κ), where (κ) is The sum of the parameter of the explanatory variables, and it indicates Return to Scale, where it can be recognize three cases: $\kappa = 1$ constant Return to Scale or Liner Homogeneous, $\kappa > 1$ Increasing Return to Scale, $\kappa < 1$ Decreasing Return to Scale (PRASAD & WAGLE, 2016).

Time Series Stationary Test

Commonly time series are characterized as nonstationary series which meaning their statistical properties change over time, and this is consequent to containing the series a trend or a seasonal combination, and when the studied time series is nonstationary it would reach a spurious results. Time series be Stationary if it achieves these conditions (WOOLDRIDGE, 2012):

a. Mean constant and independent in each moment:

$$E(y_t) = E(y_{t+\eta}) = \mu \qquad : \forall\, t, n \qquad (2)$$

b. Variance is finite and independent in each moment:

$$\mathrm{var}(y_t) = \sigma_y^2 < \infty \qquad : \forall t \qquad (3)$$

c. Covariance depends only on (h: time gap) not on (t: time):

$$\mathrm{cov}(y_t, y_{t+h}) = E[(y_t - \mu)(y_{t+h} - \mu)] = \gamma_h \qquad (4)$$

Sometimes it is not accurate to determine if time series is stationary or nonstationary from observation or graph. Therefore, To make sure if time series is stationary or nonstationary, and to know its stationary degree, we use Uni Root Test. Augmented Dick-Fuller test is a wildly spread used test of Unit Root Test.

ADF test searches in time series stationary state throughout estimating three formulas of AR(P) by OLS (ASHOUCH & ARBID, 2015) :

a. First formula without constant or trend:

$$\Delta y_t = \delta y_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta y_{t-j} + \varepsilon_t \quad (5)$$

b. Second formula with constant:

$$\Delta y_t = \beta_1 + \delta y_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta y_{t-j} + \varepsilon_t \quad (6)$$

c. Third formula with constant and trend:

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta y_{t-j} + \varepsilon_t \quad (7)$$

Where:

$\Delta Y_t = Y_t - Y_{t-1}$ (The first difference of variable), $\delta = \rho - 1$ (coefficient of lagged variable), ε_t: error term, p: lag rank of variable to get rid of autocorrelation of residuals, usually determine by criteria like (Akaike, Schwarz).

Cointegration Test

The cointegration is considered one of the basic concepts in the econometrics analysis based on simulating the existence of a long-term equilibrium between a set of nonstationary time series, means they are divergent in the short-term and converge over time to achieve a stable equilibrium relationship called cointegration. Thus, cointegration provides a correct basis for statistical and economic analysis through the error correction model that explains the behavior of nonstationary variables in short-term which leads to achieving equilibrium in the long-term (ASHOUCH & ARBID, 2015).

Autoregressive Distributed Lag is an appropriate cointegration technique when studied variables are integrated of different order I(0) , I(1) or a combination of both, on condition no one of underlying variables is I(2).

Before estimating cointegration model it must be determined the appropriate lag length for each variable by using selection criteria such as: AKAIKA or SHWARZ to reach a standard normal error term of estimated cointegration model, and it is necessary to notice that PESARAN (2009) recommended to use lag = 2 when analyzing annual data (ACHOUCH, 2018).

ARDL approach distinguish with possibility of estimating short-term and long-term in single model equation called unrestricted error correlation model with using appropriate lag length, and ability of driving separating model for each short-term and long-term model. UECM formulated as follow (NKORO & UKO, 2016):

$$\Delta y_t = \alpha + \sum_{i=1}^{p} \gamma\, \Delta y_{t-i} + \sum_{i=0}^{q} \varphi\, \Delta x_{t-i} + \lambda_1 y_{t-1} + \lambda_2 x_{t-1} + \varepsilon_t \quad (8)$$

Where:

$\Delta Y_t = Y_t - Y_{t-1}$, α: constant, γ and φ: short-term coefficient, λ_1 and λ_2: long-term coefficient, p and q: lags, ε_t: error term.

After confirming the existence of cointegration, the short-term dynamics effects are measured through Error Correction Model ECM that is given by the following equation:

$$\Delta y_t = \alpha + \sum_{i=1}^{p} \delta\, y_{t-1} + \sum_{i=0}^{q} \vartheta\, x_{t-i} + \psi ECT_{t-1} + \varepsilon_t \quad (9)$$

ECT_{t-1}: indicates to error term resulting from the cointegration model and measures the speed of adjustment of the short-term disequilibrium to the long-term equilibrium. ψ: The coefficient of adjustment speed, it measures the speed of adjustment which the disequilibrium in the short-term is adjusted towards the equilibrium in the long-term. A positive value of ψ indicates to divergence while negative value indicates to convergence. Whenever the value of ψ is closer to 1 it means the speed of adjustment of disequilibrium in the short-term towards the equilibrium in the long-term is faster. Then it can be derived long-term model from model (7) as follow:

$$y_t = \varsigma + \sum_{i=1}^{p} \delta\, y_{t-i} + \sum_{i=0}^{q} \vartheta\, x_{t-i} + \varepsilon_t \quad (10)$$

Where:

ς: constant, δ and ϑ are estimated coefficient, p and q: lags, ε_t: error term.

RESULTS AND DISSECTION

At the beginning it should be applied ADF Unit Root Test for logarithm value of data in Table.1, Table. 2, Table.3, Table. 4 to accrue proportionality data for analysis via E-Views. 10.

Results presented in Table. 5, indicate that Lcapital and Lrequirments have no unit root and time series are stationary at level, while Lproduction and Llabor have unit root at level but become stationary after first difference. Hence for these results Autoregressive Distributed Lag Cointegration is the Technique to be adopted in the analyzing and testing the significance of cointegration between agricultural production and (fixed capital, requirements, and labor). So, we have to applying Bound Test for logarithm value of data in Table.1, Table. 2, Table.3, Table. 4.

Table 5. ADF Unit Root Test results

Variable	Level		1st difference		Result
	Trend & Intercept	Intercept	Trend & Intercept	Intercept	
Lproduction	0.5717	0.0624	0.000	0.000	I(1)
Lcapital	0.0266	0.0051	0.000	0.000	I(0)
Lrequirments	0.0018	0.2423	0.003	0.000	I(0)
Llabor	0.6639	0.3928	0.004	0.000	I(1)

Source: prepared by researchers using E-views.10

Table.6 shows results of Bound Test, and it can be noticed F-statics value is greater than the upper bound critical values at all insert levels of significance therefore, there is a significant cointegration between agricultural production and (fixed capital, requirements, and labor). After Bound Test and before estimating Error Correction Model the lag length must be determined. The following Fig.1 represents Akaike Criteria output which reveal the best estimating of ECM is obtained with (2.2.1.0) it means that two lags length for each Lproduction and Lcapital and one lag length for Lrequirments and no lag length for Llabor have been selected.

Table 6. Results of Bound Test

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	8.377243	10%	2.72	3.77
k	3	5%	3.23	4.35
		2.5%	3.69	4.89
		1%	4.29	5.61

Source: prepared by researchers using E-views.10

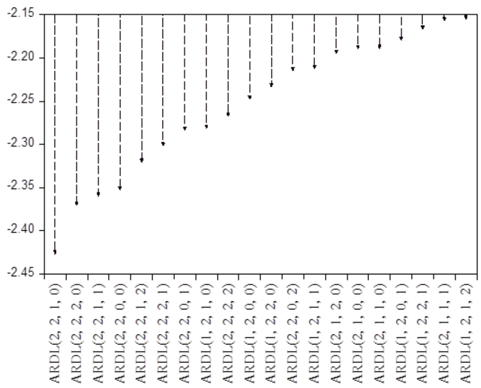

Fig1. Akaike Information Criteria (top 20 models)

Table. 7 shows parameters of ARDL model according to (2.2.1.0), which include long-term and short-term, and it can be represented as following:

$$D(Lproduction) = -1.001 - 0.481\,Lproduction(-1) + 0.384\,Lcapital(-1) + 0.128Lrequirments(-1) + 0.125\,Llabor - 0.255\,D(Lproduction(-1)) + 0.111\,D(Lcapital) - 0.145(\mathrm{Lproduction} - (0.799\,\mathrm{Lcapital}(-1) + 0.267\,\mathrm{Lrequirments}(-1) + 0.261\,\mathrm{Llabor}(-1)) + 0.306\,\mathrm{D}(\mathrm{Lrequirments})) + \varepsilon_t \quad (11)$$

Table 7. Estimated ARDL (2.2.1.0) model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.000703	0.916668	-1.091675	0.2880
Lproduction(-1)*	-0.480906	0.108311	-4.440029	0.0003
Lcapital(-1)	0.384138	0.073249	5.244248	0.0000
Lequirments(-1)	0.128270	0.069045	1.857766	0.0780
Llabor**	0.125491	0.052702	2.381140	0.0273
D(Lproduction(-1))	-0.254720	0.116477	-2.186878	0.0408
D(Lcapital)	0.111000	0.050729	2.188084	0.0407
D(Lcapital (-1))	-0.145383	0.054294	-2.677693	0.0145
D(Lrequirments)	0.305745	0.094179	3.246440	0.0040

Source: prepared by researchers using E-views.10

To ensure the estimated ARDL model does not represent spurious results, some tests should be applied

Table. 8 reveals that error term follow Normality distribution, there are no autoregression between their values, and there is no heteroscedasticity in error term. Also, the curve of cumulative sum of residuals (CUSUM) presenting in Fig. 2, and (QCUSUM) presenting in Fig. 3 showing curves are laid within the critical bands of the 5% confidence level, which indicates the stability of the estimated model parameters and there is no instability structure in the model during studied period.

Table 8. Results of diagnostic test for estimated ARDL model

Test	Coefficient	Prob.
Normality Test (Jarque-Bera Test)	0.830880	0.660050
Serial Correlation LM Test	1.903097	0.3861
Heteroskedasticity Test	5.466895	0.7067

Source: prepared by researchers using E-views.10

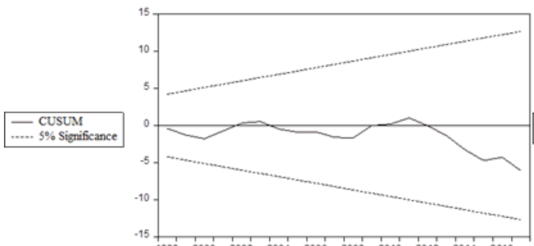

Fig.2 CUSUM

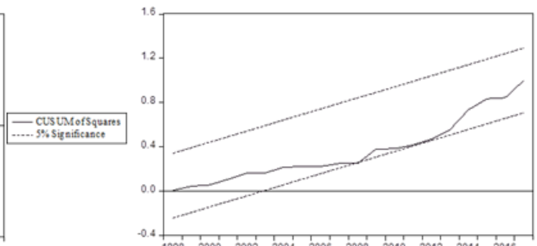

Fig.3 CUSUM of Squares

After making sure of ARDL model reliability it, is possible to drive the short-term model and the long-term model.

Table. 9 shows parameters of short-term model which can be formulated as following:

$$D(LProduction) = -1.001 - 0.255(LProduction(-1)) + 0.111D(LCapital) - 0.145D(LCapital(-1)) + 0.306D(Lrequirments) - 0.481CointEq(-1) + \varepsilon_t \quad (12)$$

The short-term model is significant at 5% confidence level, and explains 67.08% of changes in - agricultural production in the short-term and the rest is due to other random variables, and all parameters of model are significant at 5% confidence level, and indicate the agricultural production is affected negatively with one year lagged value of agricultural production and fixed capital in the short-term that can be explain by the nature of agricultural production which is characterized by alternation and delay in achieving results of polices related to agriculture for subsequent years, and affected positively with current value of fixed capital and requirements in the short-term which reflects the cumulative and continuous impact of fixed capital, and the current impact of requirements that are often used for a one production term. Refers to the coefficient of adjustment speed $CointEq(-1)$ = - 0.481 negative and significant value at 5% confidence level means variables are converged to reach equilibrium in the long-term, and indicates that 48.09% of disequilibrium from shocks will back to equilibrium during one year. That is the divergence of agricultural production need 2.08 years to overcome the shocks and back to equilibrium in the long-term. This relatively long period reflects a low elasticity in the response of the agricultural production to any shocks occurring in the short-term, and this is what recognizes agricultural production from other sectors' production.

Table 9. Estimated short-term coefficients using ARDL (2.2.1.0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.000703	0.162919	-6.142329	0.0000
D(Lproduction(-1))	-0.254720	0.100742	-2.528438	0.0200
D(Lcapital)	0.111000	0.039199	2.831731	0.0103
D(Lcapital(-1))	-0.145383	0.050617	-2.872200	0.0094
D(Lrequirments)	0.305745	0.079515	3.845122	0.0010
CointEq(-1)	-0.480906	0.077470	-6.207682	0.0000
R-squared	0.729633	Adjusted R-squared		0.670858
F-statistic	12.41391	Durbin-Watson stat		1.828849
Prob(F-statistic)	0.000007			

Source: prepared by researchers using E-views.10

Table. 10 presents coefficients of estimated long-term which has the following form:

$$Lproduction = \mathbf{0.799}\ Lcapital + \mathbf{0.267}\ Lrequirments + \mathbf{0.261}\ Llabor + \varepsilon_t \quad \textbf{(13)}$$

Table 10. Estimated long-term coefficients using ARDL (2.2.1.0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Lcapital	0.798779	0.139318	5.733477	0.0000
Lrequirments	0.266725	0.106575	2.502685	0.0211
Llabor	0.260948	0.113864	2.291754	0.0329

Source: prepared by researchers using E-views.10

The coefficient of the estimated long-term model expresses the partial elastics of agricultural production factors. It indicate there is direct relationship between capital, requirements, and labor with agricultural production in Syria, explaining that every 1 SYP increasing in real agricultural fixed capital with the assumption of constant other factors leads to 0.799 SYP increasing in real agricultural production, every 1 SYP increasing in real agricultural requirements with the assumption of constant other factors leads to 0.267 SYP increasing in real agricultural production, every additional one agricultural labor with the assumption of constant other factors leads to 0.261 SYP increasing in real agricultural production, finally each one unit increasing in agricultural production factors together (fixed capital, requirements, labor) leads to 1.326 SYP increasing in real agricultural production. It is noted that capital factor seems more influential followed by requirements and labor with approximately same influence. Thus, agricultural production in Syria in period between 1987 and 2017 is in the stage of increasing return to scale. That is any additional increasing in production factors able to achieve higher return in the agricultural production.

CONCLUSIONS

The study found that time series of fixed capital and requirements are stationery and time series of agricultural production and labor are integrated at first deference. By using ARDL there is long-term equilibrium relationship between the agricultural production factors (fixed capital, requirements, labor) and the agricultural production. There is an influence of the agricultural production factors which studied on real agricultural production in the short-term and the long-term. 48.09% of disequilibrium from shocks will back to equilibrium during one year thus, the divergence of agricultural production need 2.08 years to overcome the shocks and back to equilibrium in the long-term, and this relatively long period related to the nature of agricultural production. Fixed capital considered more influential followed by requirements and labor with approximately same influence in the long-term therefore attention should be given to quantitative and qualitative accumulation of fixed capital, and more intensive of making needed requirements available, and developing human capital ability in agriculture. The agricultural production in Syria for period between 1987 and 2017 followed stage of increasing return to scale, which means any additional increasing in production factors able to achieve higher return in the agricultural production.

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تقدير دالـة الإنتـاج الزراعي في سـوريـة باسـتخدام نماذج الانحـدار الذاتي لفترات الإبطـاء الموزعـة (ARDL)

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يهدف البحث إلى تقدير دالـة الإنتـاج الزراعي في سوريـة خـلال الفترة الممتدة بين عامي 1987 و 2017 باستخدام دالـة Cobb-Douglas ومنهجيـة التكامل المشترك لتحديد مدى استجابـة الإنتـاج الزراعي في سوريـة للتغيرات الحاصلـة في عوامل الإنتـاج الزراعي. توصلت الدراسـة إلى مجموعـة من النتائج تسـاعد في زيـادة انتاجيـة الزراعـة للوصول إلى أفضل مستوى من الإنتـاج في إطـار الاستخدام الأمثل للموارد المتاحـة، من أهم هـذه النتائج: يوجد علاقـة تكامل مشترك بين الإنتـاج الزراعي وعوامل الإنتـاج (رأس المـال، مستلزمـات الإنتـاج، والعمالـة الزراعيـة)، ويعتبر عامل رأس المـال هو العامل الأكثر انتاجيـة بينما تنخفض انتاجيـة كل من عاملي المستلزمـات الزراعيـة والعمالـة الزراعيـة وتتقارب فيما بينها، ويتبع الإنتـاج الزراعي في سوريـة قانون الغلـة المتزايدة في الأجل الطويل، أي زيـادة قيمـة الإنتـاج الزراعي بالأسعار الثابتـة بمعدل أعلى من زيـادة عوامل الإنتـاج الداخلـة في النموذج.

الكلمـات المفتاحيـة: الإنتـاج الزراعي، عوامل الإنتـاج الزراعي، دالـة الإنتـاج، التكامل المشترك.