JEAS, Vol. 31 No. 146 (2025) pp (67-80)
P-ISSN 2518-5764 - E-ISSN 2227-703X
DOI: https://doi.org/10.33095/e1598633

Journal of Economics and Administrative Sciences

Estimation and Analysis of the Cost Function of the Food Industries in Iraq

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Received:20/8/2024 **Accepted:6/11/2024** **Published: 1/4/2025**

Abstract:
The paper analyses the production costs of Iraq's food industry and tries to establish its optimum production level. Declining contribution to GDP resulting from high production costs, competition brought about by imported products, and economic instability has been showed by the study in focusing on the industry. The paper employs econometric analysis through EViews-10 to estimate cost functions across different industrial scales (Small, Medium, and Large) for the period between the years 2004 and 2022. Findings reveal that the optimal production efficiency has not been attained so far for the food industry of Iraq. It is suffering from a high dependency on imported raw materials which increases cost and lowers their competitiveness. The production cost analysis has proven that production costs follow a cubic function indicating that food industries are still in the early phases of production, meaning there are high cost inefficiencies. In other words, the estimated value of cost elasticity (0.819) indicates that the production level can be increased to yield higher profits.
It advocates for cost minimization and productivity improvement as ways of attaining economic efficiency. It presents features that will strengthen agriculture-industry linkages towards reduced reliance on imports. The paper will therefore inform policy decisions and economic models toward making Iraq's food industry sustainable and competitive.
Keywords: Production Cost; Cost Function Estimation; Optimal Production Volume; Food Industry Economics.

1. Introduction :

The food industry is one of Iraq's most important manufacturing industries, as it plays a key role in meeting the population's needs and providing food security. It also contributes to the development of the economy through the wide interrelationship with other economic sectors, thus increasing production, improving national income, and stimulating the growth of the local economy. The great role played by food industries in diversifying the export structure and reducing dependence on imports directly contributes to improving the trade balance and balance of payments, which enhances economic stability in the country. However, despite the industry's strategic importance, Iraq's food industries have seen a marked deterioration in recent years. This deterioration is negatively reflected in the sector's contribution to GDP, its ability to provide jobs, and the low quality of local food products. This decline is due to several major factors, most notably the security instability that the country witnessed after 2003, which led to the widespread destruction of infrastructure, Including factories, and the looting of those industrial facilities that increased the depth of the crisis. Unstable political and economic conditions also play a role, as well as technical challenges as the exposure of food industries to the dumping process from neighboring countries, which deepened the size of the problem, as these factors contributed to impeding the growth of this vital sector and undermining its economic efficiency, especially in large enterprises that were the backbone of industrial production in the country (Ali & Aloosh, 2023). This led to the weakness of food industries in competing with foreign products and, thus, the loss of market share, low profits, and declining economic performance. Because of the importance of this sector, it is necessary to study it from both sides of production and costs because of their great impact on the role played by this sector in economic development. For this sector to achieve its role correctly, it is necessary to minimize costs and maximize production to (maximize the economic surplus), that is, minimize costs per unit of production. This is achieved at the optimal level of production, at which the average total costs are at their minimum end and revenues at their maximum end (Najm Aboud, 2021) ; (Shapiro et al., 2024), and when the average costs intersect with marginal costs (H.L, 2019) ; (Al-Omare, 2022). The growth of this industry is also linked to the promotion of productive integration with the agricultural sector, which is the main source of intermediate inputs for this industry (Majeed & Ahmeed, 2022), so it works to increase the productive interdependence between these two sectors, which contributes to increasing economic diversification, as well as being one of the labor-intensive industries (Habsh et al., 2020).

In this context, the current study aims to estimate and analyze the cost function and extract economic derivatives to indicate the optimal production volume of the food industry as an essential pillar for achieving food security. The study also aims to indicate the flexibility of the cost function, which expresses the degree of cost responsiveness when production changes by one unit (Myers, 2020) and, thus, the stage of production that the food industry passes through (Razika, 2020). The problem of the study can be formulated as follows: the food industries suffer from high costs and low production, thus making them produce at a level far from the optimal production volume. The importance of the paper is highlighted by estimating the cost function and by its focus on determining the optimal production volume for the food industries, which is vital for achieving economic efficiency and improving food security. It also contributes to analyzing the problems of high costs and low production. This helps improve the food industries' economic performance and ensure their sustainability.

2. Literature Review and Hypothesis Development:

Many studies indicated and addressed the cost function estimation, whether at the project or industry level. Among these studies are the following:

The study (AL-Nooar.M., 2019) aims to estimate the cost function for the cement project (SCT). The problem of the study is that this industry did not achieve the optimal production volume during the study period. The sector also suffers from high production costs, particularly the maintenance costs of production equipment. The study analyzed the costs, showing that the costs of production supplies of goods and services amounted to 81.5% of the total costs, while labor costs accounted for 18.5% of the total costs. The study recommended reducing administrative costs that contribute to the overall high-cost level. A study (Jabbar Shahab, 2019) compares the production and domestic consumption of food industries in Iraq to a sample of countries to extrapolate the importance of this industry for individual consumption and the national economy. The Iraqi industry's constraints were analyzed using quantitative methods and digital data. The results showed that increasing per capita income, rather than significant population growth, is the primary factor in the rising consumption of processed foods. The study also discusses aspects related to economic structure, proposing treatments to restore the concept of value to production and promote opportunities for innovation. A study(Abbas, 2019)on modern technology and its role in the development of food industries in Iraq discussed the natural and human potential that can be invested and employed to develop food industries in Iraq, as well as highlighting the most prominent challenges and problems faced by the food industries. A study by (Nadhir & Rashid Al-Ani, 2020) considers that the global economy is witnessing major transformations in the commercial, technological, and financial fields, which led to an increase in the movement of capital and global competitiveness. These changes have particularly affected the industrial sectors in developing countries, including Iraq, which suffers from great challenges in developing its competitiveness and continuity in light of the underdeveloped industrial reality and crippling economic policies. A study (Mekhlef & Mohamed, 2020). This study aims to analyze the problems of large industrial manufacturing in Baghdad, Basra, and Anbar governorates between 2000 and 2018, where factories faced multiple challenges, including the unstable political and security situation, administrative and financial corruption, and the lack of funding and appropriate infrastructure. These problems have led to a deterioration and disruption of production despite the vital role played by the industrial sector in Iraq's GDP. A study (AL- HALLK et al., 2020)The study aims to estimate the cost function of the beetroot crop to determine the optimal production size of the crop due to the strategic importance of the crop in addition to its contribution to meeting the market needs of sugar, and securing many job opportunities, as the study showed production costs, as employment accounted for 28%, while production requirements accounted for 51.5%. The long-term and short-term cost function was also estimated, in addition to estimating the optimal production volume, as it amounted to 6.14 tons in the short term and 7.28% in the long term. The study (Abd al-Nabi, 2021)was based on quantitative economic analysis, and the optimal production level of some of the most important crops in Libya was estimated according to the Nerloff partial modification model. The paper aimed to identify the most important factors affecting agricultural production in Libya, which may negatively affect agricultural production and is one of the reasons that can hinder sustainable economic development. A study (Al et al., 2021) aimed at analyzing the reality of the food industry in Iraq by studying and analyzing the performance indicators of the manufacturing sector in general and the performance indicators of the food industry sector in particular and identifying the obstacles that stand in the way of developing this vital sector. The problem of the study shows that this study examines the weakness of the competitiveness of the Iraqi food industries, whether the low level of quality of the products manufactured in the country or the low level of competitiveness of the products of the food industries in Iraq compared to the products imported from those industries. A study (Alfadeely & Khalf, 2021) examines the role of food industries according to sectoral linkages in diversifying the Iraqi economy.

The problem of the study is that Iraq's dependence on importing food commodities neglects the developmental role of food industries represented in the revitalization of the agricultural sector by strengthening productive linkages between the agricultural and manufacturing sectors, which contributes to raising the level of economic diversification. The study results showed that the food industries in Iraq are not qualified to play such a role due to the weak level of their forward and backward linkages, the prevalence of productive concentration, and weak diversification. Therefore, they failed to enhance the level of integration between agriculture and industry. A study(Al et al., 2022) aims to analyze the production costs in 2018 and 2019 of Al-Ma 'mun, one of Iraq's oldest food industry companies. The study tries to answer a fundamental question: Why did production costs rise in 2019 compared to 2018, while the costs of quality-related losses also rose? The study found that this company's cost system did not follow the basic premise of the P-A-F model, which states that if production costs increase, the costs of quality-related losses should decrease. The regression analysis showed that the production costs did not affect the costs of quality-related losses at a significance level of 0.05, which means that these costs did not play any role in reducing the costs of losses, indicating that the company lost its competitive advantages.(AL-Badree & AL-Keatee, 2022), this study aims to analyze the economic reality of the food industries in Iraq and Karbala Governorate from 2014 to 2020 by analyzing the numbers and their relative importance within the manufacturing industries. We found an increase in the relative importance of large food industries within the large manufacturing industries throughout Iraq during the study period, with a small decrease in 2020. The study also showed a small increase in large food industrial establishments in Karbala governorate during the study period, and this is evidenced by their relative importance compared to large food industries throughout Iraq, as they reached in 2015 and 2016 (5.7%).The most important proposal recommended by the study is the need to address the imbalance in 2020, shown by the low relative importance of large food industries in Iraq relative to other manufacturing industries, as their relative importance in 2020 reached (29.9%). Study (SALEH, 2022) The study aims to reduce waste in the use of production materials in the Abu Ghraib dairy factory through a production plan in a precise scientific manner, producing the best combination that achieves maximum economic return through the use of linear programming method. The study is based on the basic premise that using linear programming is one of the important planning and mathematical methods that will lead to determining the optimal production composition in the Abu Ghraib dairy factory.The study (Aslih, 2023) indicated to estimate the cost and production function in the food industry sector (a standard study on Palestine), as it concluded that the Palestinian food industry sector suffers from a set of problems, some of which are related to the occupation policies and financing, government policy and the production process, and consequently high production costs and failure to achieve economic savings. The study proved that the converted cost function is the most capable of expressing the cost and production functions due to its many advantages over other cost and production functions. The study recommended urging food industry institutions to increase production or merge with other industrial institutions to benefit from positive economies of scale. The study (Farhin et al., 2023) The problem of the study is that the increase in the total costs of the Diyala General Company came as a result of internal and external factors that the company was exposed to, which led to a decline in production levels to the furthest levels during the study period.

The study aims to identify trends in total costs in the general company and diagnose the levels of relative change in these costs and their distribution, then target the relationship to the cost items and estimate the cost function. Study (Ismail & Abbas, 2024) This paper aims to review the concept of food industries and their diversity according to different references and their importance in economic and social development, focusing on their ability to adapt to the circumstances that Iraq has experienced. It also discusses the characteristics and determinants of the success of these industries and reviews the types of food industries in the Maysan Governorate.

The paper concludes that the food industries in Maysan, and Iraq in general, are small industries that contribute effectively to economic development and require the support of the state and the private sector to ensure national food security rather than relying on imports from abroad.
The paper hypothesizes that the food industry suffers from high costs and low production, which means that the food industry has yet to reach the optimal production volume.

3. Methodology:

3.1 Data and Sample:

This study relies on data from the Ministry of Planning (Central Bureau of Statistics/Industrial Statistics Department), where data on the food industries (large, medium, small) regarding both costs and production were collected, for the period from 2004 to 2022. The annual data was analyzed using the statistical program (Eviews10). The study was guided by previous studies and concepts derived from economic theory in selecting the appropriate mathematical form to express the cost function.

3.2 Definition of Variables:

Economic theory posits that total costs are a function of the level of production, assuming other factors remain constant. To explore this relationship, mathematical results were used to analyze the study variables and determine the impact of different cost components within the food industries. In the context of studying food industry costs in Iraq, various cost functions were estimated. The best function was selected based on both economic and statistical criteria.
Two types of cost functions—quadratic and cubic—were estimated. Among these, the cubic form proved to be the most suitable for the relationship under study due to its alignment with statistical, standard, and economic tests. The form of the relationship between costs and production can be expressed through Figure No. (1) .

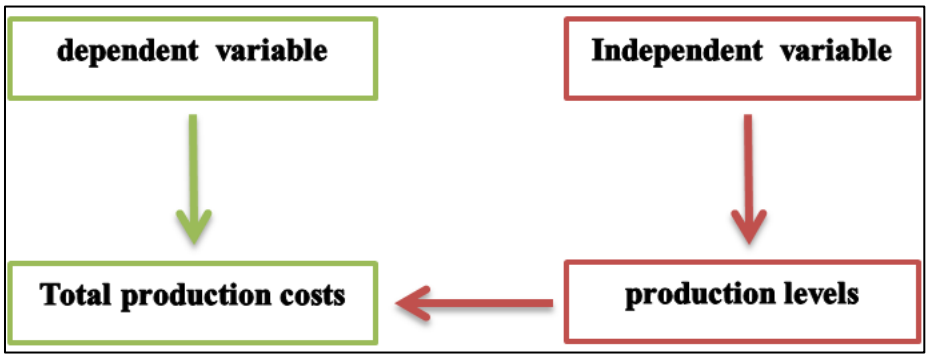


Figure 1: The Direction of the Relationship Between Study Variables
Source : Prepared by an external party.

However, there can be exceptional cases where costs may indirectly affect production. For example, if costs are very high, they might limit the facility's ability to increase production, or they may lead to a reduction in production to maintain profitability.

4. Results:

4.1 Cost and production analysis of food industries in Iraq:

Wages and salaries: It is noted in column No. (1) the value of wages and salaries amounted in 2004 to (60625) million dinars, which rose in 2022 to (329511) million dinars at a compound annual growth rate of (9.86%), and an average contribution to the total costs amounted to (22.5%), meaning that the increase in work compensation by (10%) will increase the total cost only (2.25%), and this is an indication that salaries and wages for workers in the industry are not the main reason for overworking the food industries in terms of high costs. However, disguised unemployment among workers, especially in the public sector, reduces labor productivity and thus increases the cost of production.

Table 1: Total indicators for Iraq's food industries for the period (2004-2022) million dinars

year	Value of wages and salaries	Commodity Production Requirements[1]	Costs value	production value	Contribution of wages and salaries to costs%	Production Supplies Contribution to Costs%	Cost contribution to production%
	1	2	1+2 =3	4	1/3 =5	2/3 =5	3/4 =7
2004	60625	250712	311337	337870	19.5	80.5	92.1
2005	111203	230203	341406	438826	32.6	67.4	77.8
2006	161605	351087	512692	657929	31.5	68.5	77.9
2007	154885	331368	486253	599979	31.9	68.1	81
2008	152202	352506	504708	707447	30.2	69.8	71.3
2009	165228	404021	569249	856065	29	71	66.5
2010	181855	474263	656118	1050487	27.7	72.3	62.5
2011	277468	779315	1056783	3241984	26.3	73.7	32.6
2012	257549	835629	1093178	1550545	23.6	76.4	70.5
2013	262536	642904	905440	1304451	29	71	69.4
2014	231855	594120	825975	1093319	28.1	71.9	75.5
2015	230423	824762	1055185	1361203	21.8	78.2	77.5
2016	233469	1172204	1405673	1773657	16.6	83.4	79.3
2017	222510	1551294	1773804	2244200	12.5	87.5	79
2018	273434	1782930	2056364	2463322	13.3	86.7	83.5
2019	258870	1785834	2044704	2660397	12.7	87.3	76.9
2020	278489	1639257	1917746	2512472	14.5	85.5	76.3
2021	330539	2077861	2408400	2735413	13.7	86.3	88
2022	329511	2193697	2523208	2934254	13.1	86.9	86
CAGR	9.86	12.81	12.33	12.76			
Average contribution ratio					22.5	77.5	74.9

Source: Prepared by an external party based on the data of the Ministry of Planning, the Central Statistical Organization, and the Department of Industrial Statistics.

The value of production supplies: Table (1) shows that the value of production requirements in 2004 amounted to (250712) million dinars , and increased to (2193697) million dinars in 2022 , with a compound growth rate of (12.81%), and an average contribution to total costs of (77.5%) during the study period. This is a very high percentage. The main reason for this continuous rise in production requirements is the dependence of food industries in obtaining these supplies from abroad.

The evidence for this is the weakness of local agricultural production, which is the main source of production requirements in food industries. During the study period, the coverage rate of agricultural production to local demand did not exceed (6%). This acute shortage of domestic production makes food industries highly dependent on imports to meet their needs, increasing their sensitivity to exchange rate fluctuations and deepening their connection to foreign markets (Al-Janabi et al., 2023).

[1] Commodity supplies include (raw materials and primary materials, packaging materials, energy, water, spare parts, and other commodity supplies). Service supplies include (building and equipment rental, consulting costs, transportation expenses, advertising and promotion, bank interest, expenses paid for services provided by others, and other service supplies)(Iraqi Ministry of Planning, 2019).

Production and costs for food industries: Table (1) shows the development of the value of production for the period (2004-2022) ,as we note from column (4), that the value of total production of food industries amounted in 2004 (337870) million dinars and then rose to (2934254) million dinars in 2022 and a compound annual growth rate of (12.76%) during the study period. As for production costs, they amounted to (311337) million dinars in 2004 and increased in 2022 to (2523208) million dinars with a compound growth rate of (12.33%). As for the average cost contribution to production, it reached (74.9%) during the study period. These contribution rates were significantly high in most years of study, which suggests the existence of problems and obstacles that contribute to this high percentage (high costs and low production), as these obstacles are represented by the difficulty of the availability of raw materials, the obsolescence of production lines,and weak security and political stability, in addition to the lack of skilled and qualified labor. One of the problems that the food industries suffer from is the lack of electrical energy, and some of them often need this energy , because it is the basis on which they rely to preserve their products(Bekheet et al., 2023). In addition to external competition and the weakness of the agricultural sector, the agricultural sector is directly responsible for meeting Iraq's food requirements and the needs of the industry that relies on it for production. It is well known that the agricultural sector is the main source of production inputs for the food industries and that the weakness of the agricultural sector leads to a decrease in the production of agricultural crops and animal products, which, in turn, negatively impacts the food industry.(Drebee & Abdul-Razak, 2020)

4.2 Testing the stability of the time series for the variables in the econometric model used

Time series stationary tests are used to eliminate the problem of false regression by taking the first difference when the stationary characteristic is not available at the natural level and taking the second difference in the case of non-stationarity at the first difference. In light of this, the appropriate standard models are determined in the joint integration property and come out with sound and non-false results. In order to identify the degree of stationary, the Phillips-Peron test (p.p.) was relied upon, as this test is more accurate in detecting the stationary of the time series, in addition to knowing the integration rank of the time series. (Hammad et al., 2023)

Table 2 : The results of the Phillips-Peron test

Variable name	Prob. at level			Prob. at the first difference		
	Intercept	Trend and intercept	Non	Intercept	Trend and intercept	Non
TC	0.9507	0.4761	0.9952	0.0092	0.0364	0.0051
P	0.5415	0.0897	0.822	0.000	0.000	0.000
P^2	0.3029	0.0629	0.4787	0.000	0.000	0.000
P^3	0.9383	0.4392	0.9276	0.0008	0.0006	0.0001

Source: Statistical program outputs (Eviews10).

It is noted from Table (2) that the series of variables is not stationary at the level and at a significance level (5%) and across the three cases (with a Intercept, with a Trend and intercept, and without a Trend and intercept), as the statistical results showed that there is instability in the variables under study, as the value of (Prob.) was more than (5%), which means accepting the null hypothesis H0:B=0 and rejecting the alternative hypothesis, which means that the time series of variables is not stationary because it contains a unit root. After taking the first difference of the variables, they all became stationary, as it was found that the probability value (prob.) is significant at a level less than (5%), and here we must accept the alternative hypothesis H1: B = 1, which states that there is no unit root and reject the null hypothesis, which means that the variables are stationary from the first degree and across their three cases, which means the possibility of applying the ARDL methodology to reveal the nature of the relationship between the variables.

4.3 ARDL estimation results:

Before conducting the ARDL model test, there are two basic conditions that must be met: -(Saleh, 2021)

First: The variables included in the model must be either stationary at level (Io) or stationary at the first difference (I1) or a combination of both.(Kripfganz & Schneider, 2023)

Second: The dependent variable must be stationary at the first difference (I1)

After examining the stationary of the studied variables included in the model, which are the dependent variable total costs (TC) and the value of the independent variables production values ((P), it became clear to us through Table (3) The test results for (P.P) that all these variables (independent variables) were stationary in the first difference (I1) and also that the dependent variable (TC) was stationary in the first difference (I1) as well, and thus these two conditions enabled us to apply the ARDL model test. Table (3) shows us the test results for this model.

Table 3: Model Test Results (ARDL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
TC(-1)	-0.774513	0.199385	-3.8845	0.0030
P	0.829889	0.371139	2.23606	0.0493
P(-1)	0.875337	0.339924	2.57509	0.0276
P2	-3.33E-04	1.03E-04	-3.2233	0.0091
P2(-1)	-1.72E-04	7.38E-05	-2.3376	0.0415
P3	1.16E-07	2.35E-08	4.91795	0.0006
C	39.47485	34.14725	1.15602	0.2745
R-squared	0.847156	Mean dependent var		116.5767
Adjusted R-squared	0.75545	S.D. dependent var		197.6477
S.E. of regression	97.7408	Akaike info criterion		12.29542
Sum squared resid	95532.64	Schwarz criterion		12.6385
Log likelihood	-97.51104	Hannan-Quinn criter.		12.32952
F-statistic	9.237697	Durbin-Watson stat		1.806379
Prob(F-statistic)	0.001335			

Source: Statistical program outputs (Eviews10)

It is noted from Table (3) that the (ARDL) model automatically determines the number of optimal time delay degrees for the variables included in the model, as the time delay degree for the dependent variable (TC) was a one-time degree, while for the independent variables, production values, the delay period was also one time period. The results of the statistical tests of the model show us the quality of the estimated model through the value of the coefficient of determination (R-Square) which reached (0.847156) which shows the explanatory power of the model used, i.e. the independent variables (production values) explain (84%) of the changes in the dependent variable while (16%) fall within the random error, while the value of the corrected coefficient of determination (R-Square Adjusted) reached (0.75545), while the value of (F-Statistic) reached (9.237697) and it is also significant with a probability value of (0.001335) at a significance level of (5%) which indicates the significance of the model as a whole from a statistical point of view, and the statistics (Durbin-Watson stat) which reaches (1.806379) indicate that the model is free from the problem of false deviation, in addition to the model that was chosen according to the (ARDL) test which is of rank (1,1,1,0) and according to the criteria of the lag time tests (AIC, HQ).

4.4 Bound test results:

To detect the long-term equilibrium relationship between the independent variable and the dependent variable, the (F) statistic is calculated. Suppose the calculated (F) value is greater than the upper limit value of the (F) table. In that case, the null hypothesis is rejected, and the alternative hypothesis is accepted, which means a joint integration relationship exists between the variables under study. However, suppose the (F) value is less than the lower limit of the (F) table value, meaning there is no joint integration between the variables. In that case, the null hypothesis is accepted, and the alternative hypothesis is rejected. However, the result is confusing and inconclusive if it could be clearer and more conclusive (Dawood & Al-Sawa'i, 2013, p. 122), and Table (4) shows this.

Table 4 : The results of the bound test

Test Statistic	Value	k
F-statistic	20.99867	3
Critical Value Bounds		
Significance	I(0) Bound	I(1)Bound
10%	2.72	3.77
5%	3.23	4.35
2.50%	3.69	4.89
1%	4.29	5.61

Source: Statistical program outputs (Eviews10).

4.5 Error Correction Term (ECM) and short run results:

After conducting the boundary test and confirming the existence of a co-integration relationship between the dependent variable and the independent variables, we must estimate the short-term parameters and the error correction parameter, as shown by the statistical results in Table (5):

Table 5: Short-run results (ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TC(-1)	-1.774513	0.199385	-8.899936	0.0000
D(P)	0.829889	0.371139	2.236057	0.0493
P(-1)	1.705226	0.437734	3.895577	0.0030
D(P2)	-3.33E-04	1.03E-04	-3.223253	0.0091
(P2)(-1)	-5.05E-04	1.23E-04	-4.106848	0.0021
P3	1.16E-07	2.35E-08	4.917953	0.0006
C	39.47485	34.14725	1.156018	02745
CointEq(-1)	-1.774513	0.163524	-10.85169	0.0000

Source: Statistical program outputs (Eviews10).

Table (5) shows us the results of estimating the parameters of the independent variables in the short term, as it confirms that there is a balanced relationship between the independent variables, production values, and the dependent variable, total costs (TC). This is confirmed by the error correction parameter, which is (-1.774513) at a significance level of (0.0000), meaning that it is negative and significant. Since it is negative and significant, this parameter expresses the speed of adaptation in the changes that occur between the dependent and independent variables. This means that the error correction coefficient explains the value of (-1.77) of errors in the short term in the previous period (t-1) that can be corrected in the current period (t) in order to return to balance when a shock or change occurs in the independent variables. In the short term, the results of the parameters indicate a direct relationship between the independent variable, the production value (P), and the dependent variable, the total costs (TC), i.e., increasing production by one unit will lead to an increase in (TC) by (0.829889), assuming that other factors are constant and at a

significance level of (Prob=0.0493) and a time lag ((D(P), which is consistent with the economic theory, where every increase in production is met by an increase in costs. Also, increasing production by one unit will lead to an increase in costs by (1.705226) at a significance level of (Prob=0.003) and with a time lag of (-1), and it is also consistent with the logic of the economic theory. As for squaring the production value P^2, there is an inverse effect, i.e., increasing the production value (P^2) by one unit will lead to a decrease in costs (TC) by (0.000333), assuming that other factors are constant and at a significance level of (Prob.=0.0091) and with a time lag (D(P2)) and that Due to the law of diminishing returns, i.e. costs decrease with each increase in production, as increasing production by one unit will lead to a decrease in costs by (0.000505) at a significance level of (0.0021) and with a time lag of (-1) and also agrees with the economic theory. As for the cube of the production value (P^3), there is a direct relationship with the value of total costs, as increasing the value of production (P^3) by one unit leads to an increase in the value of costs by (0.000000116) assuming the stability of other factors and at a significance level of (prob.= 0.0006) and this also agrees with the logic of the economic theory.

4.6 Estimating the long-run:

This test shows the estimation of the long-term parameters in order to reveal the degree of influence of the independent variables on the dependent variable, as well as determining the type of long-term relationship, and Table (6) shows that.

Table 6: Estimating the long-run coefficients

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
P	0.960954	2.45E-01	3.929568	0.0028
P2	-0.000285	6.70E-05	-4.248123	0.0017
P3	6.52E-08	1.13E-08	5.78435	0.0002

Source: Statistical program outputs (Eviews10).

Table (6) shows us the results of estimating the parameters of the independent variables in the long run, as it shows that there is a direct relationship between the independent variable, the production value (P) and the dependent variable, the total costs (TC), i.e. increasing the production value by one unit will lead to an increase in the total costs by (0.960954) at a significance level (Prob.=0.0028) assuming that other factors are constant. This is consistent with the logic of economic theory, as increasing production may require expanding the industry, updating equipment, or purchasing new machines.

These new investments lead to an increase in costs. There is an inverse relationship between the independent variable, the squared production value (P^2) and the dependent variable, the total costs value (TC), as increasing production by one unit leads to a decrease in costs by (0.000285) at a significance level (Prob.=0.0017) assuming that other factors are constant. This is due to the economic economies of scale, as the cost of producing one unit decreases with increasing production, as well as the use of modern technology in production. These factors help reduce costs with increasing production in the long run. There is also a direct relationship between the cube of the production value ((P^3) and the dependent variable, the total cost value (TC), as increasing production by one unit leads to an increase in costs by (0.0000000652) and at a significance level (prob.=0.0002) assuming that other factors are constant, and this is consistent with the logic of economic theory, as increasing production is met by an increase in costs.

4.7 ARDL Diagnostic Tests :

In order to verify the validity and accuracy of the results obtained in the previous tests, we will conduct some important diagnostic tests to prove this as follows:

Autocorrelation test and variance difference problem test: The results of the autocorrelation problem test show that the probability value (Prob. Chi-Square) is (0.5159 (which is greater than (5%), which means that there is no autocorrelation problem, and therefore here we must accept

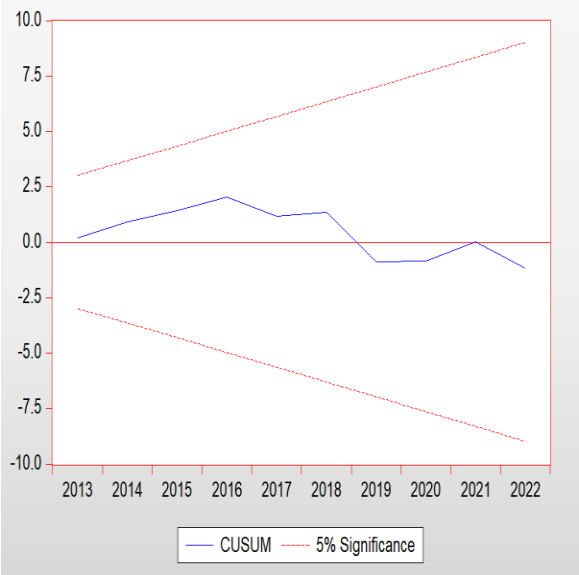
the null hypothesis that states that there is no autocorrelation problem between the random residuals and reject the alternative hypothesis. The results of the autocorrelation test also show variance, that the probability value ((Prob.Chi-Square is (0.3982) which is greater than (5%), and this means that the model is free from the problem of variance difference, and then here we must accept the null hypothesis which states that there is no problem of variance difference between the random residuals and reject the alternative hypothesis.

Table 7 : Results of Econometric problems (model quality)

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	0.337703	Prob. F(2,8)	0.7231
Obs*R-squared	1.323502	Prob. Chi-Square(2)	0.5159
Heteroskedasticity Test (ARCH)			
F-statistic	0.653705	Prob. F(1,14)	0.4323
Obs*R-squared	0.713764	Prob. Chi-Square(1)	0.3982

Source: Statistical program outputs (Eviews10).

Testing the normal distribution of the residuals and the structural stability test: It is clear from Figure (2) that there is no problem in the normal distribution of the model residuals because the probability (Jarque-Bera) reached (0.913856), which is greater than (5%), which means that there is no problem with the normal distribution, and then here we must accept the null hypothesis that states that there is no problem with the normal distribution and reject the alternative hypothesis that states that there is a problem with the normal distribution, and then this test enhances the accuracy of the results of the model for (ARDL). As for the structural stability test of the model, it is noted from Figure (3) that the blue (wavy) line falls within the critical red dotted limits, which means that the estimated parameters of the model are stable. Then, this test enhances the accuracy of the (ARDL) model results.



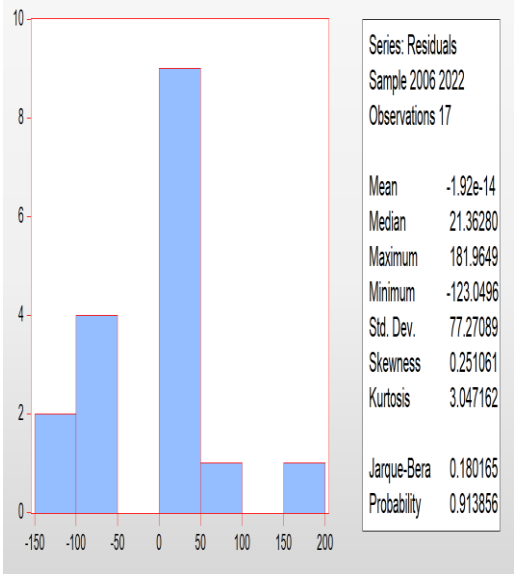


Figure 3 : Structural Stability Test (CUSUM) **Figure 2:** Jarque-Bera test for normal distribution of residuals

Source: Statistical program outputs (Eviews10).

5. Discussion of Results:

After conducting economic, statistical and Econometric tests for the total cost function, the long-run total cost function can be obtained as follows:

$LRTC = 0.960954P - 0.000285P^2 + 0.0000000652P^3$--- (1)

This function is a polynomial and of the third degree, which reflects the relationship between total costs and production volume.

5.1 Economic derivatives of the cost function:

A. Long-term average costs (LRATC): The equation for average total costs can be extracted by dividing the equation for total costs No.(1) by the value of production, and the equation for average costs in the long run was as follows:

$$\text{LRATC} = \frac{\text{LRTC}}{\text{P}} = \frac{(0.960954P - 0.000285P^2 + 0.0000000652P^3)}{P}$$

$$\text{LRATC} = 0.960954 - 0.000285P + 0.0000000652P^2 \text{--- (2)}$$

B. Long-run marginal costs (LMC): They are found by deriving the total cost equation No. (1) with respect to the value of production, and thus we obtain the marginal cost equation.

$$\text{LMC} = \frac{\text{d LRTC}}{\text{d P}} = 0.960954 - 0.00057\,P + 0.0000001956\,P^2 \text{---(3)}$$

C. The optimal production volume for food industries:

The optimal production volume can be determined by equating the average total costs with the marginal costs of the agency industry:

LMC = LRATC

$$0.960954 - 0.00057\,P + 0.0000001956\,P^2 = 0.960954 - 0.000285\,P + 0.0000000652P^2$$

$$-0.000285\,P + 0.00000013\,P^2 = 0$$

$$0.00000013\,P^2 = 0.000285\,P$$

$$0.00000013\,P = 0.000285$$

$$P = \frac{0.000285}{0.00000013} = 2192.3 \text{ billion dinars}$$

When comparing the average actual production with the optimal production, we find that the average actual production is less than the optimal production, with the former reaching (1606.5 billion dinars) [2] , while the latter reached (2192.3 billion dinars). This confirms that the food industry, during the paper period, did not achieve the optimal production level. This is because the food industries are still in the first stage of production, a stage characterized by high production costs and low output at the same time.

D. Elasticity of production costs (ETC): Cost elasticity can be obtained by dividing marginal costs by average costs.

$$\text{ETC} = \frac{LMC}{LRATC} = \frac{0.960954 - 0.00057\,(1606.5) + 0.0000001956\,(1606.5)^2}{0.960954 - 0.000285(1606.5) + 0.0000000652(1606.5)^2} = 0.819$$

The elasticity of costs ETC= 0.819, This means that increasing production by one unit leads to an increase in costs by (0.819). Therefore, there is a possibility to increase production for the purpose of achieving more profits as long as the increase in costs is less than the increase in production .

6.Conclusions:

We conclude from the statistical estimates that the cubic function is one of the best functions in representing the relationship between production and costs for the food industries and that the cubic function is the one that passed the statistical and standard tests and met the criteria of economic theory. The food industries have not yet reached the optimal production volume, as the average actual production reached (1606.5 billion dinars), which is less than the optimal production volume, which reached (2192.3 billion dinars), this is due to the cost inflation and low production, which indicates that the food industries are still in the first stage of production, characterized by the absence of economic efficiency in production, as for cost elasticity, it reached (0.819), which means that increasing production by one unit leads to an increase in costs by (0.819), so there is a possibility to increase production to achieve more profits as long as the increase in costs is less than the increase in production.

[2] Extracted by the researcher based on the data presented in Table 1, with the assistance of Microsoft Excel.

Authors Declaration:

Conflicts of Interest: None

-We Hereby Confirm That All The Figures and Tables In The Manuscript Are Mine and Ours. Besides, The Figures and Images, which are Not Mine, Have Been Permitted Republication and Attached to The Manuscript.

- Ethical Clearance: The Research Was Approved by The Local Ethical Committee in The University.

References:

Abbas, A. (2019). Modern technology and its role in the development of Iraq's food industries. *Arab Journals Platform*, 34(7), 45–59.

Abd al-Nabi, N. al-D. (2021). Benchmark estimate of some of the most important factors affecting Libya's agricultural production and estimate the optimal production of the most important crops produced in Libya's agricultural sector. *The Scientific Journal of University of Benghazi*, 34(1), 12.

AL- HALLK, R., AL-ALI, J., & AL-DMAN, E. (2020). Inspection of production costs and determination of optimal size of sugar chondar production in the jungle. *Hama University Journal*, *3*(14), 78–89.

AL-badree, huseen, & AL-keatee, A. (2022). Analysis of the economic reality of the food industries in Iraq, with special reference to Karbala Governorate for the period from (2014-2020). *Al Kut Journal of Economics and Administrative Sciences*, *14*(45), 134–150.

Al-Janabi, S. M., Albander, M. H. M., & Mashkour, S. J. (2023). Effect of Financial Independence on Reducing Risk of Financial Fragility. *International Journal of Professional Business Review*, 8(6), 91–107.

AL-Nooar.M. (2019). Analysis and estimation of the short-term cost function (case study of the Tebessa Cement Company (SCT)). *Journal of the College of Economic Sciences, Commercial Sciences and Management Sciences*, 12(34), 123–148.

AL-OMARE, M. (2022). *Principles of microeconomics* (1st ed.). Iraq Publishing Office - PP BAGHDAD.

Al Aidi SABAH Mehdi. (2021). *Analysis of the competitiveness and requirements of the food industry sector in Iraq's economy for the period 2003-2018(Master's thesis, Al-Mustansiriya University)*.

Al Mosaoy, D., & Hasan, W. (2022). Cost of quality and competitive advantage: empirical evidence from food industry in Iraq. *Central Asia And The Caucasus*, *23*(5), 1–12.

Alfadeely, M., & Khalf, F. (2021). The role of food industries in achieving interconnections between productive sectors and economic diversification in iraq. *Iraqi Journal of Economic Sciences*, *2021*(70), 101–119.

Ali, A., & Aloosh, J. (2023). An economic analysis of the reality of the manufacturing sector in iraq and its performance indicators for the period (2004_2020). *Wasit Journal for Human Sciences*, *19*(54), 11–32.

Aslih, S. (2023). Estimating the cost and production function in the food industry sector (a standard study on Palestine),. *Islamic University Journal*, *12*(24), 23-45 PP-Islamic University Journal.

Bekheet, H. N., Al Sudany, N. K., & Najm, S. S. (2023). Iraqi economy and renewable energy projects between economic necessity and investment challenges. *International Journal of Professional Business Review: Int. J. Prof. Bus. Rev.*, *8*(8), 71.

Drebee, H. A., & Abdul-Razak, N. A. (2020). The impact of corruption on agriculture sector in Iraq: econometrics approach. *IOP Conference Series: Earth and Environmental Science*, *553*(1), 12019.

Farhin, M., hameed, O., & ZEEA, A. (2023). Estimating and analyzing the cost function for Diyala General Company during the period (2002-2021). *Journal of Business Economics for Applied Research*, *4*(5), 379–396.

H.L, A. (2019). *Principles of Microeconomics, 22e*. S. Chand Publishing.

HABSH, B., ISMAEEL, S., & TAHA, Z. (2020). The reality of manufacturing industries and ways to reduce the rentier economy in Iraq (a future vision). *Journal of Economics and Administrative Sciences*, *26*(119), 417–427.

Hammad, S. A., Shallal, A. A. H., Allah, A. K. A., Faisal, F. G., & Abdullah, T. H. (2023). The Impact of Public Spending on Unemployment: A Study on the Iraqi Economy for the Period 2004-2021. *Global Journal of Economics & Business*, *13*(4), 22–37.

Iraqi Ministry of Planning, C. B. of S. (2019). *Report on industries in Iraq*. Central Bureau of Statistics/Directorate of Industrial Statistics.

ismail, I., & abbas, arkan. (2024). Food Industries, Their Importance, Characteristics, Types and Historical Development in Iraq and Misan Governorate for 2021. *Journal of the College of Basic Education*, *29*(122), 429–447.

Jabbar Shahab, S. (2019). The economic importance of Iraq's food industries (compared to global economic indicators). *Iraqi Journal of Market Research and Consumer Protection*, *1*(10), 116–130.

Kripfganz, S., & Schneider, D. C. (2023). ardl: Estimating autoregressive distributed lag and equilibrium correction models. *The Stata Journal*, *23*(4), 983–1019.

MAJEED, A., & AHMEED. (2022). A breakdown of the reality of food products and their diversity in kalar district. *Journal of Kurdistani for Strategic Studies*, *3*(5), 23–45.

Mekhlef, S., & Mohamed, A. (2020). The problems and obstacles that stopped large industrial manufacturing in three governments (Baghdad, Basra and Al-anbar). *Dirasat: Human and Social Sciences*, *47*(2), 276–293.

Myers, K. (2020). The elasticity of science. *American Economic Journal: Applied Economics*, *12*(4), 103–134.

Nadhir, A. muhamad, & Rashid Al-Ani, T. M. (2020). Global developments and their repercussions on the international competitiveness of industry in iraq - theoretical research. *Journal of Economics and Administrative Sciences*, *26*(124), 341–361.

Najm Aboud, A. (2021). Optimal use of certain economic resources and its impact on the development of industry realities in the Islamic economy perspective. *Iraqi Journal of Economic Sciences*, *21*(70), 24–40.

Razika, M. (2020). *Micro-economy: Resilience* (2nd ed.). Academic Book Center PP - Amman.

SALEH, T. (2022). *Determining the optimal production volume for the Abu Ghraib dairy factory using linear programming(Master's thesis, Al-Mustansiriya University)*.

Shapiro, D., MacDonald, D., & Greenlaw, S. A. (2024). *Principles of Macroeconomics 3e* (3rd ed.). OpenStax PP - Houston, Texas.