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ARTICLE

Estimating The Impact of Agricultural Investment and Food Price Volatility on Poverty Levels in Iraq

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ABSTRACT

The research aims to estimate the impact of food price volatility and agricultural investment on poverty levels in Iraq, using quarterly data from 2004 to 2022. The relationship between the variables was studied using the Autoregressive Distributed Lag (ARDL) model methodology. The results showed the existence of a long-term cointegration between the dependent variable (poverty level Y) and the independent variables (agricultural investment X2) and the real global food price X1. As a result, the error correction coefficient was negative and statistically significant at the 5% significance level. The research concluded that food prices (X1) are positively associated with the degree of poverty in the long term and had a significant effect at the 1% probability level. In the long term, agricultural investment (X2) is negatively associated with the degree of poverty and has a significant effect at the 1% probability level. The study results also showed that the control variables have a statistically significant effect on the level of poverty in the long term. Inflation is positively associated with poverty, while the average per capita GDP and population growth are negatively associated with poverty, as poverty levels decrease with an increase in per capita income and population growth. The research concluded with a set of recommendations, the most impor-

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tant of which are the necessity to control food price volatility, enhance investments in the agricultural sector, and improve its infrastructure in order to reduce inflation by promoting macroeconomic stability.
Keywords: Agricultural Investment; Food Price Volatility; Poverty Alleviation; ARDL Model; Iraq Economy

1. Introduction

Achieving food security has become an increasingly important challenge, especially in poor areas. Evidence indicates that sustainable local livelihood strategies, such as gathering food from urban areas, contribute to enhancing food security and support the ability of families to adapt to economic shocks [1].

There have been consistent attempts over the past few decades to define poverty more broadly because development professionals, notably economist Sen, have maintained that this definition of economic well-being is still too limited to represent individual well-being [2]. In the past, the inability to afford enough food and other essentials was the main factor used to define poverty. The lack of control over one's resources, or material deprivation, remains the primary focus today. Recognizing that material deprivation may encompass more than just a lack of personal resources is one way to expand the definition of poverty. Residents of a hamlet without electricity could earn a substantial amount of money, but they would not have a dependable power supply. In a similar vein, without basic health services, no amount of money may be enough to pay for accessible and efficient healthcare, education, security, and other essentials of life [3]. To achieve various development goals, including reducing poverty, the international community has recognized the importance of maintaining a steady and dependable food supply. The first goal of sustainable development SDGs is to eradicate poverty, and the second goal is to eliminate hunger and achieve food security [4]. This objective makes food security a top priority. Since food, agriculture, and nutrition are important components of the SDGs for reducing poverty, enhancing health, encouraging sustainable consumption and production, and fostering climate change adaptation and mitigation, other SDGs are intimately tied to one another [5]. Concerns have been raised that poverty rates will continue to be high between 2020 and 2030 since the global effort to reduce poverty has slowed dramatically, nearly to a halt, over the last five years. The poverty rate decreased from 38% in 1990 to 8.5% in 2024, but it has since plateaued due to a number of shocks, such as the COVID-19 pandemic, rising food costs, and a spike in both internal and foreign wars in nations around the globe, as well as slowing economic development. According to the slightly higher poverty line of $3.65 per person per day (which is the national poverty line used in lower-middle-income countries), roughly 1.7 billion people (21.4%(, or roughly one-fifth of the world's population) will be living in poverty in 2024. Poverty rates are still higher than they were five years ago.

The poverty line in Iraq can be calculated based on a monthly per capita income of less than 137,000 dinars, equivalent to approximately $105.30 per month and $3.50 per day [6]. Rapid and uncontrolled increases in food prices pose a gradual problem for every household. Both the rich and the poor are affected by rising food prices, making it difficult for households to plan their income. Food availability, affordability, and accessibility are significant issues, given that food security is directly linked to commodity prices [7]. Through channels of income and consumption, changes in the price of food throughout the world can have an impact on poverty and inequality. The cost of keeping a constant consumption basket rises in tandem with food costs, which lowers consumer welfare [8]. Higher food costs, however, result in higher monetary income for the demographic group whose income is reliant on agricultural markets. Loss of buying power (consumption effect) and higher income (income effect) will determine the net welfare impact of rising food costs for each family. Changes in food prices will have a substantial welfare impact on both farmers and lower-income consumers since most individuals in poverty spend the majority of their money on food, and many farmers make a sizable amount of their income from growing food [9].

The theory of food price fluctuations explains that

the volatility (rise and fall) in agricultural commodity prices in developing countries, which suffer from high poverty rates, increases economic uncertainty for households and poverty rates as well, since these households primarily rely on food consumption and do not have sufficient savings or insurance. Food price fluctuations lead to a reduction in the quantity or quality of food consumed, and also affect spending on health and education, which in turn weakens food security [10]. Moreover, price volatility limits the ability of productive households and small-scale agriculture to plan and invest, reducing their income and exacerbating the effects of poverty. This highlights the importance of social protection policies and investments in agricultural commodity prices as tools to mitigate the economic risks for households suffering from low cash income.

Macroeconomically speaking, the large proportion of agriculture and food in overall production, consumption, employment, commerce, and government income makes nations more susceptible to changes in the price of food globally. Rising food costs have a disproportionately negative impact on the poorest groups of people at the microeconomic level, especially those who depend mostly on food purchases for their subsistence. To reduce volatility, governments in emerging and developing nations frequently take drastic measures in response to abrupt shifts in the price of basic foods [11]. In the near term, domestic food costs are often less unpredictable than those of the world, but over time, they tend to return to their initial connection. The success or failure of poverty reduction in developing countries can be attributed to public and private sector agricultural investment as a tool to stimulate economic growth and promote poverty reduction [12]. Agricultural investments increase production, reduce unemployment, raise incomes, and support and complement other industrial sectors, all of which contribute to reducing or even eliminating poverty within societies [13].

The justifications for the research in this study lie in highlighting one of the problems faced by the Iraqi economy, which is the high levels of poverty amid the decline in agricultural output in the economy, limited agricultural investments, inability to control food price levels, and the security and political conditions experienced during the study period. This study is significant because it focuses on agricultural investment, food prices globally, and how these factors affect Iraq's poverty levels. One indicator of a nation's economic health is its level of poverty. The necessity for the agricultural sector to boost productivity and the fact that food costs have a significant impact on poverty alleviation make agricultural investment crucial. Iraq's agricultural sector is in decline and unable to meet local demand, despite the potential and resources available to boost production and reduce poverty. As a result, it has been forced to import more agricultural goods. In 2022, there was a 41% increase in the trade exposure index for live animals and agricultural products overseas. This high percentage suggests a reliance on external sources to supply agricultural goods, which might cause instability and raise the possibility of failing to achieve food security and lower poverty levels [14]. Tracking poverty levels and identifying the variables that affect them, in addition to diagnosing the problems and obstacles that exacerbate these levels, is crucial for achieving social justice and societal peace, as well as promoting political stability and a nutritional level consistent with natural standards. The fundamental problem in the Iraqi economy lies in the high poverty rates and the inability to reduce them to normal levels. This problem can be formulated in the following questions.. Does the availability of agricultural investment assistance boost output and reduce poverty? What impact do increasing food costs have on poverty throughout the world? What are the limitations and additional economic factors that affect the development of poverty? This study aims to measure and estimate the impact of agricultural investment and food price fluctuations on the level of poverty in Iraq and to determine the relationship between them through the use of the Autoregressive Distributed Lag (ARDL) model to analyze the relationship between variables in the short and long term. This model is considered flexible as it allows for variables with different orders of integration I(0) and I(1). The model is applied to test the existence of a long-term equilibrium relationship between the variables using the Bounds Testing approach.

2. Literature Review

Several preceding research have addressed the problem of poverty and its influencing elements, such as Valero-Gil and Valero (2008), which examined the outcomes of growing food charges on poverty and intense poverty in Mexico in the course of the period 2006–2008. They looked at targeted on the bad's intake of simple meal objects and analyzed the exchange in their intake because of price changes. It confirmed that the price of excessive poverty rose from 10. Fifty eight% to 16% as a result of growing food fees. They have a look at endorsed reducing the price stress of food items consisting of eggs, vegetable oils, milk, and chicken [15]. Another observe, Nazima (2015), tested the connection between meals price inflation and poverty in Pakistan over the period 1990-2015. The examine taken into consideration meals-related inflation and its courting to poverty at both countrywide and worldwide tiers and identified the primary reasons of food rate inflation. The Autoregressive Distributed Lag Model (ARDL) was used to discover the fast- and long-run relationships. The predominant effects indicated a robust hyperlink among meals price inflation and poverty level [16].

Ebastien Dessus (2008) checked out the financial expenses of urban poverty and how it affected a sample of 72 developing countries in 2005 due to rising meals charges. The trade inside the poverty deficit (PD), or the difference in the amount of cash required to stop poverty underneath full targeting, is used to calculate this cost. The findings indicated that at the same time as the cost is much less than 0.2% of GDP within the majority of countries, it could surpass three% within the most seriously impacted nations. The rate shock's negative effect on the actual income of previously impoverished families is the principle purpose of the shift in the poverty deficit [17]. Fiyinfoluwa Giwa (2020) appeared into how variations in food costs affected food insecurity and economic nicely-being in some southern African countries between 1980 and 2016. These international locations have been Lesotho, Malawi, South Africa, Mozambique, and Botswana. To confirm how the variables affected one another, an autoregressive dispensed lag (ARDL) version become anticipated. The look at's findings verified that while exchange and inflation have a right away have an effect on on a nation's financial nicely-being, changes in food costs have an extended-term fine effect [18].

The study by Al-Haboubi et al. (2014) addressed the impact of growth in the agricultural sector on poverty reduction in Iraq. The study's results showed that an increase in agricultural GDP contributes to raising the incomes of poor households through the strong linkage between agriculture and other sectors. The study also revealed that the agricultural sector represents an effective tool for diversifying the economy and reducing poverty rates in Iraq [19]. Martin's 2016 study also examined the impact of food prices on poverty levels across 20 developing countries, concluding that price effects depend on the structure of the economy and its reliance on the agricultural sector. Additionally, rising food prices lead in the short term to increased hardship for urban poor households, but in the long term contribute to improving the conditions of rural poor by increasing demand for agricultural labor and raising wages [20].

The intention of Osinubi and Apanisile (2021) research became to evaluate how agricultural establishments and funding affected food safety and poverty in 24 African nations from 2001 to 2016. To accomplish its dreams, the study used a-step GMM estimation procedure. The findings display that during some African nations, agricultural funding improves food safety and lowers poverty, and that governance practices and inner and overseas conflicts both gain meals protection [21]. Wardhani and Haryanto (2020) observe aimed to assess the effect of foreign direct funding in the agricultural area on food security in growing international locations over the length 2012–2017, using several variables (rural population, GDP consistent with capita, purchaser rate index, and meals imports and exports). Dynamic panel information techniques have been used to check the pooled information. The results confirmed that every one independent variables had a substantial effect on food safety in developing nations simultaneously, except for meals imports [22].

Daniel Mason (2019) examined the value of agricultural investments and their capability to relieve hunger in Africa via 2030. In order to provide a extra cor-

rect evaluation of the fees involved in accomplishing expected agricultural upgrades, this have a look at is included with a brand new funding estimating version based on the Perpetual Inventory Methodology (PIM). According to projections, hunger will upward push inside the ensuing decades due to climate trade, setting 16 million greater Africans vulnerable to hunger through 2030 than inside the absence of weather change. Investment flows have the potential to reinforce agricultural output, mitigate the unfavourable results of climate change, and lower the percentage of the populace at risk of famine [23].

Despite the lifestyles of many research that have tested the impact of food fees and agricultural investment on poverty, there is a clear lack of research which have addressed Iraq during the period from 2004 to 2022. Moreover, few research have investigated the joint impact of food charge fluctuations and agricultural funding on poverty. Additionally, using economic models such as the ARDL model, which combines brief-term and lengthy-term evaluation with spatial and temporal information to comprehensively verify this courting, has no longer been sufficiently utilized.

3. Materials and Methods

To verify the effect of agricultural investment and meals charges on poverty ranges in Iraq, time series statistics acquired from the Iraqi Ministry of Planning (Directorate of National Accounts) had been converted to quarterly information for the duration 2004–2022. The Autoregressive Distributed Lag (ARDL) model changed into applied, which helps determine the impact of financial variables on one another, offering more accuracy in analysis and dimension [24]. It is finest for analyzing the dynamic relationship between those variables due to its ability to procedure first-order incorporated data and concurrently analyze both quick- and lengthy-term hyperlinks [25]. The ARDL method is predicated on numerous fundamental assumptions to make sure the validity and accuracy of the results, the maximum critical of which are that the variables are desk bound at stage I (zero) or after the primary distinction I (1) with out the presence of 2nd-order incorporated variables, no autocorrelation or heteroscedasticity in the errors, and a regular distribution of residuals. It also assumes the existence of a protracted-term equilibrium courting between the variables, with the most suitable lag lengths for every variable decided on using criteria together with AIC or SBC, and the version's stability validated the use of tests like CUSUM and CUSUMSQ [26].

Table 1 clarifies the independent variables (agricultural investment and food prices) and the dependent variable (Poverty Level). Control variables (inflation, GDP per capita, population growth rate) were selected to control for economic and demographic factors and to ensure an accurate estimation of the impact of food prices and agricultural investment on poverty.

Table 1. Research variables.

Variable	Description	Variable Type	Source
Y X1	Poverty Level Food Prices	Dependent Variable	Iraqi Ministry of Planning [27]
X2 X3	Agricultural Investment Inflation	Independent Variables	
X4 X5	Average per capita GDP Population growth	Control Variables	

The economic model was formulated according to the following equation:

$$Y = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \beta_5 X_{5t} + \mu_t \quad (1)$$

Where: (Y) poverty level, (X1) food prices, (X2) agricultural investment, (X3) Inflation, (X4) Average per capita GDP, (X5) Population growth, (t) time, (ut) random variable, and (βo) intercept.

The stationarity of the time series was assessed using the (ADF) test, which was the first unit root test used to apply the steps of the standard model. In addition to determining the optimal lag period for the lagged periods and calculating the error correction parameter,

short- and long-run parameters, and other factors, the (F) test is used to evaluate the limits of the variable relationships. The safety of the model against frequent challenges will be assessed using the ARCH test, the LM test, the appropriateness of the functional form test, the structural stability test of the estimated model parameters, and the residuals' normal distribution test [28].

4. Results and Discussion

4.1. Descriptive Statistics

Presenting the basic statistical characteristics of the study variables is an important matter that must be ensured before conducting standard tests, as it provides indicators of central tendency, variance, and distribution, ensuring the suitability of the data for standard analysis [29]. **Table 2** shows the descriptive indicators of the study variables.

Table 2 proves that there are no outliers and that every research variable has an arithmetic mean. It is evident that the values of the variable (Y), which represents the poverty level, are as follows: the arithmetic mean (22.91987), the standard deviation (4.57725), the minimum (18.18891), and the maximum (35). However, the food price variable (X1) has a standard deviation of −55284773, a minimum value of −55284773, a maximum value of 1310000000, and an arithmetic mean of 411000000. The variable denoted as agricultural investment (X2) has an arithmetic mean of 102.0889. Its range is 77.18225 at the lowest and 141.4 at the highest, with a standard deviation of 14.26493. (X3) is the variable that reflects inflation and has an arithmetic mean of 8.095305, a maximum value of 57.01867), a minimum value of −11.4239, and a standard deviation of 14.16261. This variable, which represents per capita GDP, has an arithmetic mean of 4592822, a maximum value of 5441207, a minimum value of 3634268, and a standard deviation of 550933.6. On the other hand, the standard deviation of the variable (X5), which illustrates population growth, is 1.235649. −0.80601 is its lowest number, 4.825916 is its highest, and 2.621939 is its arithmetic mean.

Table 2. Descriptive statistical indicators of the research variables.

	Y	X1	X2	X3	X4	X5
Mean	22.91987	411000000	102.0889	8.095305	4592822	2.621939
Median	20.50679	363000000	100.2216	2.877747	4665724	2.456271
Maximum	35	1310000000	141.4	57.01867	5441207	4.825916
Minimum	18.18891	−55284773	77.18225	−11.4239	3634268	−0.80601
Std. Dev.	4.57725	323000000	14.26493	14.16261	550933.6	1.235649
Skewness	1.136882	0.755109	0.338756	2.043126	−0.21063	−0.75769
Kurtosis	2.956375	3.161661	3.371359	6.541852	1.860416	4.086092
Jarque-Bera	15.73122	7.016791	1.815661	88.94493	4.48986	10.57274
Probability	0.000384	0.029945	0.403398	0	0.105935	0.00506
Sum	1673.151	30000000000	7452.492	590.9573	3.35E+08	191.4015
Sum Sq. Dev.	1508.488	7510000000000000000	14651.16	14441.73	2.19E+13	109.9317
Observations	76	76	76	76	76	76

4.2. Unit Root Tests

Three factors—the level of poverty in Iraq, global real food prices, and agricultural investment—were examined. The findings of the two augmented Dickey-Fuller (ADF) tests showed that these variables were not persistent at the level. In all test models (with a constant, with a trend, and without a constant), the probability values were not statistically significant. Thus, the alternative hypothesis (H1), according to which the time series are stationary at first differences, is accepted and the null hypothesis (H0), according to which the time series are non-stationary at first differences, is rejected. The statistical results showed first-order integration and were highly significant at the 1% level (18). **Table 3** shows the test findings.

The first difference was chosen because some of the variables under investigation had a unit root, which indicates that they were not stationary at the first data level, as seen in **Table 3**. At the 1% significance level, it is clear that all of the variables become stable after taking the first difference, indicating that they are integrated

of order I (1). The null hypothesis (H0), according to which the time series are non-stationary at the first difference, must be rejected in order to adopt the alternative hypothesis (HI), which asserts that the time series are stationary at the first difference. The Autoregressive Distributed Lag (ARDL) model is thus the best option.

Table 3. ADF test results.

UNIT ROOT TEST TABLE (ADF)							
At Level							
		Y	X1	X2	X3	X4	X5
With Constant	*t*-Statistic	−18.385	−2.2839	−0.9994	−2.5657	−1.6003	−1.6731
	Prob.	0.000	0.1799	0.7497	0.1046	0.4775	0.4401
		***	n0	n0	n0	n0	n0
With Constant & Trend	*t*-Statistic	−15.919	−2.2029	−1.5029	−2.287	−1.4275	−1.4372
	Prob.	0.0001	0.4805	0.8201	0.4355	0.8449	0.8408
		***	n0	n0	n0	n0	n0
Without Constant & Trend	*t*-Statistic	−13.467	−1.1533	1.1392	−1.1531	0.8139	-0.1226
	Prob.	0.000	0.2247	0.933	0.2249	0.8857	0.6378
		***	n0	n0	n0	n0	n0
At First Difference							
		d(Y)	d(X1)	d(X2)	d(X3)	d(X4)	d(X5)
With Constant	*t*-Statistic	−11.372	−5.9606	−8.6845	−8.5347	−8.6058	−5.7461
	Prob.	0.000	0.000	0.000	0.000	0.000	0.000
		***	***	***	***	***	***
With Constant & Trend	*t*-Statistic	−9.3524	−5.9561	−8.6517	−8.7859	−8.6597	−5.7874
	Prob.	0.000	0.000	0.000	0.000	0.000	0.000
		***	***	***	***	***	***
Without Constant & Trend	*t*-Statistic	−12.776	−6.0065	−8.544	−8.544	−8.544	−5.811
	Prob.	0.000	0.000	0.000	0.000	0.000	0.000
		***	***	***	***	***	***

Note: (***) Significant at the 1%.

4.3. Preliminary Estimation According to the (ARDL) Model

Table 4 shows the variable connection's first estimate findings from the (ARDL) model.

Table 4 demonstrates that the model's explanatory strength was shown by the 93% coefficient of determination and 89% adjusted coefficient of determination. Additionally, the findings demonstrate that the model's relevance is shown by the statistical significance of the F−statistic value.

Table 4. Preliminary estimation results according to the (ARDL) model.

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
Y(−1)	0.297806	0.105376	2.826132	0.007
Y(−2)	−2.72E−15	0.102307	−2.66E−14	1.0000
Y(−3)	1.33E−15	0.102307	1.30E−14	1.0000
Y(−4)	−0.77037	0.120407	−6.39805	0.0000
X1	1.88E−08	3.24E−09	5.797971	0.0000
X1(−1)	−4.51E−09	3.64E−09	−1.24068	0.2212
X2	−0.67055	0.124011	−5.40718	0.0000
X2(−1)	0.038956	0.140857	0.276564	0.7834
X2(−2)	−5.54E−14	0.140925	−3.93E−13	1.0000
X2(−3)	4.19E−15	0.140925	2.98E−14	1.0000
X2(−4)	0.451924	0.144269	3.132514	0.003
X3	0.703822	0.503601	1.39758	0.1691
X3(−1)	−0.05874	0.620205	−0.0947	0.925
X3(−2)	−6.71E−13	0.619125	−1.08E−12	1.0000
X3(−3)	2.51E−13	0.619125	4.06E−13	1.0000
X3(−4)	1.171489	0.472517	2.479251	0.017
X4	−4.34E−06	6.43E−06	−0.67439	0.5035
X4(−1)	2.27E−06	8.28E−06	0.274749	0.7848
X4(−2)	−2.16E−17	8.11E−06	−2.66E−12	1.0000
X4(−3)	1.79E−17	8.11E−06	2.21E−12	1.0000

Table 4. *Cont.*

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
X4(−4)	−1.56E−05	6.36E−06	−2.45332	0.0181
X5	−5.54239	1.811651	−3.05931	0.0037
X5(−1)	−1.44904	1.589173	−0.91182	0.3667
X5(−2)	1.52E−13	1.596114	9.51E−14	1.0000
X5(−3)	−2.65E−13	1.596114	−1.66E−13	1.0000
X5(−4)	3.893405	1.29305	3.011024	0.0043
C	73.14139	14.89358	4.910933	0.0000
R−squared	0.931499	Mean dependent var		7.358687
Adjusted R−squared	0.891921	S.D. dependent var		14.40964
S.E. of regression	4.73722	Akaike info criterion		6.228774
Sum squared resid	1009.856	Schwarz criterion		7.082524
Log likelihood	−197.236	Hannan-Quinn criter.		6.568655
F−statistic	23.53569	Durbin-Watson stat		1.27826
Prob(F−statistic)	0.00000			

4.4. Optimal Deceleration Test

Figure 1 shows that the model of order (4,1,4,4,4) was chosen by the ARDL procedure. The tests (HQ, SC, AIC, FPE, and LR) were performed to determine the optimal lag period length for each model variable. The best lag duration is chosen for the lowest value as it produces the lowest results for most of the criteria examined.

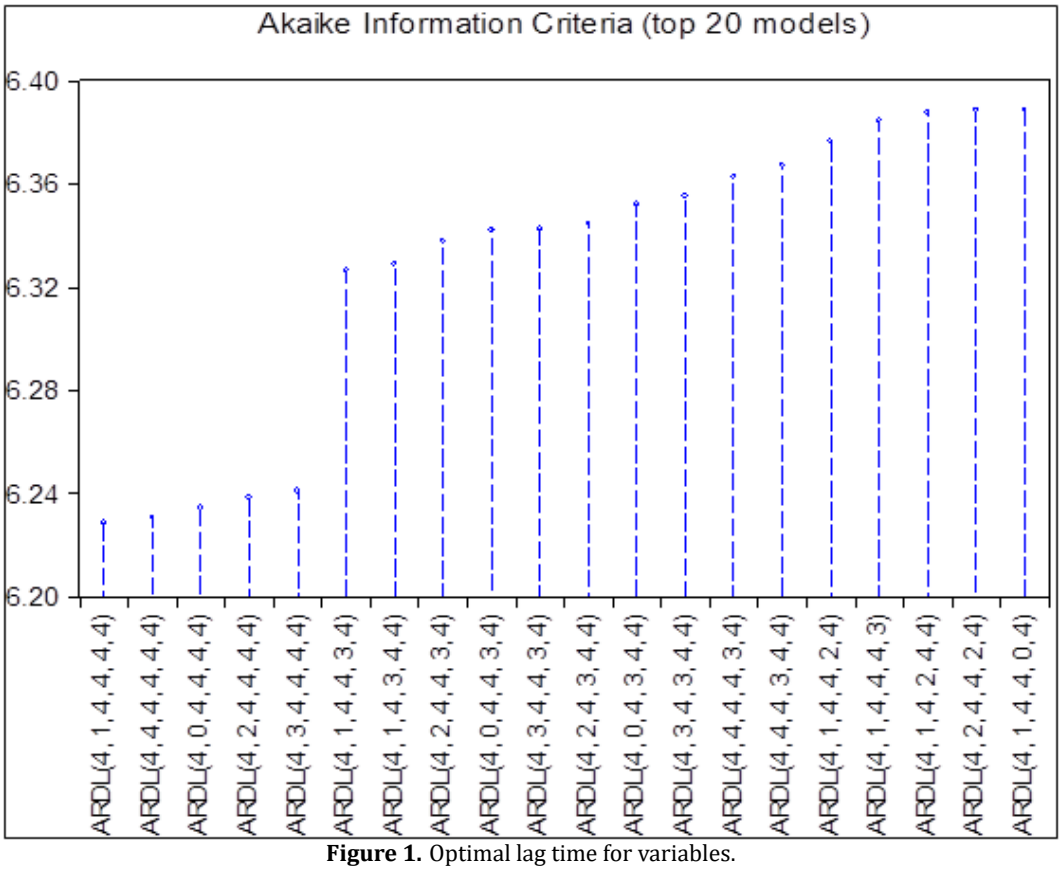

Figure 1. Optimal lag time for variables.

4.5. Bounds Testing for the Relationship Between Variables:

"The (F) statistic is computed to determine if there is a cointegration connection between the independent and dependent variables". We reject the null hypothesis, which holds that there is no long-term cointegration relationship between the variables, and accept the alternative hypothesis, which holds that there is a long-term cointegration relationship between the variables, if the com-

puted (F) statistic value is higher than the upper bound of the critical values. Nonetheless, we accept the null hypothesis and reject the alternative hypothesis if the computed (F) statistic value is smaller than the lower limit of the crucial values. It is impossible to determine if cointegration is present or not until the estimate tests for the short-, long-, and error correction parameters have been finished. If the calculated value of the F statistic is in the zone of uncertainty, it is between the two boundaries. The (ARDL) model's limits test results are shown in **Table 5**.

Table 5. Bounds testing for the relationship between variables.

Test Statistic	Value	*K*
F−statistic	14.71972	5
	Critical Value Bounds	
Significance	I0 Bound	I1 Bound
10%	2.260	3.350
5%	2.620	3.790
2.50%	2.960	4.180
1%	3.410	4.680

According to **Table 5**'s findings, the calculated value of the (F) statistic, which is 14.71972, is more than the critical (F) value at its upper limit at the 1 percent level, which is 4.680. This suggests that there was a cointegration relationship between the variables throughout the study period, which supports the alternative hypothesis and rejects the null hypothesis.

4.6. Error Correction Parameter, Long-Run, and Short-Run Parameters

"It is now necessary to get the error correction parameter and the long- and short-term estimators of the estimated model parameters in order to confirm that there is a cointegrating connection between the variables" (refer **Table 6**).

Table 6. Estimation results of the long-run and short-run parameters and the error correction parameter.

Variable	Coefficient	Std. Error	*t*−Statistic	Prob.
D(Y(−1))	0.770369	0.120407	6.398049	0.0000
D(Y(−2))	0.770369	0.120407	6.398049	0.0000
D(Y(−3))	0.770369	0.120407	6.398049	0.0000
D(X1)	0.00000	0.00000	5.797971	0.0000
D(X2)	−0.67055	0.124011	−5.40718	0.0000
D(X2(−1))	0.00000	0.140925	0.0000	1.0000
D(X2(−2))	0.00000	0.140925	0.0000	1.0000
D(X2(−3))	−0.45192	0.144269	−3.13251	0.003
D(X3)	0.703822	0.503601	1.39758	0.1691
D(X3(−1))	0.00000	0.619125	0.0000	1.0000
D(X3(−2))	0.00000	0.619125	0.0000	1.0000
D(X3(−3))	−1.17149	0.472517	−2.47925	0.017
D(X4)	−0.000004	0.000006	−0.67439	0.5035
D(X4(−1))	0.00000	0.000008	0.0000	1.0000
D(X4(−2))	0.00000	0.000008	0.0000	1.0000
D(X4(−3))	0.000016	0.000006	2.453321	0.0181
D(X5)	−5.54239	1.811651	−3.05931	0.0037
D(X5(−1))	0.00000	1.596114	0.00000	1.0000
D(X5(−2))	0.00000	1.596114	0.00000	1.0000
D(X5(−3))	−3.89341	1.29305	−3.01102	0.0043
CointEq(−1)	−0.47256	0.165301	−8.90837	0.0000
	Cointeq = Y − (0.0000X1 −0.1220X2 + 1.2336X3 −0.0000X4 −2.1038X5 + 49.6694)			
	Long Run Coefficients			
Variable	**Coefficient**	**Std. Error**	***t*−Statistic**	**Prob.**
X1	0.0000	0.0000	6.073189	0.0000
X2	−0.12201	0.046751	−2.60982	0.0123
X3	1.233615	0.157365	7.839217	0.0000
X4	−1.2E−05	0.000001	−11.1501	0.0000
X5	−2.10383	0.562159	−3.74241	0.0005
C	49.66942	7.451755	6.665466	0.0000

It is evident from **Table 6** that there is long-term cointegration between the independent and dependent variables since the error correction parameter (−0.47256) is negative and statistically significant at a level below 1%. The error correction coefficient, which expresses the rate of adjustment from the short term to the long term, must be negative and significant to show that the variables are cointegrated. Given that the error correction coefficient value is significant and negative, the results show that statistical significance has been reached. Assuming a negative sign, the error correction parameter is statistically significant at a level below 1%, and the dependent variable may correct 0.47 of the short-term errors caused by shocks in the independent variables in a single time unit. The degree to which the independent variables influence the dependent variable is well-represented by the statistically significant correlations shown by the short-term parameters.

The long-term relationship can be explained as follows:

1. At a 1% probability level, food prices (X1) have a considerable impact and have a long-term positive correlation with the poverty level. This finding is consistent with the research of Valero-Gil & Valero [15], which indicates that families' buying power, particularly that of the impoverished, is directly impacted by increases in the costs of staple foods. Every time food prices rise, living expenses rise as well, pushing more people into poverty and making it harder for them to pay for other necessities like health and education.
2. The findings show that agricultural investment (X2) is adversely connected with the degree of poverty over the long run and has a substantial impact at a probability threshold of 1%. There is a 0.12201 unit drop in poverty for every unit increase in agricultural investment. According to this conclusion, which is consistent with the Mteti research [30], more investment in this area raises agricultural output and lowers the cost of local food. Low-income populations will benefit from this, and poverty rates will drop as a result.
3. The long-term correlation between inflation (X3) and the poverty level is positive, and it has a substantial impact at a probability level of 1%. The poverty level rises by 1.233615. This is equivalent to a one unit increase in the inflation rate. The research by Akbar et al. [31] is in line with this conclusion, since increasing prices often reduce families' real earnings, particularly those with low or fixed incomes. As living expenses rise and buying power declines due to higher inflation, poverty levels rise.
4. The average per capita GDP (X4) is negatively correlated with the amount of poverty over the long run and has a substantial impact at the 1% probability level. The poverty level falls by (−1.2E−05) units for every unit rise in the average per capita. This outcome aligns with the research conducted by Balasubramanian et al. [32]. This inverse connection shows that economic expansion raises living standards and lowers poverty rates when it is converted into individual income. An increase in the average per capita income lowers poverty levels by improving access to basic items and buying power.
5. Population growth (X5) has a significant effect at a 1% probability level and is inversely related to the poverty level in the long term. As population growth increases by one unit, the poverty level decreases by (2,262,014.87) units. This result aligns with the findings of Saidu et al. [33] and the study by Siburian et al. [34]. The reason for the inverse relationship between population growth and poverty can be explained by the fact that population increase has stimulated economic activity rather than being a burden; it provided a young and productive workforce and expanded the market size, which enhances investment and aggregate demand. Economic policies have also helped accommodate this increase, alongside the role of migration and remittances in improving household incomes, which positively impacted the reduction of poverty levels.

Despite studies involving food prices and agricultural investment that provide important insights into their impact on poverty, there are several limitations that must be taken into account. These include armed conflicts and political instability, internal and external migration, and environmental shocks (droughts, floods,

agricultural diseases) that can further reduce investment levels in the agricultural sector, thereby decreasing household incomes and affecting the effectiveness of food policies.

4.7. Model Validity Check and Diagnostics

To verify that the estimated model does not have issues with normalization, several tests are used to validate the estimated model, as outlined in **Table 7**.

Table 6 displays the findings of the diagnostic tests conducted to ensure the estimated model's validity and safety. The LM test for autocorrelation verified that there was no serial correlation among the residuals, and the ARCH test for heteroscedasticity showed that the model was free of heteroscedasticity problems. Last but not least, the Ramsey RESET test confirmed the model's functional form and the lack of specification mistakes, improving the dependability of the ARDL model's output.

The stability of the projected model parameters was evaluated using the CUSUM OF SQUARE and the CUSUM test. At a 5% significance level, the CUSUM and CUSUM test graphs fell within the upper and lower critical limits, suggesting that the computed parameters were structurally stable. As a result, the null hypothesis—which holds that all computed parameters are structurally stable—was approved (refer **Figure 2**).

Table 7. Diagnostic tests for the model.

Test	Statistic	*p*–Value	Significance at 5%
ARCH Heteroscedasticity Test	F = 1.610903	0.2086	Not significant
LM Autocorrelation Test	F = 0.344809	0.7097	Not significant
Ramsey RESET Test (t–statistic)	*t* = 0.668346	0.5063	Not significant
Ramsey RESET Test (F–statistic)	F = 0.446687	0.5063	Not significant

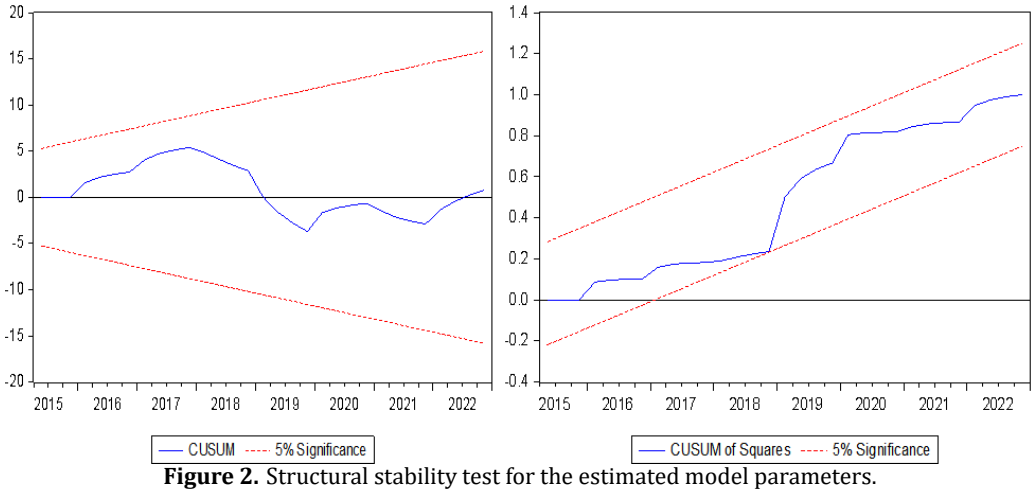

Figure 2. Structural stability test for the estimated model parameters.

Figure 2 makes it clear that the CUSUM test and CUSUM OF SQUARE are curves that lie within the upper and lower critical limits at a significance level of 5%. Therefore, the null hypothesis—that all measured values are structurally stable—was chosen to be accepted.

The Bera probability test was used to look at the residuals' distribution in the model. The normal distribution issue of the residuals of the model is resolved if this probability exceeds 5%. The test may be seen in **Figure 3**.

It is evident from the **Figure 3** that the probability value reached (0.291339), which is greater than (5%), necessitating the acceptance of the null hypothesis stating that the distribution of random errors does not differ from the normal distribution of residuals, and rejecting the alternative hypothesis stating that the random variable is not normally distributed. This means there is no problem with normal distribution, and therefore, this test enhances the accuracy of the characterization of the variables in the (ARDL) model.

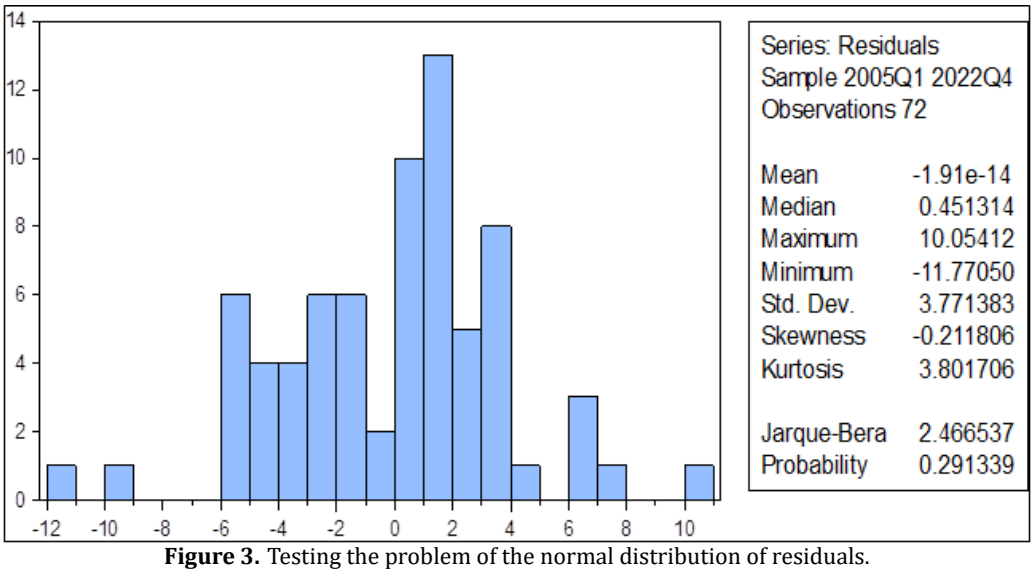

Figure 3. Testing the problem of the normal distribution of residuals.

5. Conclusion

Poverty in Iraq represents a structural and complex challenge in which the monetary size intertwines with social, demographic, and political elements. This research sought to investigate the effect of agricultural funding and food charges on poverty at some stage in the period (2004–2022) using the ARDL method, which lets in distinguishing between brief-term and long-time period results. The outcomes showed that food expenses have a advantageous and large effect on poverty, that means that any boom in food prices will cause a rise in poverty levels. Conversely, agricultural investment turned into an effective device in decreasing poverty within the long time, with this investment having a terrible and great effect, indicating that expanded investment within the agricultural sector will translate into improved agricultural productiveness, progressed food protection, accelerated income, and for that reason a reduction in poverty fees.

The outcomes also showed that control variables which includes inflation, in line with capita GDP growth, and population growth play vital roles. Inflation results in the erosion of actual earning and will increase living pressures, as inflation has a high quality and massive effect on poverty prices. Meanwhile, an growth in the common in line with capita GDP contributes to poverty discount, given the negative and enormous impact of this common on poverty fees, highlighting the importance of inclusive economic growth. As for population growth, it showed a terrible and considerable impact on poverty because population increase in Iraq inspired economic hobby; in place of being a burden, it multiplied market size, which boosted investment and aggregate demand, and provided a young and effective group of workers. This explains the inverse relationship between population increase and poverty.

Based on those findings, the take a look at recommends the necessity of improving agricultural funding via institutional and legislative reforms that ensure an attractive surroundings for neighborhood and overseas investors, and enhancing rural infrastructure, consisting of irrigation networks, rural roads, and services helping production and advertising. Additionally, it requires controlling meals price fluctuations thru effective tools inclusive of establishing strategic reserves of fundamental commodities, diversifying import sources, and adopting pricing rules that balance the hobbies of manufacturers and clients. It also emphasizes strengthening macroeconomic stability thru financial and monetary regulations that limit inflation and shield the purchasing strength of low-earnings corporations.

This have a look at contributes to the scientific literature via offering benchmark proof at the twin impact of both food costs and agricultural investment on poverty inside the context of a developing economy laid low with institutional fragility and monetary volatility. It also opens the door for future studies to discover oblique

channels of influence, together with the function of agricultural generation, exchange policies, or the connection among migration, remittances, and poverty.

Author Contributions

Methodology, A.M.H.; formal analysis, A.A.H.S. and T.H.A.; data curation, S.A.J.; writing—original draft preparation, N.Y.O. and S.A.H.; writing—review and editing, M.F.H. and F.G.F. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

The data supporting the findings of this study are available from the Iraqi Ministry of Planning (National Accounts Directorate) as cited in reference[27]. The author has obtained and used the data from the publicly accessible source: https://cosit.gov.iq/ar/ .

Additional processed data used in the analysis are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there are no conflict of interest.

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