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Iraqi Manufacturing Industries: Analysis and Indicators

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Abstract

The industrial sector is considered one of the main sectors in the development of the national economy and contributes effectively to the gross domestic product and national income, and the manufacturing process plays its role in the transition of the national economy to a developed economy that achieves sustainable development. The manufacturing sector is the most important sector in industrial production, has an active and influential role in the development and revitalization of the local economy of the state, and contributes effectively to building an independent economy. The research aims to shed light on this vital industrial sector and analyze its data for the period 2015–2020. According to the availability of data from the source, the analysis was done using the statistical program Minitab, and the research included conclusions, which indicate that the manufacturing industry in Iraq from 2015 to 2021 were not at the required level and were fluctuating from year to year. We recommended that the developing future visions for the development of the manufacturing industry, acquiring knowledge, relying on available resources, building an industrial development model, and harnessing the available workforce.

Keywords: Statistical indicators, production values, wages and salaries values, production requirements values, sales values, index numbers, secular trends.

1. Introduction

The manufacturing industry is the main sector in diversifying the country's economy, increasing added value, achieving self-sufficiency in goods and services, supporting the national income of the state, improving the balance of payments, raising the level of individual income, and reducing unemployment and poverty rates. Manufacturing industries contribute to reducing the phenomenon of economic instability and not relying on limited resources to finance national income, and they also contribute to strengthening the local currency, whether through exports or reducing imports of similar foreign goods, which in turn leads to the provision of foreign currency and strengthening economic independence, which enhances the political independence of the state. Manufacturing industries contribute to the acquisition of technical skills, the development of means of production and their modernization, the transformation of local raw materials and energy into finished products after providing the required capital to finance projects, and the modernization of equipment and equipment produced in order to develop the quality of their products, enter the competition, and find ways to increase demand for the local product and not customer reluctance and switch to similar or imported products. The manufacturing industry in Iraq suffered from significant backwardness as a result of the economic, political, and security conditions that the country went through, and therefore it was completely unable to support the national economy, achieve sustainable development, increase competitiveness, exit hard currency, and meet high inflation rates. The research aims to analyze the data of the manufacturing sector and discuss the role of this sector

in the development of the country's economy, achieving accelerated economic growth, providing investment opportunities, and optimizing the use of available resources and potential. The research was based on the publications of the Ministry of Planning and Development Cooperation and the Central Bureau of Statistics for the manufacturing industry sector for the period 2015–2021, depending on the availability of data from its source, and a descriptive analytical approach was used in evaluating the industrial development process.

2. Methods and Data

Table 1 shows the variables that were used in the analysis related to manufacturing industries, namely, the number of establishments, the number of employees, the value of production, the value of production supplies, wages and salaries, and the value of sales. It is clear that the number of establishments was in decline for the years 2016–2019 and began to rise for the subsequent two years of the series. As for the number of employees, there is a fluctuation and a decrease; counting in 2019, there was a noticeable increase (133998) (Figure 1). Table 2 shows the normality test of the variables, which was normalized by the Kolmogorov-Smirnov and Shapiro-Wilk test.

Table (1): Manufacturing Industry Activities

Years	No. Factories	No. Employee	Production Value (Billion)	Wages & Salaries (Billion)	Production Requirements Value (Billion)	Sales Value (Billion)
2015	618	128456	4229	1305	2271	3912
2016	564	109014	4964	1246	2810	4963
2017	583	110818	5995	1428	3488	5649
2018	598	114057	6399	1444	3865	6120
2019	616	133998	7310	1542	3822	7840
2020	716	125292	6714	1397	3475	6068
2021	779	114428	8226	1456	4211	7641

Source: Ministry of Planning and Development Cooperation / Central Statistics Organization / Industrial Sector Bulletins 2021, elaborated by author [8].

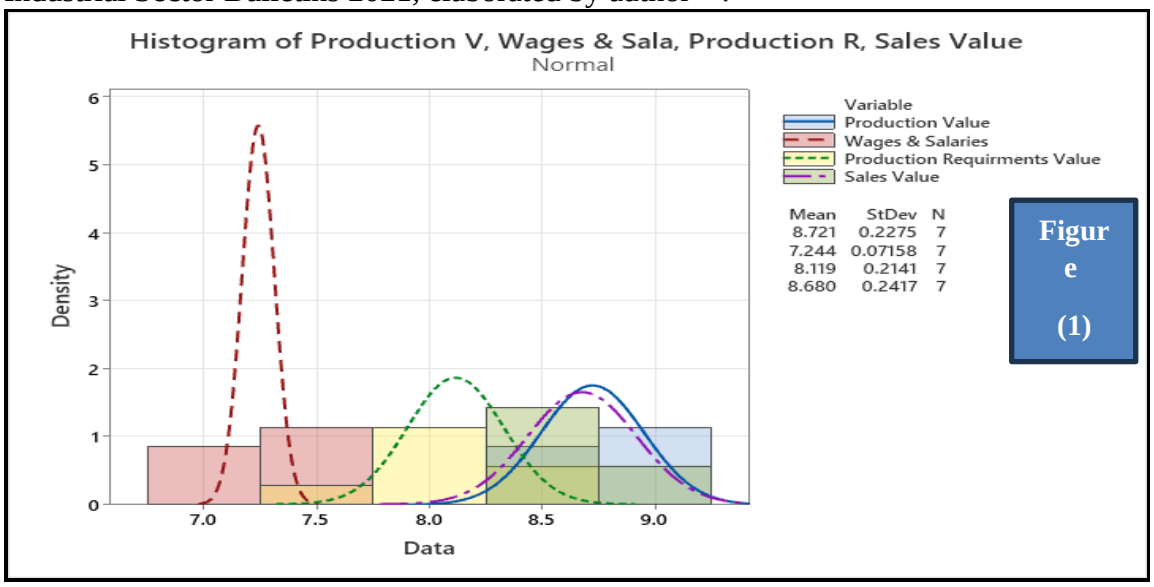

Figure (1)

Source: Minitab program chart outputs, elaborated by the author.

Table (2): Tests of Normality

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
No. Employee	.263	7	.156	.900	7	.332
Production Value	.175	7	.200*	.967	7	.874
Sales Value	.149	7	.200*	.944	7	.678
Wages & Salaries	.204	7	.200*	.947	7	.705
Production Requirements Value	.278	7	.109	.890	7	.274

Source: Minitab program outputs, elaborated by the author.

3. Statistical Analysis

3.1 Econometrics Production Model

To analyze the data of the manufacturing sector in Iraq for the period 2015–2021, as shown in Table 1, the Cobb-Douglas function for production was used using the statistical program (Minitab) for analysis.

The mathematical formula of the Cobb-Douglas function is[2];

$$Y_i = \beta_0 X_1^{\beta_1} X_2^{\beta_2} e^{u_i} \qquad (1)$$

Where;

Y_i: output

X_1: Labor input

X_2: Capital input

u_i: Stochastic distturbance term

e: Base of natural logarithm

β_0: Efficiency Parameter

β_1: Labour Elasticity

β_2: Capital Elasticity

Equation (1) turns to be nonlinear relation between input and output. Taking logarithm;

$$\ln Y_i = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + u_i \qquad (2)$$

We can get some economic indicators by using Cobb-Douglas function as;

- ❖ Production process density, which has three cases;
  - ➢ Production process intensified for labor factor

$$\frac{\beta_1}{\beta_2} > 1 \qquad (3)$$

  - ➢ Production process intensified for capital

$$\frac{\beta_1}{\beta_2} < 1 \qquad (4)$$

  - ➢ Production process intensified for production factors

$$\frac{\beta_1}{\beta_2} = 1 \qquad (5)$$

- ❖ The share of the element in the production process
  - Share of labor in the production process

$$\delta_1 = \frac{\beta_1}{\beta_1 + \beta_2} \qquad (6)$$

  - The share of the capital in the production process

$$\delta_2 = \frac{\beta_2}{\beta_1+\beta_2} \quad (7)$$

❖ Scale Revenue

It is the production response to the increase of all inputs:

✓ Stability of scale revenue

$$\beta_1 + \beta_2 = 1 \quad (8)$$

✓ Increasing of scale revenue

$$\beta_1 + \beta_2 > 1 \quad (9)$$

✓ Decline of scale revenue

$$\beta_1 + \beta_2 < 1 \quad (10)$$

For the purpose of estimating Cobb-Douglas function using the data in Table (1);

- **The dependent variables are defined as**:

Y_1: $Production\ Value$

Y_2: Sales Value

- **The independent variables are;**

X_1: Employee Number

X_2: Wages & Salaries

X_3: Production Requirements Value

A. Production Value as a dependent variable (Y_1), employee number (X_1), and production requirements value (X_3), as independent variables.

Table (2): Regression Equation

Production Value	=	-5.61 + 0.499 No. Employee + 1.046 Production Requirements Value

Source: Minitab program outputs, elaborated by the author.

Table (3): Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	**-5.61**	3.94	-1.42	0.227	
No. Employee	**0.499**	0.315	1.58	0.188	**1.02**
Production Requirements Value	**1.046**	0.118	8.85	0.001	**1.02**

Source: Minitab program outputs, elaborated by the author.

Table (4): Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.0613838	**95.14%**	92.72%	89.43%

Source: Minitab program outputs, elaborated by the author.

Table (5): Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	0.295365	0.147683	**39.19**	**0.002**
No. Employee	1	0.009451	0.009451	2.51	0.188
Production Requirements Value	1	0.294965	0.294965	78.28	0.001
Error	4	0.015072	0.003768		
Total	6	0.310437			

Source: Minitab program outputs, elaborated by the author.

Table (6): Durbin-Watson Statistic

Durbin-Watson Statistic =	**1.952319**

Source: Minitab program outputs, elaborated by the author.

From tables (2 – 6) above, we get;

- The estimated regression equation that represents the production function equation is:

$$\widehat{ln\,Y_1} = -5.61 + 0.499\ ln\,X_1 + 1.046\ ln\,X_3$$

This estimated equation means that an increase in the input component by (100%), leads to an increase in the value of production by (49.9%), while an increase in the input product by (100%) leads to an increase in the value of production by (104.6%).

- The value of the determination coefficient of the estimated model was ($R^2 = 0.9514$), i.e., the independent variables (number of employees, the requirements production value) explain about (95%) of the changes in the value of production, while the remaining (5%) due to unexplained factors within random error.
- The calculated value (F) is (39.19) which is significant with P- value (0.002).
- Durbin – Watson value was (1.95), VIF value was (1.02), which means there is no autocorrelation or multicollinearity problem in the model.
- Production process density for Cobb – Douglas was ($\frac{\beta_1}{\beta_3} = 0.47$) which means that the process intensified for input value.
- Scale revenue ($\beta_1 + \beta_3 = 1.54$) means increasing in scale revenue.
- Element share in the production process

✓ Employee share

$$\delta_1 = \frac{\beta_1}{\beta_1 + \beta_3} = 0.32$$

✓ Production requirments value share

$$\delta_2 = \frac{\beta_3}{\beta_1 + \beta_3} = 0.67$$

- Mean Square Error was very weak, ($MSE = 0.0613838$), which means the model with high significance.

B. Production value as a dependent variable (Y_1), wage & salaries (X_2), and requirements production value (X_3), as independent variables.

From tables (7 – 11), below, we get:

- The estimated regression equation that represents the production function equation is:

$$\widehat{\ln Y_1} = -1.38 + 0.362\ \ln X_2 + 0.921\ \ln X_3$$

This estimated equation means that an increase in the input component by (100%), leads to an increase in the value of production by (36.2%), while an increase in the input product by (100%) leads to an increase in the value of production by (92.1%).

- The value of the determination coefficient of the estimated model was ($R^2 = 0.9254$), i.e the independent variables (wages and salaries, the requirements production value) explain about (93%) of the changes in the value of production, while the remaining (7%) due to unexplained factors within random error.
- The calculated value (F) is (24.82) which is significant with P- value (0.006).

- Durbin – Watson value was (1.905602), VIF value was (2.13), which means there is no autocorrelation or multicollinearity problem in the model.
- Production process density for Cobb – Douglas was ($\frac{\beta_2}{\beta_3} = 0.39$) which means that the process intensified for input value.
- Scale revenue ($\beta_2 + \beta_3 = 1.28$) means increasing in scale revenue.
- Element share in the production process

✓ Employee share

$$\delta_3 = \frac{\beta_2}{\beta_2 + \beta_3} = 0.28$$

✓ Supplies value share

$$\delta_4 = \frac{\beta_3}{\beta_2 + \beta_3} = 0.71$$

- Mean square error was very weak, ($MSE = 0.0760711$), means the model is highly significance.

Table (7): Regression Equation

Production Value	=	-1.38 + 0.362 Wages & Salaries + 0.921 Production Requirements Value

Source: Minitab program outputs, elaborated by the author.

Table (8): Coefficients

Term	**Coef**	**SE Coef**	**T-Value**	**P-Value**	**VIF**
Constant	**-1.38**	3.93	-0.35	0.743	
Wages & Salaries	**0.362**	0.743	0.49	0.651	**2.13**
Production Requirements Value	**0.921**	0.248	3.71	0.021	**2.13**

Source: Minitab program outputs, elaborated by the author.

Table (9): Model Summary

S	**R-sq**	**R-sq(adj)**	**R-sq(pred)**
0.0760711	92.54%	88.82%	84.18%

Source: Minitab program outputs, elaborated by the author.

Table (10): Analysis of Variance

Source	**DF**	**Adj SS**	**Adj MS**	**F-Value**	**P-Value**
Regression	2	0.287290	0.143645	**24.82**	**0.006**
Wages & Salaries	1	0.001376	0.001376	0.24	0.651
Production Requirements Value	1	0.079589	0.079589	13.75	0.021
Error	4	0.023147	0.005787		
Total	6	0.310437			

Source: Minitab program outputs, elaborated by the author.

Table (11): Durbin-Watson Statistic

Durbin-Watson Statistic =	**1.905602**

Source: Minitab program outputs, elaborated by the author.

C. Sales value as a dependent variable (Y_2), employee number (X_1), and requirements production value (X_3) as independent variables.

Table (12): Regression Equation

Sales Value	=	-8.21 + 0.684 No. Employee + 1.096 Production Requirements Value

Source: Minitab program outputs, elaborated by the author.

Table (13): Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	**-8.21**	4.99	-1.65	0.175	
No.Employee	**0.684**	0.399	1.71	0.162	**1.02**
Production Requirements Value	**1.096**	0.150	7.32	0.002	**1.02**

Source: Minitab program outputs, elaborated by the author.

Table (14): Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.0777430	**93.10%**	89.65%	71.35%

Source: Minitab program outputs, elaborated by the author.

Table (15): Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	0.32622	0.163109	**26.99**	**0.005**
No. Employee	1	0.01775	0.017745	2.94	0.162
Production Requirements Value	1	0.32344	0.323442	53.51	0.002
Error	4	0.02418	0.006044		
Total	6	0.35039			

Source: Minitab program outputs, elaborated by the author.

Table (16): Durbin-Watson Statistic

Durbin-Watson Statistic =	**2.92929**

Source: Minitab program outputs, elaborated by the author.

From tables (12 – 16), we get;

- Regression equation which represents the production function equation is;

$$\widehat{\ln Y_2} = -8.21 + 0.684 \ln X_1 + 1.096 \ln X_3$$

This estimated equation means that an increase in the input component by (100%), leads to an increase in the value of production by (68.4%), while the increase of an input product by (100%) leads to an increase in the value of production by (109.6%).

- The value of the determination coefficient of the estimated model was ($R^2 = 0.9310$), i.e the independent variables (number of employees, the requirements production value) explain about (93%) of the changes in the value of production, while the remaining (7%) due to unexplained factors within random error.
- The calculated value (F) is (26.99) which is significant when with P- value (0.005).
- Durbin – Watson value was (2.92929), VIF values was (1.02), that means there is no autocorrelation and multicollinearity problem in the model.
- Production process density for Cobb – Douglas was ($\frac{\beta_1}{\beta_3} = 0.62$) which means that the process intensified for inputs value.
- Scale revenue ($\beta_1 + \beta_3 = 1.78$) means increasing in scale revenue.
- Element share in production process

✓ Employee share

$$\delta_5 = \frac{\beta_1}{\beta_1 + \beta_3} = 0.38$$

✓ Supplies value share

$$\delta_6 = \frac{\beta_3}{\beta_1 + \beta_3} = 0.61$$

- Mean Square Error was very weak, ($MSE = 0.077743$), means the model with high significant.

D. Sales Value as dependent variable (Y_2), wage & salaries (X_2), and requirements production value (X_3), as independent variables.

From tables (17 – 21), below, we get;

- The regression equation that represents the production function equation is:

$$\widehat{\ln Y_2} = -3.66 + 0.742 \ln X_2 + 0.857 \ln X_3$$

This estimated equation means that an increase in the input component by (100%), leads to an increase in the value of production by (74.2%), while an increase in the input product by (100%) leads to an increase in the value of production by (85.7%).

- The value of the determination coefficient of the estimated model was ($R^2 = 0.8968$), i.e the independent variables (wages and salaries, the requirements production value) explain about (90%) of the changes in the value of production, while the remaining (10%) due to unexplained factors within random error.
- The calculated value (F) is (17.39) which is significant with P- value (0.011).
- Durbin – Watson value was (2.43342), VIF value was (2.23), which means there is no autocorrelation or multicollinearity problem in the model.
- Production process density for Cobb – Douglas was ($\frac{\beta_2}{\beta_3} = 0.86$) which means that the process intensified for input value.
- Scale revenue ($\beta_2 + \beta_3 = 1.59$) means increasing in scale revenue.
- Element share in the production process

✓ Employee share

$$\delta_7 = \frac{\beta_2}{\beta_2 + \beta_3} = 0.46$$

✓ Supplies value share

$$\delta_8 = \frac{\beta_3}{\beta_2 + \beta_3} = 0.53$$

- Mean square error was very weak, ($MSE = 0.0950573$), means the model is highly significant.

Table (17): Regression Equation

Sales Value	=	-3.66 + 0.742 Wages & Salaries + 0.857 Production Requirements Value

Source: Minitab program outputs, elaborated by the author.

Table (18): Coefficients

Term	**Coef**	**SE Coef**	**T-Value**	**P-Value**	**VIF**
Constant	**-3.66**	4.91	-0.75	0.497	
Wages & Salaries	**0.742**	0.928	0.80	0.469	**2.23**
Production Requirements Value	**0.857**	0.310	2.76	0.051	**2.23**

Source: Minitab program outputs, elaborated by the author.

Table (19): Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.0950573	**89.68%**	84.53%	55.35%

Source: Minitab program outputs, elaborated by the author.

Table (20): Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	0.314250	0.157125	**17.39**	**0.011**
Wages & Salaries	1	0.005778	0.005778	0.64	0.469
Production Requirements Value	1	0.068960	0.068960	7.63	0.051
Error	4	0.036144	0.009036		
Total	6	0.350394			

Source: Minitab program outputs, elaborated by the author.

Table (21): Durbin-Watson Statistic

Durbin-Watson Statistic =	**2.43342**

Source: Minitab program outputs, elaborated by the author.

Table 22 shows the statistical measures extracted from the above analysis of the production function with other independent variables, as the best of them was between the production function and the two independent variable the number of employees and the value of production inputs, although all the measures were very close to the four functions.

Table (22): Statistical Summaries

	β_1	β_2	β_3	R^2	F	S	VIF	D.W
A	0.499	-	1.046	0.95	39.20	0.06	1.02	1.95
B	-	0.762	0.921	0.93	24.82	0.07	2.13	1.91
C	0.684	-	1.096	0.93	26.99	0.07	1.02	2.92
D	-	0.742	0.857	0.90	17.39	0.09	2.23	2.43

2.2 Index numbers

To know the development of manufacturing industrial activities during the time series 2015–2021, the index scale was used. Table 23 shows that all activities were fluctuating and unstable, and manufacturing industrial activity did not show any development.

Table (23): Manufacturing industries index numbers

Years	No. Factories	No. Employee	Production Value (Billion)	Wages & Salaries (Billion)	Production Requirements Value (Billion)	Sales Value (Billion)
2015	1.00	1.00	1.00	1.00	1.00	1.00
2016	0.91	0.84	1.17	0.95	1.23	1.26
2017	0.94	0.86	1.41	1.09	1.53	1.44
2018	0.96	0.88	1.51	1.10	1.70	1.56
2019	0.99	1.04	1.72	1.18	1.68	2.00
2020	1.15	0.97	1.58	1.07	1.53	1.55
2021	1.26	0.89	1.94	1.11	1.85	1.95

2.3 Secular Trends

To know the secular trend of manufacturing industrial activities during the time series 2015-2021, the secular trend line was used, and the figures (2,3,4, and 5) show that all the trends of activities were positive despite the fluctuation of these activities, and this is an important factor indicating the existence of the possibility of developing these industries. The equations of the general trend line were:Production Value $= 3862 + 600.2\ t$

- Wages & Salaries Value $= 1278.4 + 31\ t$
- Production Requirements Value $= 2351 + 267.3\ t$
- Sales Value $= 3801 + 557\ t$

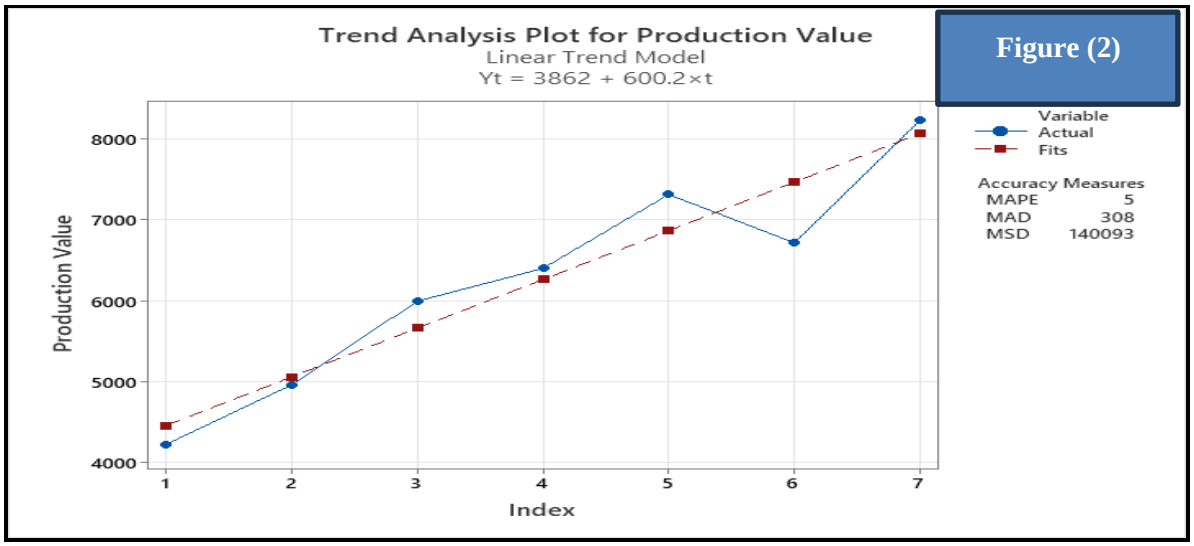

Figure (2)

Source: Minitab program outputs, elaborated by the author.

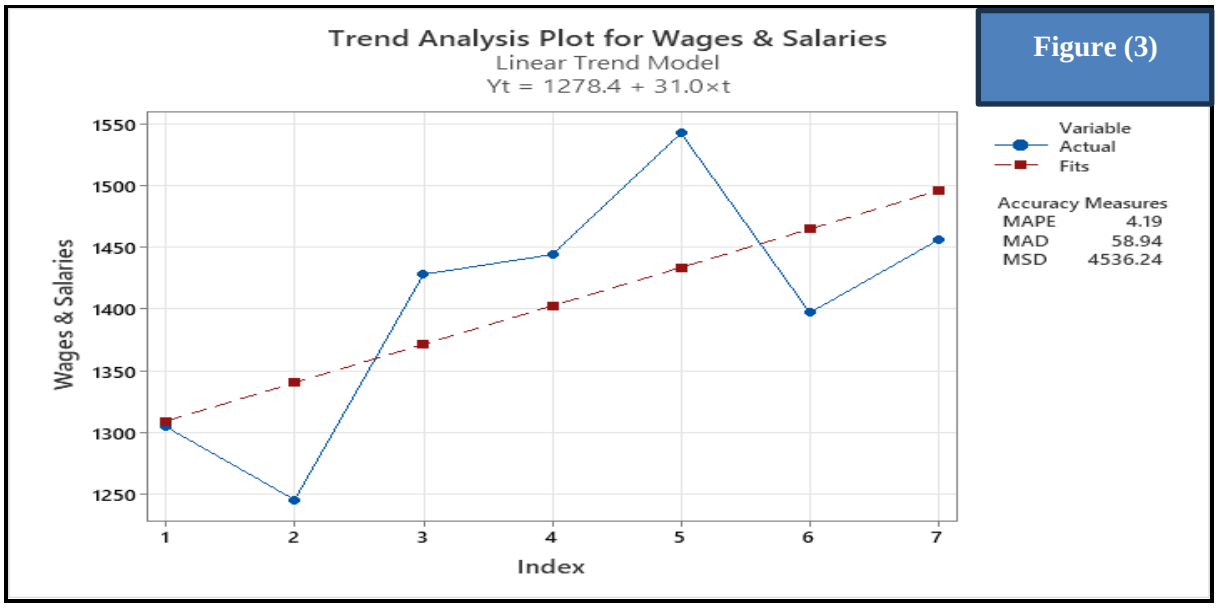

Figure (3)

Source: Minitab program outputs, elaborated by the author.

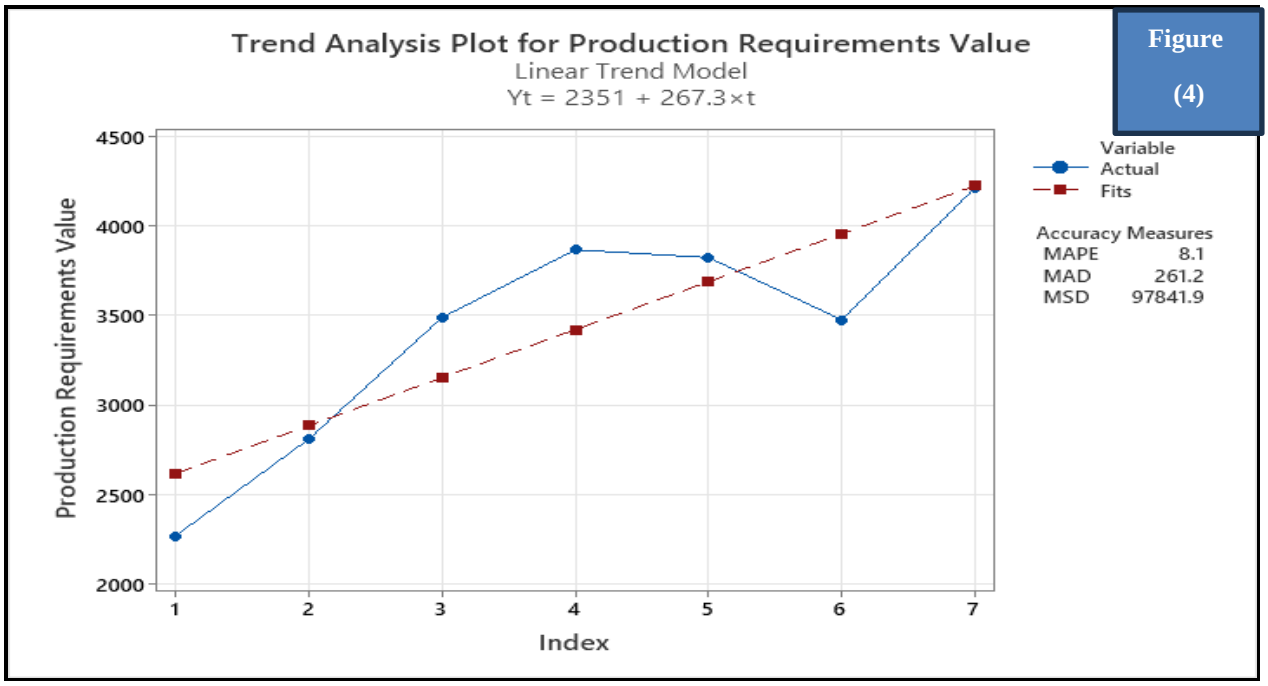

Figure (4)

Source: Minitab program outputs, elaborated by the author.

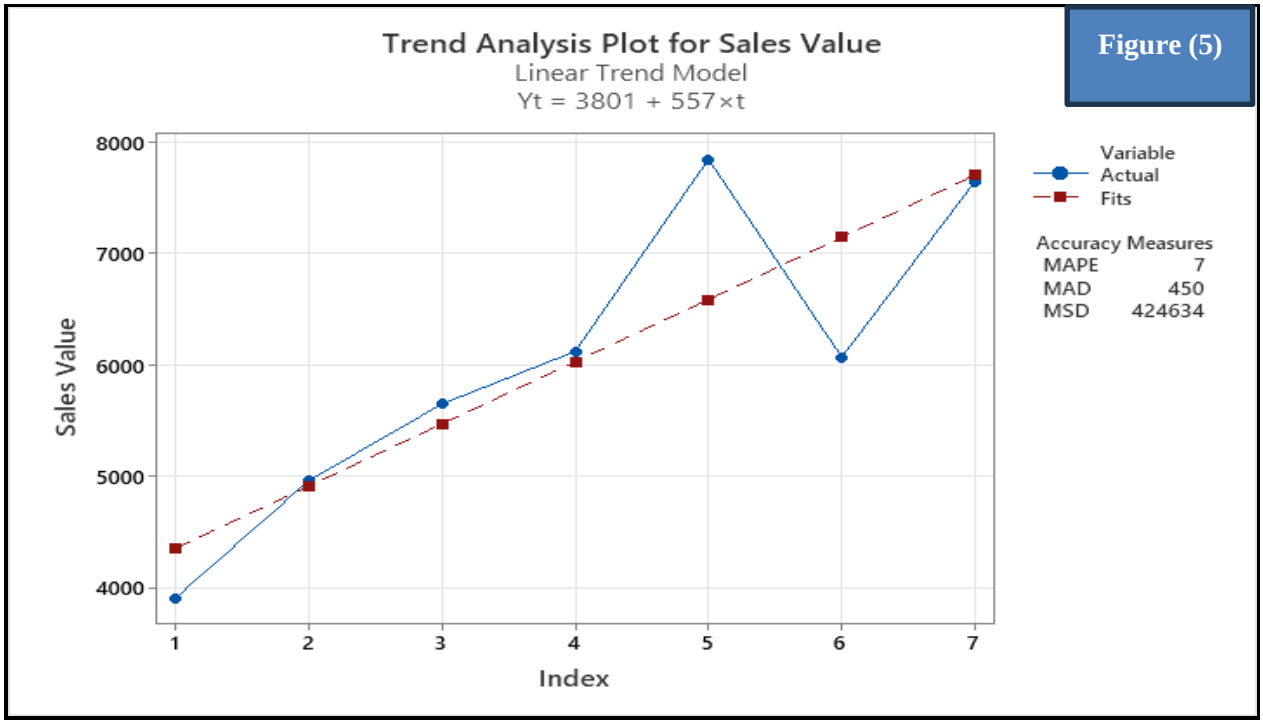

Figure (5)

Source: Minitab program outputs, elaborated by the author.

Conclusions and recommendations

1. All the statistical measures extracted for the variables under study were positive and fluctuated in very simple proportions, and this indicates that the manufacturing industries in Iraq remain ranged in place and there is a high potential in the development of this industry according to

statistical indicators that sharply encourage the development of this industry and provide the necessary support for it.

2. The indicators of the manufacturing industry in Iraq from 2015 to 2021 were not at the required level and were fluctuating from year to year, and this led to the manufacturing sector remaining lagging behind and unable to contribute to the development of the Iraqi economy. From the statistical analysis contained in the body of the research, we conclude:
3. The development of the manufacturing sector in Iraq requires reconsidering the current goals, policies, and mechanisms and making them an effective contribution to the development of the national economy.
4. Developing future visions for the development of the manufacturing industry, acquiring knowledge, relying on available resources, building an industrial development model, and harnessing the available workforce.
5. Support, assist, and develop the private sector, and provide the necessary facilities for the development of the manufacturing industry.
6. Aligning the adopted policies, strategies, and standards with the set goals and moving quickly to build a transformative industrial base that will affect the development of the national economy.
7. Encouraging local and foreign investment and providing legislative and legal facilities to build a permanent transformational industrial base.

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الصناعات التحويلية العراقية: تحليل ومؤشرات

يعتبر القطاع الصناعي من القطاعات الرئيسية في تنمية الاقتصاد الوطني ويساهم بشكل فعال في الناتج المحلي الإجمالي والدخل القومي، وتلعب عملية التصنيع دورها في انتقال الاقتصاد الوطني إلى اقتصاد متطور يحقق التنمية المستدامة. يعتبر قطاع التصنيع أهم قطاع في الإنتاج الصناعي، وله دور فاعل ومؤثر في تنمية وتنشيط الاقتصاد المحلي للدولة، ويساهم بشكل فعال في بناء اقتصاد مستقل. يهدف البحث إلى تسليط الضوء على هذا القطاع الصناعي الحيوي وتحليل بياناته للفترة 2015-2020. وبحسب توافر البيانات من المصدر، فقد تم التحليل باستخدام البرنامج الإحصائي (Minitab)، وتضمن البحث استنتاجات تشير إلى أن الصناعة التحويلية في العراق من عام 2015 إلى عام 2021 لم تكن بالمستوى المطلوب وشملتها التقلبات من سنة إلى أخرى. وأوصينا بتطوير الرؤى المستقبلية لتطوير الصناعة التحويلية، واكتساب المعرفة، والاعتماد على الموارد المتاحة، وبناء نموذج للتنمية الصناعية، وتسخير القوى العاملة المتاحة.