# The Causal relationship between Industrial GDP and Development Bank Loans using Vector Error Correction Model approach

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## ABSTRACT

The study aimed to investigate the causal relationship between Industrial GDP and Development Bank Loans in Libya using the Vector error correction (Vecm) mechanism. Time series data obtained from the Central Bank of Libya for this purpose during the period 1990-2015. The study showed many specific results based on its empirical analysis. In the beginning, the variables were not stationary at the level and became stationary at the first difference. Additionally, there is at most one co-integration vector between the series. Moreover, there is a uni-directional causal relationship running from Development Bank loans toward GDP in the long run. In the short-run, there is a causal running from development bank Loans toward the industrial GDP and there is no causal relationship running from industrial GDP toward the development bank Loans. This demonstrates the importance of development bank loans in enhancing and advancing the industrial GDP.

**Keywords**: Industrial GDP, Development Bank Loans, Con-integration, Vecm Causality, Libya.

العلاقة السببية بين الناتج المحلي الإجمالي الصناعي وقروض بنك التنمية باستخدام منهج نموذج تصحيح الخطأ المتجه

الملخص :-

هدفت الدراسة إلى التحقق من العلاقة السببية بين الناتج المحلي الإجمالي الصناعي وقروض مصرف التنمية في ليبيا باستخدام آلية تصحيح الخطأ المتجه (Vecm). بيانات السلاسل الزمنية التى استخدمت لهذا الغرض تم الحصول عليها من مصرف ليبيا المركزي خلال الفترة 1990-2015. أظهرت الدراسة العديد من النتائج المحددة بناءً على تحليلها التجريبي. في البداية لم تكن المتغيرات مستقرة عند المستوى وأصبحت مستقرة عند الفرق الأول. بالإضافة إلى ذلك ، يوجد متجه تكامل مشترك واحد على الأكثر بين السلسلة. علاوة على ذلك، هناك علاقة سببية أحادية الاتجاه تمتد من قروض بمصرف التنمية نحو الناتج المحلي الإجمالي على المدى الطويل. اما على المدى القصير، هناك علاقة سببية تمتد ايظا من قروض مصرف التنمية إلى الناتج المحلي الإجمالي الصناعي ولا توجد علاقة سببية تمتد من الناتج المحلي الإجمالي الصناعي إلى قروض بنك التنمية. وهذا يدل على أهمية قروض مصرف التنمية في تعزيز وتطوير الناتج المحلي الإجمالي الصناعي.

الكلمات المفتاحية: الناتج المحلي الإجمالي الصناعي، قروض مصرف التنمية، التكامل المشترك، نموذج تصحيح الخطأ المتجه للسببية في الاجل الطويل ، اختبار والد للسببية في الاجل القصير ليبيا.

## 1. INTRODUCTION

The industrial sector is one of the basic elements in developing countries, especially in the early stages of economic development by creating job opportunities. In addition, it generates income and produces food. Furthermore, providing food and raw materials to other sectors as well as earning foreign exchange (Sahoo and Sethi, 2012).

In Libya, the industry before the discovery of oil was represented by traditional industries, which required capital and lacked scientific and technical capabilities and trained manpower (Al-Naas, 2010). As for its contribution after the discovery of oil, it was characterized by growth and positivity in some periods. Its contribution was represented by the number of employment and the ratio of its production to local production. While it's share in the gross domestic product was about (2821) million L.D in the year 2019 (Libyan Central Bank, 2023).

Government lending plays a vital role in making loans available on more favorable terms (Desai, 2010) due to institutional loans are more useful compared to non-institutional loans from every angle because they are properly organized, available adequate loans, and at the same time ensure equitable distribution among producers as part of wider policies of economic development to increase production, ensuring greater use of modern technical inputs, promoting productivity practices and meeting the needs of producer adequately (Ghosh, 2011).

In this context, the Libyan government established the development bank in 1984 in 27 branches in main Libyan cities, which it is one of specialized public banks. It had established to create economic projects in different activities that contribute to providing job opportunities, diversifying sources of income, and achieving social stability for the citizen according to the conditions and customs of his region. These loans amounted to 1409.148 million Libyan dinars during the period (1990-2015) (Libyan Central Bank, 2023).

## 2. RESEARCH PROBLEM

The issue of developing economic activities in Libya has become an important matter dictated by the necessity of diversifying sources of national income and reducing the dependence on the oil and gas sector activity as the sole source of income. This is done by supporting the industrial and agricultural production sectors to increase their production on the one hand and meet the increasing demand for food on the other hand. The lending process played an important role in providing the necessary funds to various industrial activities through the lending process granted by the Development Bank which was founded to contribute in development rates in this sector. Therefore, the problem of the study lies in knowing to what extent the types of Development Bank loans in various industrial activities stimulate the industrial sector in increasing its GDP by knowing the causal relationship between each other and the direction of this relationship in the short and long run.

## 3. RESEARCH IMPORTANCE

In keeping the view of the study subject outlined, the importance of the study has been segregated into the following two segments:-

1. Identify the impact and interaction between industrial GDP and Development Bank loans to provide more meaningful empirical evidence results for the decision maker to improve the lending process and its effect on industrial GDP.

2. The study enriches subsequent experimental studies that relate to this topic by highlighting some points for future further researches, as well as this study is considered an addition to previous studies.

## 4. RESEARCH OBJECTIVES

The main objective of the research is to determine the causal relationships between industrial GDP and Development Bank loans and its direction.

### Specific Objectives

The following three tasks are to be accomplished to achieve the general objective of the research:

1. To description of study variables during 1990 – 2015.
2. Investigate the short-run causal relationship between industrial GDP and development bank loans.
3. Investigate the long-run causal relationship between industrial GDP and development bank loans.

## 5. PREVIOUS EMPIRICAL STUDIES

The aforementioned previous empirical studies indicate that loans play a very crucial and constructive role in accelerating the growth of Industrial GDP. Elijah (2018) employed an autoregressive distributed distribution (ARDL) model to examine the impact of bank credits on the output of the manufacturing sector in Nigeria during the period from 1986 to 2016. The study finding found that bank credits have a positive impact on the output of the manufacturing sector in the short and long term. The study recommended increasing the direction of bank credits to the industrial sector. Also in the same context, Ibrahim and Abubakar (2021) analyzed the relationship between bank credit and manufacturing sector output in Nigeria using an autoregressive nonlinear distributed (ARDL) model during the years 1981 and 2019. The results found that there is a positive effect between positive changes in bank credit and manufacturing production. The study confirmed that financing positively stimulates production growth in the manufacturing sector in the long term, with an error correction of 21%.

Furthermore, Olawumi and Ogungbenle (2022) attempted to analyze the secondary data during the period (1981- 2020) to determine the nexus relation among bank lending, economic growth, and manufacturing sector performance in Nigeria by using the ARDL model. Empirical results showed that the total loan of commercial banks has a meaningful on manufacturing sector output. Additionally, Naeem et al (2024) used time series data from 1990 to 2022 in Pakistan to assess the causal and dynamic relationship between economic growth and green finance. The results found that the long and short-term association exists between economic growth and green financial growth.

In Arabic countries, Mohieldin et al (2019) used using the time-series techniques of the ARDL procedure to determine the relationship between the development of the financial sector and economic growth in Egypt over the period 1980 to 2016. The study results showed a strong association between real growth per capita and financial development. Next, Awad and Al Karaki (2019) in their study analyzed the lending-economic growth nexus in Palestine. The study used time series data from 1996 to 2015 to estimate the production function model. The study results indicated that the long-run relationship exists among the variables and there is unidirectional causality running from GDP to bank lending. Using Vector Error Correction Model (VECM) and Granger Causality Test Ananzeh (2016) analyzed the relationship

between bank credit and economic growth in the industrial sector in Jordan over the period 1993 to 2014. The empirical results showed a long-run relationship between Real GDP, and Bank Credit for Industry sector.

In another range of studies in Turkey, Beybur (2022) utilized the Engel-Granger cointegration test and the Granger causality test to study the relationship between industrialization rates and bank loans in Turkey. The results of the study showed that all variables integrate in the long run. Besides that, there is a unidirectional causal relationship of bank loans for the manufacturing industry. Next, Uğurlu (2019) aimed to investigate the relationship between credits and economic growth during the period (2004 - 2014) using the REM model. This study was conducted on 11 nuts 1 region in Turkey. The results of the study indicated that there is a positive, statistically significant relationship between the two variables.

In the same vein, Dişbudak (2010) sought to determine the impact of GDP and banks using loan volumes at traditional and participating banks in Turkey. To achieve this purpose, quarterly data for the period 2006-2017 was used. The study findings concluded that there is a unidirectional causal relationship between reverse traditional banks. Moreover, Tekin (2021) used the Johansen co-integration test to study the causality relationships among the Islamic and conventional banks on the one hand and industrial production on the other hand. The outcome of VECM indicated that the study variables move together in the long run. Also, there is a long-run causality relationship between bank loans to industrial production.

In another study in Brazil, Schuh et al (2017) carried out a study about the Brazilian economy by examining the influence of granting of payroll loans and macroeconomic aggregates. The study used the Vector Error Correction Model (VECM) over the period 2004 to 2014. The research results reveal that the granting of payroll loans leads to an increase in macroeconomic aggregates while over longer periods this increase tends to be eliminated. Leitão (2012) sought to determine the link between bank credit and economic growth for the European Union (EU27) during the period (1990-2010) by using dynamic panel data (GMM System estimator). The research finding presented that domestic credit discourages growth

## 6. DATA AND METHODOLOGY

### 6.1. Data

The Study utilized secondary data which have been collected from the Libyan Central Bank during the period 1990 to 2015 to study the causal relationship between industrial GDP and Development bank Loans in Libya.

### 6.2. Methodology

The study uses the descriptive and quantitative analysis, where quantitative analysis employed the Johansen test for co-integration of to find whether there is co-integration or not. Then, the Granger Causality test is used to identify the short and long-run between the study variables based on the results of the Vecm model and Wald test. To achieve that; several steps

must be taken such as all the series must be stationary I(1); determine the optimal lag length (*P*) for the model; Johansen for co-integration; perform some diagnostic test; after (ect) exist and be negative and less than one, it expresses the causal relationship in long-run be exit. While the short-run causality is tested using the Wald test.

The econometric form of equation for this study will be shows as: -

$$INGDP=\int(DL) \quad (1)$$

$$INGDP= \alpha +\beta\ DL + \varepsilon_t \quad (2)$$

where:-

INGDP= Industrial Gross Domestic Product

DL= Development Bank Loans

It is clear from the above equation that Industrial GDP is the dependent variable and is affected by the Development Loans which is independent variables, where GDP is represented by the logarithm of the Industrial gross domestic product (Ln IGDP). The independent variable of this study (Ln DL) is the logarithm of the Development Bank Loans (LDL). Also, the vector error correction model formula is written as follows:-

$$\Delta LnIGDP_t = \sigma + \sum_{i=1}^{k-1} \beta_i \Delta lnLIGDP_{t-i} + \sum_{j=1}^{k-1} \Phi_j \Delta lnDL_{t-j} + \lambda_1 ECT_{t-1} + u_{1t} \quad (3)$$

$$\Delta LnDL_t = \alpha + \sum_{i=1}^{k-1} \beta_i \Delta lnLIGDP_{t-i} + \sum_{i=1}^{k-1} \Phi_j \Delta lnLDL_{t-j} + \lambda_1 ECT_{t-1} + u_{2t} \quad (4)$$

Where:

$K_{-1}$= the laq length is reduced by1

$\beta_i$ , $\Phi_j$ = short-run dynamic coefficients of the models adjustment long-run equilibrium

$\lambda_1$= speed of adjustment parameter with a negative sign

$ECT_{t-1}$= the error correction term is the lagged value of the residuals obtained from the cointegrating regression of the dependent variable on the regressors. Contains long-run information derived from the long-run cointegrating relationship.

$u_{it}$ = residuals (stochastic error terms often called impulses, or innovations or shocks).

## 7. Results and Discussion

## 7.1. Description of study variables during 1990 – 2015.

Economic planning in Libya has taken place since the 1960s, after the discovery of oil. The general strategy of development was to maximize the growth rates of the primary economic activities as the manufacturing and agricultural sectors. This process is based on the diversification of income sources, so the country can become self-sufficient and not rely on oil as the sole source of income.

Based on Table 1, the Industrial GDP increased during the study period from 457.66 million LD in 1970 to 2786.3 million LD in 2015, with an annual average of 1959.508 million LD. The highest value was 5011.3 million LD in 2008, while the lowest value was 457.6 million LD in 1990, as shown in Figure 1.

**Table1.Development of Industrial GDP and Development bank loans trend in Libya (Million LD)**

| Years | Industrial GDP | Years | Industrial GDP | Years | Development Bank Loans | Years | Development Bank Loans |
|---|---|---|---|---|---|---|---|
| 1990 | 457.6 | 2003 | 764.7 | 1990 | 4.0051 | 2003 | 77.8257 |
| 1991 | 476.1 | 2004 | 2451.8 | 1991 | 1.7196 | 2004 | 36.0228 |
| 1992 | 555.0 | 2005 | 3124.8 | 1992 | 2.5476 | 2005 | 254.408 |
| 1993 | 699.6 | 2006 | 3602.6 | 1993 | 1.4412 | 2006 | 177.4763 |
| 1994 | 604.0 | 2007 | 4032.1 | 1994 | 1.1806 | 2007 | 221.9399 |
| 1995 | 743.1 | 2008 | 5011.3 | 1995 | 1.4905 | 2008 | 60.9685 |
| 1996 | 702.9 | 2009 | 4299.1 | 1996 | 8.0409 | 2009 | 86.7847 |
| 1997 | 818.6 | 2010 | 4463.0 | 1997 | 27.0817 | 2010 | 89.4703 |
| 1998 | 779.3 | 2011 | 1163.0 | 1998 | 2.5316 | 2011 | 121.1152 |
| 1999 | 863.1 | 2012 | 3795.7 | 1999 | 3.5834 | 2012 | 51.4364 |
| 2000 | 889.7 | 2013 | 2840.2 | 2000 | 20.7218 | 2013 | 25.4289 |
| 2001 | 877.8 | 2014 | 3332.7 | 2001 | 31.7042 | 2014 | 28.3192 |
| 2002 | 813.1 | 2015 | 2786.3 | 2002 | 69.1666 | 2015 | 2.7372 |

Source: Economic Bulletin, Statistics and Researches Department, Central Bank of Libya. Various bulletins

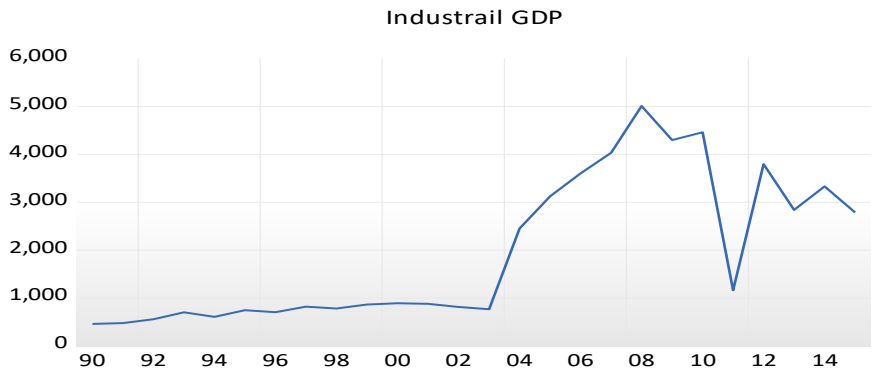


Figure1. The Industrial Gross Domestic Product in Million LYD trend during 1990-2015.

As for the development bank loans attach to several industrial activities. This production importance aims to secure production requirements so that an effective contribution to reach the self-sufficiency of industrial products is made. The Development Bank is aware of the sensitivity of this important topic, so it is doing all that it can financially and technically to advance industrial activities. This procedure also intends to develop industrial communities and contribute to the promotion of job opportunities, through providing loans to unemployed individuals focused on industrial activities.

In the development bank loans, table 1 shows the value of loans granted by the development bank that were given to individuals to cover their industrial activities such as the food industry, building materials, chemical and plastics industries, metal industrial, textile industry, furniture industry, Industrial services, and other industrial activities. The total disbursement of these industrial activities during the 90 -2015 period was 1409.148 million LYD, with an annual average of 54.198 million LD. The highest value was 254.408 million LYD in 2005, while the lowest value was 1.8106 million LYD in 1990, as shown in Figure 2.

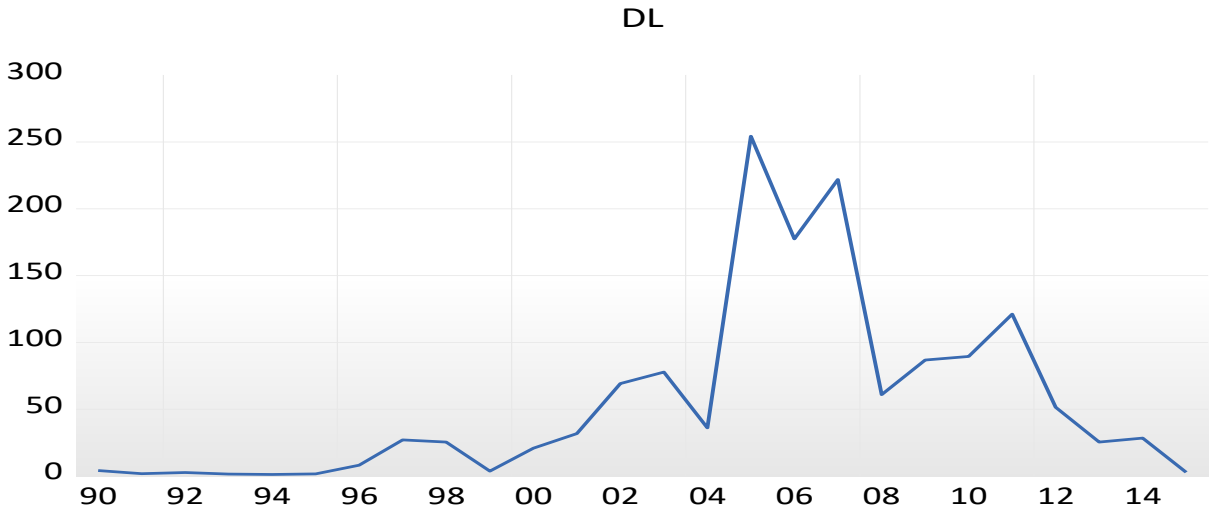


Figure2. The Development Banks Loans in Million LYD trend during 1990-2015

## 7.2. Unit roots Test

Many economic and financial time series exhibit trending behavior or non-stationarity in the mean (Zivot et al, 2003). Therefore, a stationary test must be conducted for the study variables to ensure that they are stationary at the first difference to use the VECM model. For this purpose, the Augmented Dickey-Fuller (ADF) and Philips-Peron unit root tests were used. Accordingly in Table 2, the (ADF) and (PP) test results revealed that the two variables were not stationary at level and became stationary at the first difference.

**Table 2: ADF and PP Stationary Test Results Variables**

| Variables | ADF | | PP | | Decision |
|---|---|---|---|---|---|
| | Level | First Difference | Level | First Difference | |
| Ln INGDP | -1.610969 | -7.210491 | -1.458086 | -7.210491 | I(1) |
| Ln DL | -1.485111 | -4.871453 | -1.397294 | -4.847241 | I(1) |
| Critical Values | | | | | |
| 1%* | | | | | |
| 5%* | -3.72400 | -3.737853 | -3.724070 | -3.737853 | |
| 10%* | -2.986225 | -2.991878 | -2.986225 | -2.991878 | |
| | -2.632604 | -2.635542 | -2.632604 | -2.635542 | |

Note: Ln INGDP = Industrial gross domestic products; Ln DL= loans of development Bank.

To select the appropriate lag, the Akaike Information Criterion (AIC) for order selection criteria was used. In this research, the optimal based on AIC which can be performed in a small sample (Enders, 2004). Following the AIC, the optimal lag for is two as shown in Table 3.

**Table 3. VAR Lag Order Selection Criteria**

| Lag | AIC | SC |
|---|---|---|
| 0 | 42.46334 | 42.56151 |
| 1 | 41.32300 | 41.61751* |
| 2 | 41.28749* | 41.77835 |

* indicates lag order selected by the criterion
AIC: Akaike information criterion
SC: Schwarz information criterion

## 7.3. Cointegration Test

Co-integration describes a long-term relationship between variables. In Johansen co-integrating tests context, there are two tests used; the trace and the max-Eigen test. Based on the co-integration results in Table 4, the statistics value of Track and Maximum- Eigen values statistics were greater than the critical values at 5%. That indicates that there is at most one co-integration vector between the series.

**Table 4: Johansen Cointegration Test**

| Hypothesized no .of CE(s) | Trace Statistic | 5% critical Value | Max-Eigen Statistic | 5% Critical Value |
|---|---|---|---|---|
| Non* | 26.56775 | 15.49471 | 22.93095 | 14.26460 |
| At most 1 | 3.636796 | 3.841466 | 3.636796 | 3.841466 |

Trace and Max-Eigen value test indicate 1 cointegration eqn (s) at the 0.05 level.

## 7.4. Long Run Causality Test

The process of long-run causality by using the vector error correction mechanism takes place after co-integration among the study variables exists. The error correction factor (ECT), C (1), and C(7) indicate that there is a positive long-run causality from development bank

loans bank to industrial GDP and vice versa when C1 and C(7) are negative and statistically significant. The C (1) refers to the long-run causality relationship from development bank loans bank toward industrial GDP which its equation was estimated as follows:-

D(LIGDP) = C(1)*( LIGDP(-1) - 0.395336591073*LDL(-1) - 3.34564290051) + C(2)*D(LIGDP(-1)) + C(3)*D(LIGDP(-2)) + C(4)*D(LDL(-1)) + C(5). (5)

**Table5. Long-run causality relationship**

| | Coefficient | Std. Error | t-Statistic | Prob |
|---|---|---|---|---|
| C1* | **-0.789578** | 0.207735 | -3.800893 | **0.0014** |
| C2 | -0.022888 | 0.206092 | -0.111059 | 0.9129 |
| C3 | 0.157184 | 0.186485 | 0.842878 | 0.4110 |
| C4 | -0.261034 | 0.103745 | -2.516108 | 0.0222 |
| C5 | -0.204051 | 0.094039 | -2.169860 | 0.0445 |
| C6 | 0.107805 | 0.080390 | 1.341013 | 0.1976 |

Source: Eviews version 12 outputs

The results in Table 5 showed that C (1) is negative (- 0.789578) and significant (0.0014), this shows that there is a long-run positive causality relationship from the development Loans toward industrial GDP.

As for the C (7), which refers to the long-run causality relationship from industrial GDP toward development bank loans and its equation was as follows:-

D(LDL) = C(7)*( LIGDP(-1) - 0.395336591073*LDL(-1) - 3.34564290051 ) + C(8)*D(LIGDP(-1)) + C(9)*D(LIGDP(-2)) + C(10)*D(LDL(-1)) + C(11) *D(LDL(-2)) + C(12). (6)

From Table 6, it is clear that the ECT, C (7) was negative but insignificant, which indicates that there is no long-run causal relationship from industrial GDP toward Development Bank loans. Therefore, the conclusion from Tables 5 and 6, there is a uni-directional causal relationship running from Development Bank loans toward GDP and there is no causal relationship running from Industrial GDP toward Development Bank Loans. This means that industrial GDP does not cause development bank loans in the long-run.

**Table6. Long-run causality relationship**

| | Coefficient | Std. Error | t-Statistic | Prob |
|---|---|---|---|---|
| **C(7)*** | **-0.284827** | 0.691284 | -0.412026 | **0.6855** |
| C(8) | 0.716912 | 0.685817 | 1.045339 | 0.3105 |
| C(9) | 0.546187 | 0.620569 | 0.880139 | 0.3911 |
| C(10) | -0.234578 | 0.345236 | -0.679471 | 0.5060 |
| C(11) | -0.226292 | 0.312935 | -0.723128 | 0.4794 |
| C(12) | -0.054130 | 0.267517 | -0.202341 | 0.8421 |

Source: Eviews version 12 outputs

## 7.5. Short Run Causality

Table 7 and Table 8 showed causality test results based on the Wald causality test in the short run. The results of the Wald test in Table 7 indicate there is short-run causality running from Development Bank Loans towards the Industrial GDP because; the probability of $\chi 2$ is (0.02) less than 5%. On the reverse side, there is no short-run causal relationship from the industrial GDP toward the Development Bank loans, because; the probability of $\chi 2$ is (0.51) greater than 5%. That means there is no causal relation in the short-run running from the industrial GDP towards Development Bank Loans.

**Table 7: Results of Wald Test**

| Wald test statistic | Value | df | Probability |
|---|---|---|---|
| Chi-square | 7.793039 | 2 | **0.0203** |
| Null Hypothesis: C(4)=C(5)=0 | | | |

Source: Eviews version 12 outputs

**Table 8: Results of Wald Test**

| Wald test statistic | Value | df | Probability |
|---|---|---|---|
| Chi-square | 1.335376 | 2 | **0.5129** |
| Null Hypothesis: C(8)=C(9)=0 | | | |

Source: Eviews version 12 outputs

## 7.6. Diagnostic tests

The diagnostic tests as shown in Table 9 confirm that the model does not suffer from any problems, as it was noted that there is an absence of both serial correlation and heteroskedasticity, because; their probability is greater than 5%.. In addition, the model follows a normal distribution

**Table 9: Diagnostic tests**

| Test | Probability |
|---|---|
| Serial Correlation LM Test | 0.320 |
| Heteroskedasticity Test | 0.830 |
| Normality test Jarque-Bera | 0.889 |

Source: Eviews version 12 outputs

## 8. Recommendations

Based on the study results that emphasized on the role of development bank loans in the effect and stimulating the industrial GDP. Therefore, the study recommends the following recommendations.

1- Formulating policies to ensure that industrial loans is able to absorb the benefits of industrial production activities by creating loans schemes that will focus on serious individuals who want to contribute to increasing industrial production.

2- Linking the bank granting loans with the production process.

3- Implementing policies that will develop industrial loans supply process. It will be through increase the industrial granting without the need to borrow to process its actions because the Libyan development Bank has well capitalization which is funded by the Libyan government and does not need to borrow to fund its actions and achieve more granting loans. Thus, the policy maker depends on this advantage to elaborate on industrial loans granting to the serious and needy individuals to increase industrial production growth.

4- The industrial loans is playing a vital role in supporting serious and needy individuals in the production operations, especially for needy individuals in difficult conditions. Loans planners can be guided by comparison between the Loans process before and after the application of loans program after considering to each separately problem and find a solution to it.

5- The government should increase the allocation of funds from GDP to the development bank and link credit granting to the production process and increase surveillance in the use of this Loans.

6- In the charge of the disbursement of Loans to avoid giving cash to individuals who are not need it, particularly the non-serious individuals.

7- The repayment of loans capacity to ensure that they are able to pay and recycle the loans process.

8- Carrying out consistent visits to the individuals who benefit from these loans in the industrial projects.

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