



Estimation and Analysis of the Agricultural Investment Model in Iraq (1990-2020) using the Autoregressive Distributed Lag Methodology

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Abstract

In this research, the effects of some financial and economic determinants of agricultural investment in Iraq during the period (1990-2020) were analyzed using the autoregressive distributed lag (ARDL) methodology. In this context, agricultural loans, inflation rate, budget deficit, exchange rate, and financial allocations to support agricultural projects were chosen as determinants of agricultural investment. The problem of the research is that the Iraqi agricultural sector possesses many components and capabilities that encourage investment, but it suffers from low investments directed to it. This is not commensurate with the importance of this sector, which negatively affects the rates of agricultural development and the decline in the agricultural sector's ability to increase the rates of self-sufficiency in agricultural products. The research aimed to know the economic determinants and the extent of their impact on investment in the Iraqi agricultural sector. An inferential analytical approach was used based on estimating the autoregressive distributed lag model and demonstrating its suitability to the research data by testing statistical hypotheses related to the model. The data were analyzed and econometric models were estimated using econometrics and time series analysis software Eviews-12. The results of estimating the long-run relationship showed that all determinants have significant effects on agricultural investment except the inflation rate, the most influential of these determinants is the exchange rate, which negatively affects agricultural investment as the dollar exchange rate increases by one dinar, this leads to a decline in agricultural investment by (1.444854) million dinars. Then agricultural loans with a positive impact where an increase in the agricultural loans by one million dinars is offset by an increase in agricultural investment by (53,057) dinars. Followed by financial allocations for agricultural projects with a positive impact, where every increase in investment allocations by one million dinars will lead to an increase in agricultural investment by (422) dinars. And finally, the public budget deficit with a negative impact on agricultural investment, where every increase in the budget deficit by one million dinars will be offset by a decline in agricultural investment by (50) dinars. The joint integration test showed a long-run equilibrium relationship between economic and financial determinants and agricultural investment. The research recommends the need for the state to implement a package of policies and procedures to activate the role of variables affecting agricultural investment, which contribute to attracting local and foreign investments, most notably maintaining a stable exchange rate for the local currency and increasing the volume of agricultural loans provided.

Key words: autoregressive distributed lag models, co-integration, agricultural investment, agricultural loans, inflation, exchange rate

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Introduction

The agricultural sector is one of the important economic sectors not only in Iraq but also in most economies of the world because it is the sector that provides food for the population and its industrial and commercial importance and so on. Therefore, the developed countries governments have attached great importance to it, as they have invested hundreds of billions dollars for the purpose of developing it and building infrastructure as well as direct and indirect, financial, administrative, technological and informational support for agricultural research centers. In Iraq, the agricultural sector suffers from a package of challenges that require the state to intervene, direct and indirect support, and direct more investments for the purpose of its development and removal of these challenges. However, public and private direct investments witnessed a significant decline due to a number of economic, social and political factors, as well as security reasons and the issue of administrative and financial corruption, which led to a deterioration in production and a decrease in its contribution to the gross domestic production, and Iraq became dependent on global markets to provide its food security at very high rates, which constitutes a threat to national security. To demonstrate the impact of agricultural loans on the growth and development of the agricultural investment and then diversify the sources of agricultural loans, agricultural loans and agricultural investment in Iraq were studied for the period of time (2003-2015). The problem of the study was that the weakness of agricultural investment in Iraq is mainly due to both the weakness of agricultural financing represented by agricultural loans and the weakness of agricultural credit management. The most important findings of the study are the significant impact of agricultural loans on the

growth and development of agricultural investment in Iraq, and the limited contribution of agricultural loans to financing agricultural investment due to their reliance on one source of borrowing, which is the cooperative agricultural bank, in addition to the spread of administrative and financial corruption. As a result of the spread of favoritism and political and sectarian considerations among administrative structures in the country [1]. The determinants of private investment in the agricultural sector in Iraq were studied for the period (1990-2014) to address the problem of the weak contribution of the agricultural sector to national income and its inability to activate economic activity. The study aimed to measure the impact of each of the gross domestic product, average exchange rate, interest rate, inflation rate and public consumer spending on private investment in the agricultural sector, by using the autoregressive distributed lag (ARDL) model, the study concluded that there is a long-term equilibrium relationship between private investment and its determinants in the agricultural sector, and that gross domestic product has a positive effect on investment, while the effect of other variables was negative on agricultural investment. Yes, some determinants also differed in their impact Between the long and short terms during the study period. The study recommended directing investment spending towards real agricultural investment, which works to expand agricultural production capacity [2]. Agricultural investment plays an important role in sustainable agricultural development. In a study entitled (sustainable agricultural development in Iraq, its concept, importance, and obstacles for the period 1990-2017), it aimed to shed light on sustainable agricultural development, explain the most important obstacles that stand in the way of developing

the agricultural sector, and attempt to present possible solutions to improve the efficiency of this sector in providing food to the population. The research was based on the hypothesis that it is difficult to achieve sustainable agricultural development in light of the prevailing economic, geopolitical and environmental situation in Iraq. By adopting the research on the descriptive approach represented by a case study, the research concluded that the agricultural problem in Iraq is not related only to the amount of arable land, but also to the decline in agricultural production and thus the decline in food security due to the inadequacy of this output in covering the population need, as well as the decline of most agricultural development indicators. In addition to the scarcity of water sources, high transportation costs, and the high share of the production unit in fixed costs. In light of this, the research recommended the necessity of developing an integrated plan to develop the agricultural sector that includes rationalizing the use of water resources, using modern means and methods in agriculture, and developing livestock using modern methods [3].

In 2008, the Iraqi government launched the agricultural initiative to stimulate investment and encourage the agricultural sector, which represented one of the financing policies adopted by the government after 2003. So Al-Obaidi and Al-Polani published research on the role of this initiative, and stated the research problem (despite the government providing capital to the agricultural sector with the aim of stimulating investment and promoting the agricultural sector, but the financing policy may fail to achieve this for subjective reasons related to the extent of its commitment to the standards and foundations of sound financing, and objective reasons related to the extent of interoperability and coordination between it and other economic and agricultural policies). The research assumed that there is a positive relationship between agricultural financing and stimulating investment, but conditional on the availability of correct financing foundations and rules. A method of analyzing and measuring some economic indicators (production and productivity of wheat) was used as a strategic crop. The research found that there is a delay

in the financing policy in some economic and agricultural policies that have economic indicators. Influenced by this, the study recommended that the agricultural financing policy be the one that governs the Agricultural Bank after its restructuring, and that there be coordination and consensus between agricultural policies, especially marketing and financing [4]. All previous studies that dealt with the factors affecting agricultural investment in Iraq dealt with the descriptive analytical approach based on analyzing the reality of the development of these variables over the required time periods, in addition to using some of them static regression models, so this study came to use dynamic models in explaining the impact of economic and finance determinants on agricultural investment, as these models enable finding relationships in the short and long run, as well as testing the co-integration between these determinants and agricultural investment.

The problem of current research is that the agricultural sector in Iraq has many elements and potentials that encourage investment, but it suffers from low investments, which reflects negatively on agricultural development rates and the low ability of the agricultural sector to increase self-sufficiency rates of agricultural products, which requires the need to expedite pumping the necessary investments into the agricultural sector, in order to help increase its productivity. The importance of research lies in the importance of agricultural investment, which is the main engine and driver of agricultural development, through which food security is achieved and the efficiency of exploitation of available resources is raised. Investment leads to the establishment of new projects that have the capacity for productive and human development, which lead to an increase in income growth rates and economic well-being. The research aims to measure and analyze the long-run dynamic effects of some determinants of agricultural investment in Iraq during the period (1990-2020), based on the main hypothesis that there is a long-run co-integration relationship between the agricultural investment and some economic and financial determinants (agricultural loans, inflation rate, budget deficit, exchange rate, investment projects allocations), and that these

determinants can enhance agricultural investment in Iraq. On the empirical study, the econometric approach was relied upon by estimating the autoregressive distributed lag model (ARDL) to estimate the short and long-run relationships between agricultural investment and economic and financial factors. For this purpose, Eviews-12 econometrics and time series software was used.

Material and Methods

1. Concept of Agricultural Investment

Agricultural investment represents the optimal utilization of available agricultural production factors of land, labor and capital..., in order to produce agricultural products to meet consumer needs and obtain the best possible results. These results vary according to the prevailing economic system. In a capitalist system, agricultural investment must achieve the best return. economical possible, in the sense of the greatest profit value. In the socialist system, agricultural investment must achieve the best economic return in addition to the social return at the same time [5]. The investment process means sacrificing the satisfaction of a current consumer desire, in the hope of obtaining more saturation in the future, and that sacrifice must be matched by assuming a certain level of risk and thus obtaining a certain level of return [6].

Agricultural investment is the investment of funds in agricultural projects, whether plants or animals, for the purpose of obtaining a satisfactory return for the individual or the company, or striving to provide the country's needs of basic and necessary foodstuffs that contribute to achieving food security and economic and social development [7].

2. Importance of Agricultural Investment

Agricultural investment reflects the importance of the role of the agricultural sector in economic development, especially in developing countries, particularly in the early stages. Adequate size, reduce high rents and improve land surveying [8]. The progress of countries is measured based on the size of their investments or assets, which are among the most important financial factors for raising national income and the standard of living. Therefore, investments have economic, social and strategic importance, and the importance

of agricultural investment is positively linked to the growth of production, which is considered one of the most important factors of economic growth, and is also considered one of the important factors affecting the increase in in agricultural production supply [9]. Investing in the agricultural sector will open broad economic prospects and agricultural activity and will develop the reality of this sector and provide multiple benefits, mainly [10]:

Improving the performance and effectiveness of the agricultural sector and establishing agricultural projects.

- 1) Raising agricultural production through optimal utilization of agricultural natural resources.
- 2) The increasing input of various technological innovations and inventions related to agricultural technology.
- 3) Increasing agricultural competitiveness and enabling national production to replace agricultural imports that deplete the trade balance.
- 4) Increasing agricultural production in quantity and quality so that it can cover consumption.
- 5) For growing agricultural crops vegetables, fruits, industrial agricultural crops cotton, sugar cane, pastures and forests
- 6) Raising the income of families in agricultural and rural areas, because the encouragement of income levels for those families is continuous and increasing.
- 7) Increasing workers in the agricultural sector and then employing a lot of manpower and absorbing unemployment through creating new job opportunities as well as developing the efficiency of workers in this sector and raising their level.
- 8) Reducing the migration of farmers from the rural to the city, which resulted in population density in cities, through the establishment and construction of modern villages.
- 9) Raise the percentage of exporting agricultural products, even if it was by a small percentage, after they were imported from outside Iraq, and thus the volume of trade exchange between Iraq and neighbouring countries or other countries of the world will be expanded.

3. Determinants of Agricultural Investment

Agricultural investment is determined by a group of direct and indirect factors, some of which are internal and external variables. The reason for the occurrence of periods of recession and prosperity in the national economy is the fluctuations in the volume of investment. Among the most important of the direct determinants are [11]:

- 1) Interest rate: the relationship is inverse between the interest rate and the investment. When the interest rate falls, it leads to an increase in investment demand, so the return on investment will be greater.
- 2) Population growth: consumption increases with the increase in population numbers and the proportion of income allocated to investment decreases. This means that increasing in population growth rates lead to negative impact on investment.
- 3) The security and political situation: The main determinant of investment is the security stability that leads to attracting investments inside the country
- 4) Financial and administrative corruption: Financial and administrative corruption is widespread at the present time, and it is an obstacle to economic growth, and this causes a decrease in agricultural investment.
- 5) Expectations: Future expectations are related to the nature of the economic policies adopted by the state in order to encourage investment
- 6) Profit: profit is the main incentive for all agricultural and other projects, and it is one of the most important factors determining investment, and the relationship between profit and investment is a direct relationship, as with increasing profits, investments will increase.
- 7) Risk: It is the degree of lack of knowledge of future matters, with data and statistics that can be referred to determine the probability of an event occurring.
- 8) Uncertainty: it is the uncertainty of any events that can occur in the future and cannot be measured and there are no data and statistics that can be referred to.

As for the indirect determinants of agricultural investment, they include unmeasurable variables and factors, including:

- 1) Technology: It is considered one of the important factors associated with fixed investment, as increasing production and reducing costs requires the use of modern technological methods and means.
- 2) Expectations: The expectation factor is considered very important for making the right decision. Expectations are divided into optimistic and pessimistic. When a feeling of optimism prevails among investors, this will lead to an increase in the level of investment. On the contrary, if a feeling of pessimism prevails among investors, they often postpone or abandon their investment decisions.
- 3) Investor personality: In order for investment to be effective, the investor's personality must be characterized by several characteristics, including the desire to invest and courage.
- 4) Customs, traditions, and cultural level prevailing in society.

4. Agricultural Investment Environment

The successive policies in Iraq did not view the agricultural sector as an effective element in economic growth and a driving force for it, which could make important contributions to the structural transformation of the economy. These policies generally understood development in terms of the growing role of the industrial sector and the low relative share of agriculture in national production. These views focused on industry as an engine of economic growth based on the fact that investments in industry lead to subsequent investments in other income-generating economic activities in the course of development, which in turn will lead to faster and broader-based economic growth. As for investments in the agricultural sector, and for reasons related to the nature of the sector itself, according to their point of view, it is not at the same level of dynamism [12]. The relative importance of the agricultural sector continued to decline until it reached only (14%) of the GDP in 1960. During the next twenty years, the growth rate of the agricultural sector was very weak (2.6%) only. Iraq was self-sufficient (100%) of agricultural production until the late fifties, then this percentage decreased to (75%) during the sixties, and then to (67%) during the seventies, to reach its lowest level (30%) during the

eighties [13]. Despite the many plans and programs to reform and develop the agricultural sector and work to establish agricultural infrastructure such as building dams and reservoirs and providing support to farmers in the form of seeds, fertilizers, equipment and purchasing agricultural crops, including the agricultural initiative launched by the Iraqi government in the year (2008) to stimulate investment and encourage the agricultural sector, and despite the government provided capital to the agricultural sector with the aim of stimulating investment and advancing the agricultural sector, but the financing policy did not adhere to standards and criteria and therefore did not lead to the desired success. Iraq's lack of clear strategies has led to comprehensive economic weakness, especially in the agricultural sector, its marginalization in development plans, and the scarcity of investment in this sector, both its plant and animal sectors, as a result of the lack of an appropriate climate for investment due to the absence of security stability, in addition to the lack of policies related to protecting the product. Iraq has abundant agricultural requirements of land, water and human resources to build a successful agricultural sector, in addition to the fact that the agricultural sector in Iraq itself constitutes fertile ground for investment in it, due to the previous capabilities that Iraq has, which makes agricultural investment projects with great and many benefits in addition to the projects Investment in livestock, as Iraq enjoys a very good environment for developing and expanding this wealth. Investment in the agricultural sector opens broad horizons for economic and agricultural activity, develops the reality of agriculture in Iraq, and attracts a lot of capital and additional investors to this sector, in addition to creating new job opportunities [14]. The success of agricultural investment in Iraq requires creating a suitable climate to activate this investment and carry it out to the fullest extent and build a base that contributes to the advancement of agricultural reality. The systems and procedures must be made as simple and effective as possible. Rehabilitation and training of farmers and their awareness of the benefits of agricultural investment serves their current reality and

works to build a method of comprehensive and integrated rural development by providing the necessary infrastructure for the success of agricultural investment projects [12].

5. Autoregressive Distributed Lag Model (ARDL)

In the case that each of the dependent and independent variables in the current time are affected by their values in previous time, this will lead to including these variables in the model, and thus will result in a dynamic model, or time-lag models, and the best example of these models is the autoregressive distributed lag model (ARDL). These models have been used for decades, but in recent years it has been concluded that these models are highly efficient in describing the relationships between economic variables and giving them a description of these relationships both in the short and long run, especially if they are used with co-integration between economic variables. This is what the classical analysis of the econometric model fails to provide. The use of co-integration methodology in ARDL models was developed by Pesaran [15], Pesaran & Shin [16] and Pesaran *et al.* [17]. Although there are other methodologies for co-integration such as Engle & Granger methodology [18] and Johansen methodology [19], there are many advantages to using the methodology of co-integration in (ARDL) models over the use of other methodologies, perhaps the most important of which are [20]:

- ARDL models can be used if the study variables are not integrated of the same order, while other methodologies such as Johansen integration and Engel-Granger require that the variables be integrated of the first order. In general, ARDL models can be used to perform co-integration between variables whose time series are stationary at level or stationary at first difference.
- ARDL models for co-integration are more efficient in the case of small samples, while other methodologies require large sample sizes.
- The use of the (ARDL) methodology leads to obtaining estimates for the parameters and their tests, even in the case of autocorrelation problem or the problem of

correlation between independent variables and error (endogeneity).

- The (ARDL) methodology allows the use of the Vector of Error Correction Model (VECM) to give a state of balance between coefficients in the long run and coefficients

in the short run without losing the validity of the coefficients in the long run.

Based on the research variables, the autoregressive distributed lag model of agricultural investment in terms of some determinants will be ARDL(p, q₁, q₂, q₃, q₄, q₅) such that:

$$\Delta Y_t = \alpha + \left\{ \sum_{i=1}^p \theta_i \Delta Y_{t-i} + \sum_{i=0}^{q_1} \beta_{1,i} \Delta X_{1,t-i} + \sum_{i=0}^{q_2} \beta_{2,i} \Delta X_{2,t-i} + \sum_{i=0}^{q_3} \beta_{3,i} \Delta X_{3,t-i} + \sum_{i=0}^{q_4} \beta_{4,i} \Delta X_{4,t-i} + \sum_{i=0}^{q_5} \beta_{5,i} \Delta X_{5,t-i} \right\} + \{ \gamma Y_{t-1} + \phi_1 X_{1,t-1} + \phi_2 X_{2,t-1} + \phi_3 X_{3,t-1} + \phi_4 X_{4,t-1} + \phi_5 X_{5,t-1} \} + \varepsilon_t \quad (1)$$

Y₁ : Agricultural investment (million dinars)

X₁ : Agricultural loans (million dinars)

X₂ : Inflation rate (%)

X₃ : Budget deficit in the state's general budget (million dinars)

X₄ : Average exchange rate of the US dollar against the Iraqi dinar

X₅ : Investment projects allocations (million dinars)

ε : Error variable in the agricultural investment model (1) that includes all other unmeasured variables and those that are not included in the model (1) and that are believed to affect agricultural investment such as political stability to the country and security stability and others.

The Error Correction Model (ECM) equation will be:

$$\Delta Y_t = \alpha + \left\{ \sum_{i=1}^p \theta_i \Delta Y_{t-i} + \sum_{i=0}^{q_1} \beta_{1,i} \Delta X_{1,t-i} + \sum_{i=0}^{q_2} \beta_{2,i} \Delta X_{2,t-i} + \sum_{i=0}^{q_3} \beta_{3,i} \Delta X_{3,t-i} + \sum_{i=0}^{q_4} \beta_{4,i} \Delta X_{4,t-i} + \sum_{i=0}^{q_5} \beta_{5,i} \Delta X_{5,t-i} \right\} + \Psi ECT_{t-1} + v_t \quad (2)$$

where ECT_{t-1} represents the Error Correction Term (ECT), which is a residual or errors of equation (1) at time (t-1), and Ψ represents the correction speed coefficient that measures the speed of adaptation or modification (speed of adjustment) in which the imbalance in agricultural investment in the short run is adjusted towards the long-run equilibrium when the independent variables deviate by one unit. In other words, the ECT represents the percentage of errors that occur in the short-run relationship as a result of the exposure of agricultural investment to shocks, which will be eliminated in the long run for each unit of time.

6. Co-integration Test

One of the co-integration relationship tests among the model variables in the long run, is

the bounds test, which is depend on the calculation of the statistic (F), where the null hypothesis states that a no co-integration relationship among the model variables against the alternative hypothesis that indicates otherwise, meaning that:

$$H_0: \gamma = \phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = 0$$

$$H_1: \gamma \neq \phi_1 \neq \phi_2 \neq \phi_3 \neq \phi_4 \neq \phi_5 \neq 0$$

Pesaran *et al.* proposed a table of critical values for the test of co-integration consisting of two terms, the values of the minimum critical values (Lower Critical Bound) assume that all model variables are stationary at level, that is, there is no co-integration relationship between the variables. While the upper critical values (Upper Critical Bound) assume that all model variables are not stationary at the level, but turned into stationary after taking their first

differences, that is, they became integrated of the first order I(1), which means that there is a co-integration relationship. When the value of the calculated (F) statistic is smaller than the minimum critical value, we accept the null hypothesis but if the value of the calculated (F) statistic is greater than the upper critical value, then we accept the alternative hypothesis, when the value of the calculated (F) statistic falls between the lower and upper critical values, then the test result is inconclusive, meaning that there is no conclusive evidence for the existence of a co-integration relationship between the model variables.

Results and Discussion

Data for this research was obtained through the Ministry of Planning - Central Statistical Organization (COS), Statistical Group for the years (1990-2020) covered agricultural investment, agricultural loans, inflation rate, budget deficit, exchange rate, investment projects allocations through estimating and analyzing the (ARDL) model [21].

1. Stationarity test of the model variables

Table (1) presents the results of the unit root test or the stationarity of the variables of the agricultural investment model for Iraq during the period (1990-2020) using Augmented Dickey-Fuller (ADF) test

Table 1. The unit root test (ADF) results of the agricultural investment model variables for Iraq (1990-2020)

	At Level		At first Difference	
	Intercept	Inter. & Trend	Intercept	Inter. & Trend
Y ₁	-0.774 ^{n.s} (0.812)	-4.940*** (0.002)	-9.131*** (0.000)	-8.970*** (0.000)
X ₁	-3.541*** (0.007)	-4.695*** (0.006)		
X ₂	-3.761*** (0.008)	-3.110 ^{n.s} (0.122)	-5.126*** (0.000)	-5.022*** (0.000)
X ₃	-3.817*** (0.007)	-3.979** (0.025)		
X ₄	-4.364*** (0.002)	-5.876*** (0.000)		
X ₅	-1.489 ^{n.s} (0.525)	-1.328 ^{n.s} (0.861)	-4.571*** (0.001)	-4.553*** (0.006)
*** significant at 1% level	** significant at 5% level	* significant at 10% level	n.s not significant	() represent P-value

We note from the results of table (1) that the variables (agricultural loans, budget deficit, exchange rate) were stationary at the level, that is, the degree of integration of each of them is zero I(0), while the variables (agricultural investment, inflation rate, investment allocations) was not stationary at the level, but it became stationary at first difference, that is, the degree of integration of each of them is one I(1), and thus the conditions for using

(ARDL) models are fulfilled.

2. Co-integration Test

To test the co-integration between economic variables and agricultural investment, the null hypothesis shows that there is no cointegration between agricultural investment and its determinants, while the alternative hypothesis indicates otherwise. So, the bounds test is used, where the results as in table (2).

Table 2. Results of the co-integration between economic variables and agricultural investment using the bounds test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Sig. F	I(0)	I(1)
F-statistic	6.0608**	10%	2.75	3.79
k	5	5%	3.12	4.25
		2.5%	3.49	4.67
		1%	3.93	5.23

** significant at 1% level

We note from table (2) that the value of (F) is (6.0608), which is greater than the upper limit I(1) at all significance levels, therefore the null hypothesis is rejected and the alternative hypothesis is accepted that the coefficients of the long run relationship are unequal and not equal to zero, meaning the existence of co-integration at (1%) significant level between the economic variables and agricultural investment.

The co-integration among economic variables

provides statistical bases for the use of the error correction model (ECM). The main reason for the frequent use of the error correction model is the short-run fluctuations of economic variables and agricultural investment that are made related to the long run equilibrium values. The ECM or co-integration coefficient indicates that in each time period a certain percentage of the imbalance in agricultural investment is adjusted to approach equilibrium in the long run relationship.

Table 3. The (ECM) coefficient result for the long run relationship between economic variables and agricultural investment in Iraq (1990-2020)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECT_{t-1}	-1.043131	0.152058	-6.860067**	0.000

** significant at 1% level

The table (3) results confirm a long run integration relationship between the model variables, that is, there is a long-run equilibrium relationship between the economic variables and agricultural investment in Iraq, where the error correction term or the co-integration coefficient appears with a negative and significant value at (1%) level and its value is estimated at (-1.043131), which refers to the amount of change in agricultural investment as a result of the deviation of economic variables in the short-run from its equilibrium values in the long-run by one unit each, that is, agricultural investment takes about a year to return to its equilibrium value in the long-run after the effects of shocks in economic variables because $\frac{1}{1.043131} = 0.9858 \cong 1 \text{ year}$.

3. Short-run Relationship Estimation

We noted from the above and based on the fact that all the variables of the study model became stationary at level or at the first difference, so (2048) ARDL models for data was estimated, it was found that the best order for the model will be the lag one for the agricultural investment variable (Y_1), the lag two for each of the agricultural loans (X_1) and the exchange rate (X_4), while the inflation rate variables (X_2), budget deficit (X_3) and investment allocations (X_5) will be stationary at level, i.e. the model will be ARDL(1,2,0,0,2,0) with constant and trend, and in confirmation of this, this model achieves the lowest value of the Akaike Information Criteria (AIC) of (17.375) among other models as can be seen from Figure (1) below.

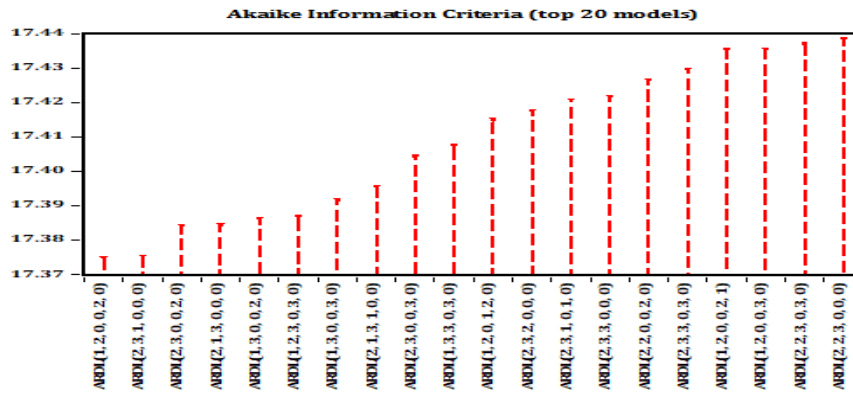


Figure 1. Akaike Information Criteria values for the best (20) ARDL models of different orders for agricultural investment variables data in Iraq (1990-2020)

Table (4) presents the results of the ARDL(1,2,0,0,2,0) model, which shows the impact of some economic variables on agricultural investment in Iraq in the short-run.

The results show a negative and significant impact from both agricultural loans and the exchange rate on agricultural investment in the short run and at (1%) significant level.

Table 4. Estimating results of the short run relationship between economic variables and agricultural investment in Iraq (1990-2020)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	644.0544	508.2476	1.26721 ^{n.s}	0.222
@TREND	257.4832	49.64701	5.18628**	0.000
$\Delta X_{1,t}$	-0.048749	0.011756	-4.14668**	0.001
$\Delta X_{1,t-1}$	-0.044850	0.015871	-2.82583*	0.012
$\Delta X_{4,t}$	-2.487784	0.789957	-3.14926**	0.006
$\Delta X_{4,t-1}$	-3.089802	0.823036	-3.75415**	0.002
R-squared	0.8030		F-Stat.	14.9483**
Adjusted R-squared	0.7493		Sig. (F-Stat)	0.003

** significant at 1% level, * significant at 5% level, n.s not significant

4. Long-run Relationship Estimation

Table (5) presents the results of the ARDL(1,2,0,0,2,0) model, which shows the

impact of some economic variables on agricultural investment in Iraq in the long-run.

Table 5. Results of estimating the long run relationship between economic variables and agricultural investment in Iraq (1990-2020)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$X_{1,t}$	0.053057	0.022658	2.341638*	0.032
$X_{2,t}$	-1.177520	1.794003	-0.656365 ^{n.s}	0.520
$X_{3,t}$	-0.00005	0.00002	-2.177245*	0.044
$X_{4,t}$	-1.444854	0.408310	-3.538620**	0.003
$X_{5,t}$	0.000422	0.000172	2.458505*	0.025
R-squared	0.9273		F-Stat.	19.7293**
Adjusted R-squared	0.8804		Sig. (F-Stat)	0.000

** significant at 1% level, * significant at 5% level, n.s not significant

Table (5) shows the following:

Agricultural loans:

There is a positive significant impact of the agricultural loans on agricultural investment in the long run and at (5%) significant level, this means every increase in the agricultural loans by one million dinars offset by an increase in agricultural investment by (53,057) dinars. This finding is consistent with the economic theory, since the agricultural sector or its investors lack their own resources, so they need to borrow to establish or develop agricultural investment projects.

Inflation rate:

There is no significant impact of the inflation rate on agricultural investment in the long-run, and this result may not be consistent with the economic theory that states that the inflation rate negatively affects agricultural investment, but since there are correlations between this variable and other independent variables in the model, this affected the relationship of the inflation rate with agricultural investment.

Budget deficit:

There is negative impact of the budget deficit in agricultural investment in the long run and at (5%) significant level, as every increase in the budget deficit by one million dinars will be offset by a decline in agricultural investment by (50) dinars. This is consistent with economic theory as increasing the state budget deficit will reduce funds for agricultural investment.

Exchange rate:

exchange rate has negative impact on agricultural investment in the long run at a

(1%) significance level, when the dollar exchange rate increases by one dinar, this leads to a decline in agricultural investment by (1.444854) million dinars. This finding is consistent with economic theory, which shows that an increasing of the US dollar (i.e., the decreasing of the local currency) will cause investors in the agricultural sector to move to other investment destinations, thereby leading to a decline in agricultural investment.

Investment allocations:

There is a direct significant effect of the volume of allocations to support investment projects in agricultural investment in the long run at (5%) significance level, when increasing investment allocations by one million dinars, this increase the agricultural investment by (422) dinars. This finding is consistent with economic theory, which shows that the impact of investment allocations is positive with increased agricultural investment.

In general, the estimated econometric model is statistically significant at a significant level (1%), meaning that all the economic variables have a significant long-run impact on agricultural investment. The estimated model has a high explanatory capacity of more than (88%), meaning that (88%) of the changes in agricultural investment in the long run are attributable to these independent variables.

5. Diagnosing Checking Tests

Table (6) presents the diagnostic checking tests for the ARDL(1,2,0,0,2,0) model including the normal distribution test of model residuals or errors, the autocorrelation test of model residuals, the heterogeneity test of residual variance, in addition to the stability and structure test of the estimated model.

Table 6. Results of Diagnostic checking tests for ARDL(1,2,0,0,2,0) model

Test	Statistic	Value	Prob.	
Normality	Jarque-Bera	Jarque-Bera	0.7134 ^{n.s}	0.700
Autocorrelation		F-Statistic	0.6985 ^{n.s}	0.416
	Breusch-Godfrey	Chi-Square	1.2131 ^{n.s}	0.271
Heteroskedasticity		F-statistic	2.1204 ^{n.s}	0.157
	ARCH	Chi-Square	2.1113 ^{n.s}	0.146
Model's Stability		t-Statistic	0.0147 ^{n.s}	0.989
	Ramsey-Reset	F-Statistic	0.0002 ^{n.s}	0.989

n.s not significant

Table (6) and figure (2) show that the probability value of the Jarque-Bera test [22] was (0.700), which is greater than the (5%) significance level, which means that residuals

generated from the ARDL(1,2,0,0,2,0) model follow the normal distribution with mean (0) and standard deviation (940.996).

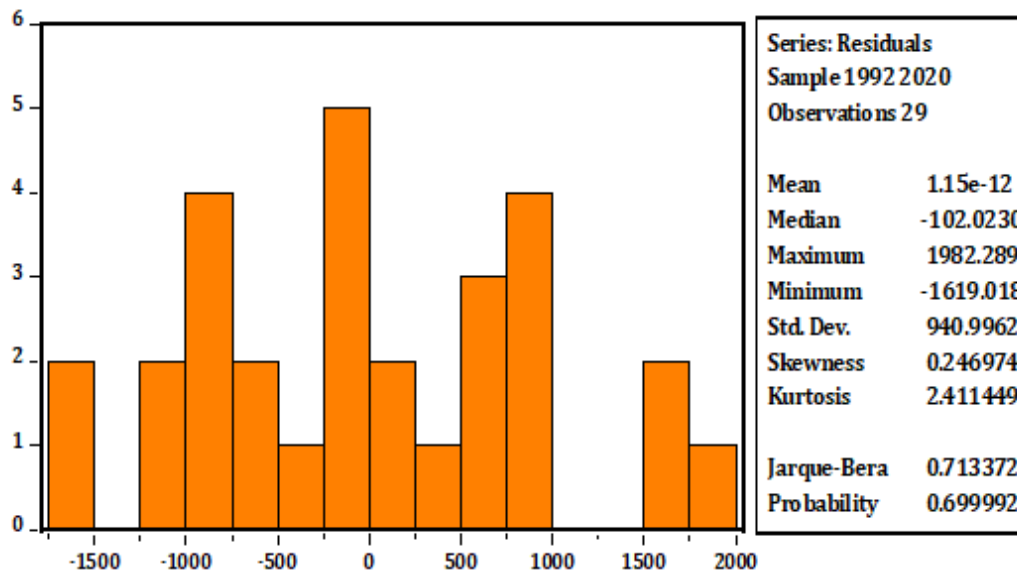


Figure 2. Normal distribution of (ARDL) model for Agricultural Investment in Iraq (1990-2020)

Table (6) also shows that the residual or errors of the ARDL(1,2,0,0,2,0) model are not correlated based on the Breusch-Godfrey autocorrelation tests [23] where the p-values of the two tests were greater than (5%). As well as the homogeneity (stability) of the residual variance through the two Autoregressive Conditional Homoscedasticity (ARCH) tests [24] whose p-values were greater than (5%). The model was also characterized by structural stability in the form of the function based on the results of the Ramsey-Reset tests [25],

whose probability values were greater than (5%), which indicates the stability and durability of the estimated model and the consistency of its long run with its short-run coefficients.

As for the test of the multicollinearity problem, table (7) shows the matrix of Pearson correlation.

coefficients between each of the two economic variables affecting agricultural investment

Table 7. Matrix of Pearson correlations between the economic variables of Iraq (1990-2021)

	X ₁	X ₂	X ₃	X ₄	X ₅
X ₁	1.0000	-0.198	0.036	0.238	0.190
X ₂		1.0000	-0.023	-0.371	-0.315
X ₃			1.0000	0.016	0.036
X ₄				1.000	0.041
X ₅					1.000

Based on the Kline test [26] and when comparing the coefficient of determination of the agricultural investment ARDL(1,2,0,0,2,0) model and its value in table (4) of (93%) with the squares of the correlation coefficients in the matrix above, we find that the determination coefficient is greater than all the squares of the simple correlation coefficients,

and this indicates that the estimated econometric model is free from the multicollinearity problem among economic variables.

Conclusions

1. Suitability of ARDL models to represent the relationship between agricultural

investment as a dependent variable and some economic variables as independent variables (agricultural loans, inflation rate, budget deficit, exchange rate, investment projects allocations), as the model showed great explanatory ability in addition to being free of econometric problems, which allows the possibility of using this model for future investment forecasting.

2. Existence of a balanced relationship between agricultural investment (Y) and each of the agricultural loans (X_1), inflation rate (X_2), budget deficit (X_3), exchange rate (X_4) and investment allocations (X_5), which is distinct in their impact between the long and short-run.
3. The study found that the exchange rate (X_4) is the most influential variable on agricultural investment in the short and long run, as the rise in the dollar exchange rate in one Iraqi dinar will lead to a decrease in agricultural investment by (2.487784) million dinars in the short run, and (1.444854) million dinars in the long-run.
4. Agricultural loans (X_1) positively affect agricultural investment in the long-run, as the increase in the loans by one million dinars will lead to increasing the agricultural investment in the long run by (53,057) dinars, while this effect turns into a negative in the short run represented by a decrease in agricultural investment by (48,749) dinars for every million dinars increase in the agricultural loans.
5. The budget deficit (X_3) showed a weak negative impact on agricultural investment in the long-run only, as increasing the budget deficit by one million dinars will be offset by a decrease in agricultural investment by (50) dinars.
6. Investment allocations (X_5) have a positive impact on long-run agricultural investment, every increase in investment allocations by one million dinars leads to an increase in long-run agricultural investment by (422) dinars.
7. Agricultural investment has not responded to any changes in inflation rate (X_2) in both the long and short-run.
8. Existence of co-integration relationship between agricultural investment and both

the agricultural loans and the exchange rate, and that (100%) of the imbalance in agricultural investment in the past year is corrected in the current year.

The research recommends the necessity of activating the state on a package of policies and procedures to activate the role of variables affecting agricultural investment, which contribute to attracting domestic and foreign investments, foremost of which is maintaining a stable exchange rate for the local currency, increasing the volume of agricultural loans provided to farmers, maintaining a low inflation rate and financing interest. Low, and increasing financial allocations to support agricultural projects.

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تقدير وتحليل أنموذج الاستثمار الزراعي في العراق للمدة (1990-2020) باستخدام منهجية الانحدار الذاتي للإبطاء الموزع

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• تاريخ استلام البحث 2023/08/30 وتاريخ قبوله 2023/09/18.

• البحث مستل من رسالة دكتوراه للباحث الأول.

الملخص

في هذا البحث تم تحليل آثار بعض المحددات المالية والاقتصادية للاستثمار الزراعي في العراق خلال الفترة (1990-2020) باستخدام منهجية الانحدار الذاتي للإبطاء الموزع (ARDL). وفي هذا السياق تم اختيار القروض الزراعية، معدل التضخم، عجز الموازنة معدل سعر الصرف، والتخصيصات المالية لدعم المشاريع الزراعية كمحددات للاستثمار الزراعي. تكمن مشكلة البحث في أن القطاع الزراعي العراقي يمتلك العديد من المقومات والإمكانات المشجعة على الاستثمار، إلا أنه يعاني من قلة الاستثمارات الموجهة إليه، ولا يتناسب ذلك مع أهمية هذا القطاع مما يؤثر سلباً على معدلات التنمية الزراعية وتراجع قدرة القطاع الزراعي على زيادة معدلات الاكتفاء الذاتي من المنتجات الزراعية. هدف البحث إلى معرفة المحددات الاقتصادية ومدى تأثيرها على الاستثمار في القطاع الزراعي العراقي. وتم استخدام المنهج التحليلي الاستدلالي المعتمد على تقدير نموذج الانحدار الذاتي للإبطاء الموزع وبيان مدى ملاءمته لبيانات البحث من خلال اختبار الفرضيات الإحصائية المتعلقة بالنموذج. تم تحليل البيانات وتقدير نماذج الاقتصاد القياسي باستخدام برنامج الاقتصاد القياسي وتحليل السلاسل الزمنية Eivews-12. وأظهرت نتائج تقدير العلاقة طويلة الأجل أن جميع المحددات لها تأثيرات معنوية على الاستثمار الزراعي باستثناء معدل التضخم، أكثر هذه المحددات تأثيراً هو سعر الصرف الذي يؤثر سلباً على الاستثمار الزراعي حيث أن ارتفاع سعر صرف الدولار بمقدار دينار واحد، يؤدي إلى انخفاض الاستثمار الزراعي بمقدار (1.444854) مليون دينار. ثم القروض الزراعية ذات الأثر الإيجابي حيث أن زيادة القروض الزراعية بمبلغ مليون دينار يقابلها زيادة في الاستثمار الزراعي بمبلغ (53,057) دينار. تليها التخصيصات المالية للمشاريع الزراعية ذات الأثر الإيجابي، فكل زيادة في التخصيصات الاستثمارية بمقدار مليون دينار ستؤدي إلى زيادة الاستثمار الزراعي بمقدار (422) دينار. وأخيراً عجز الموازنة العامة ذو الأثر السلبي على الاستثمار الزراعي حيث كل زيادة في عجز الموازنة بمقدار مليون دينار يقابلها انخفاض في الاستثمار الزراعي بمقدار (50) ديناراً. وأظهر اختبار التكامل المشترك وجود علاقة توازنية طويلة المدى بين المحددات الاقتصادية والمالية والاستثمار الزراعي. وأوصى البحث بضرورة قيام الدولة بتنفيذ حزمة من السياسات والإجراءات لتفعيل دور المتغيرات المؤثرة على الاستثمار الزراعي والتي تساهم في جذب الاستثمارات المحلية والأجنبية وأبرزها الحفاظ على سعر صرف مستقر للعملة المحلية وزيادة حجمها. القروض الزراعية المقدمة.

الكلمات المفتاحية: نماذج الانحدار الذاتي للإبطاء الموزع، التكامل المشترك، الاستثمار الزراعي، القروض الزراعية، التضخم، سعر الصرف