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The Impact of Financial Development on Bank Investment in Iraq

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Abstract:

Theoretically, the literature indicates that financial development has a positive effect on investment. therefore this study aim to determine the impact of the financial development on investment banking in iraq, during the semi-annual period (2005-2021) using autoregressive distributed lag (ardl), and using the toda yamamoto causal test, the result of the bound test (ardl) showed a long-term cointegration relationship between variables , the model showed that the financial depth positively affect the investment banks against the negative effect of the long-term financial stability index, while toda yamamoto causal test showed that there is no causal relationship between financial development and investment banking.

Paper type: Research paper.

Keywords: Financial development in Iraq , Investment bank in Iraq , ARDL model , Toda Yamamoto causal test.

1. Introduction:

Economically the growth and development of any country depend on the performance of various sectors, one of those sectors is the financial sector, the development of the financial sector lead to the access of financial services to individuals and various economic sectors, which leads to an increase in financial depth, The, financial depth refer to the process of development in the quality, quantity and efficiency of intermediate financial services (the mediation between accepting deposits and providing credit).

Financial development also lead to improving the infrastructure in the field of the financial system in developed countries, as countries that have financial development are able to increase financial investments due to the presence of effective financial institutions and markets that lead to increased levels of financial inclusion and improvement of financial efficiency, so when financial institutions are developed, this leads to achieving high investments and profits , part of those profits can also be used for investment or obtaining technology and financial systems to increase the efficiency of electronic payment systems, financial intermediation and the provision of financial services, and thus leads to improving the infrastructure of the financial system, raising the level of financial development and contributing to increasing financial investments, based on this logic, we expect that banking investments are a dependent variable of financial development, on the contrary, in countries that suffer from a low level of financial institutions, they may face low investments because they contain inefficient financial institutions, and thus increase the cost of accessing financial services including credit services, through this, financial development lead not only to providing credit to increase domestic investment, but also to increasing levels of financial inclusion, stability and efficiency, and thus increasing financial sector investments.

Moreover, financial liberalization is considered one of the most important reform to promote financial development, especially after the assumptions supporters of financial liberalization (mckinnon and shaw) in 1973, as a result, iraq adopted a policy of liberalizing the financial sector at the beginning of the current century (after 2003) through liberalizing the banking sector, free entry of foreign banks, liberalizing interest rate, and canceling the allocation of credit , after decades of repression or financial restrictions that affected the low levels of financial development in that time , so the study aims to determine the levels of financial development after the policy of financial liberalization and its impact on the banking sector investments.

The problem of this research lies in the low indicators of financial development, which led to a decrease in the level of bank investment in iraq.

The objective of this research measuring and analyzing the impact of financial development on banking investment in iraq using a model ardl and yamamoto toda test.

1.1. Literature review

There are some empirical studies that deal with financial development and its impact on investment, and those studies can be presented as follow:

Ndikumana (2003) studied the relationship between financial development and financial structure and its impact on domestic investment for selected developing countries during the period (1965-1997), the results of the study confirm that financial intermediation play an important role in increasing local investment, especially by removing financing restrictions, which allows investment companies to increase the level of investment in response to the increasing domestic demand for production ,the results also indicate that the structure of the financial system does not affect investment ,in other words, investment does not respond to changes in the level of output, while financial development increases investment's response to output growth.

Nazlioglu et al (2009) studied the impact of financial development on investment in turkey, and the study used a approach (ardl) to measure the long-term relationship between financial development and investment, using quarterly data covering the period (1987-2007), and the study concluded that there is a positive relationship between variables in the long term, as the results indicate that there is a two-way causal relationship between financial development and government investment, versus there is a one-way causal relationship from private investment to financial development.

Muyambiri (2017) examined the impact of financial development on investment in botswana during the period (1976-2014), using the (ardl) model, the results confirmed that financial development based on banks has a positive impact on investment in the long and short term in botswana, the results also show that that financial development based on market has no impact on investment in the short or long term .

Ndubuisi (2019) investigated financial development and its impact on the profitability of bank in nigeria using the ardl approach covering the period (1981-2019). the results of the study showed a short-term causal effect between the variables, and it also showed that all variables had no effect in the long term except for the variable of central bank assets on gdp, and the study recommends that banks should reduce liquidity to increase the volume of income.

Ozili and Ndah (2022) suggested measuring financial development and its impact on the profitability of banks in nigeria. the study found a negative relationship between the independent and dependent variable, meaning that an increase in the level of financial development lead to a decrease in the profitability of banks.

2. Materials and methods:

In this section, the theoretical literature between indicators of financial development and investment banking index is presented , in addition to presenting the ardl model and the toda yamamoto causal test, to prove or deny the research hypothesis, which assume that there is a positive impact of financial development on investment banking in iraq. financial development indicators can be presented in the figure(1) (Ruomeng And Julia,2020,p27) :

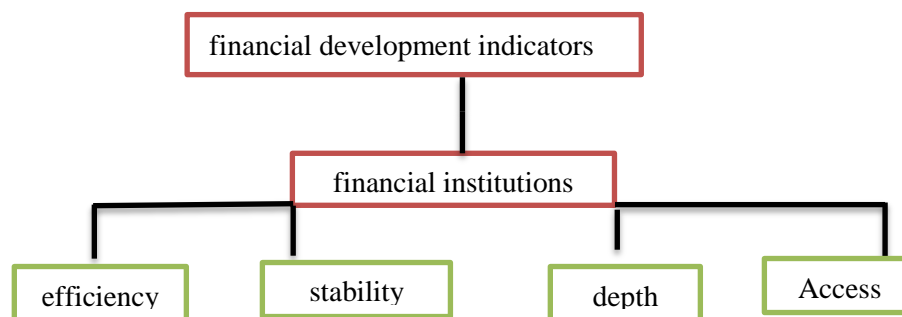


Figure 1: Indicators of financial development

2.1 The relationship between indicators of financial development and bank investment:

2.1.1 financial stability and bank investment:

Financial instability often lead to global financial crises such as the (2008-2009) crisis, which led to a significant decline in bank investments and profitability, as a result, the importance of financial stability has increased to expand bank investments and reduce financial crises , thus, one of the indicators that lead to the occurrence of financial instability is credit growth "(loan growth), as theoretical studies indicate that the expansion of credit increases investment of banks, also the investment of banks has a significant impact on the expansion of credit ,this indicates that there is a bidirectional relationship between the growth of loans and investments, and although credit growth is the main source of bank profits, the expansion of

credit may lead to an increase in bank risks because those loans will become non-performing loans later (Kohlscheen, Murcia, Contreras,2018)

In addition, a stable banking system is able to absorb financial shocks through capital expansion, which improves the stability of the financial system, this means that increasing the banks' capital leads to increasing the profitability of those banks through investing the capital in profitable investments ,in addition, the increase in capital reduces the occurrence of banking crises, especially the sudden withdrawal of deposits, and therefore it is also considered a safety precaution, as a result, a high capital adequacy ratio is an indicator of financial stability(Hussein and Hamdan,2018)

2.1.2 financial efficiency and bank investment :

Most studies focused on the determinants of financial efficiency, but few of them examined the relationship between investment banking and financial efficiency, however, if banks are effective, this leads to an increase in the volume of investments, as well as improving the efficiency of financial intermediation, providing high-quality service to consumers at a low price, as well as providing more security in attracting savings.

Theoretically, efficiency affect banking investments because efficiency reduces the costs of financial services as well as increases efficiency because effective financial institutions tend to expand the level of investment, however , the relationship is not exact (for example, if an inefficient financial system operating in a state of economic growth achieves higher investment and profitability, on the contrary, an effective system operating in a state of economic recession may experience high losses) on the other hand, if the banks are able to provide services effectively and at the required cost, this lead to more investment (Chouikh, Blagui,2017).

2.1.3 financial depth and bank investment :

Many studies have attempted to know the role of financial depth in bank investments, especially with the expansion of the global geographical spread of financial institutions, therefore, studies see that financial development policies, including financial depth policies, will lead to raising the performance and investments of banks, but the success of these policies is still difficult. while many economists support the central role of financial depth in bank investments.

Such as increasing the volume of savings deposits or time deposits, including demand deposits (deposits available in current accounts with banks) that allow banks to use part of the amounts of those deposits to provide financial services, including the provision of cash credit to the public and private sectors, such as loans and advances, and this it leads to an increase in the income and investments of banks (Olawumi et al, 2017).

2.1.4 financial inclusion and bank investment:

Financial inclusion play a role in supporting economic growth and poverty alleviation, also increase the level of banking investments through the development of new ways to provide financial services such as (atm), and banking services through the internet , and the use of the telephone in the settlement of financial transactions, also advances in payment technology such as point of sale (pos) terminals,this leads to higher investments than those provided by traditional investment methods, as (berger et al, 1999) sees that the increase in the spread of banking branches leads to an increase in the provision of financial services to individuals and a reduction in the costs of those services (jouini et al, 2021).

2.2 The ARDL model and the Toda Yamamoto causal test:

2.2.1 The ARDL model:

The ARDL model is used to test the cointegration between variables, the ardl approach is preferred over other traditional methods, for example method of engel and granger (1987, and method of johansen (1991),also method of gregory and hansen (1996) because these methods require that the time series be stationary at the first difference $I(1)$ and also requires a large number of data (Al-Kubaisi and Muthanna,2018).

The ardl approach or (bound test) proposed by pesaran et al (2001) addresses this problem. the bound test can be applied if the variables are stationary at level or the first difference, and it has another advantage as it deal with small samples, narayan (2005) suggest that the sample size ranges from 30 to 80 sample,but the bound test cannot applied if one or both of the variable stationary in the second difference $I(2)$ (Moftah And Dilek, 2021).

The model is also distinguished for estimating the short and long-term relationship between variables (sankaran et al, 2019). another advantage of this model compared to other cointegration tests is that it achieves reliable results using the error correction model, that is through the ecm approach, since the ardl is only one dynamic equation, the ardl approach to the co-integration test is estimated as follows:

$$\delta_1 x_{t-1} + \delta_2 y_{t-1} + v_{1t} \Delta y_{t-1} + \sum_{i=1}^k a_2 \Delta x_{t-1+i} \Delta X_t = \delta_0 + \sum_{i=1}^k a \quad (1)$$

$$\delta_1 y_{t-1} + \delta_2 x_{t-1} + v_{2t} \Delta x_{t-1} + \sum_{i=1}^k a_2 \Delta y_{t-1+i} \Delta Y_t = \delta_0 + \sum_{i=1}^k a \quad (2)$$

2.2.2 The Toda Yamamoto (TY) causal test:

Granger in 1969 and Sims in 1972 proposed the short-term causality test. according to granger the independent variable x causes the dependent variable y if the past and present values of the independent variable help explain the values of the dependent variable, and in order to apply the test for granger causality the time series must be stationary at its original level.

In order to avoid unstable time series, (yamamoto and toda, 1995) proposed a modification of the wald test in the var approach to check in the direction of causality, toda causality can be applied whether the series is stationary in level, first difference or second difference, an additional advantage of the toda test is the examination of long-term causation, unlike traditional granger causality testing methods which require stationary time series data (Musa and Maijama'a, 2020).

The first step in the (ty) test is to select the optimal lag length (k), after that we determine the highest degree of stationary for the time series (d_{max}), finally it is necessary to estimate the order ($k + d_{max}$) from the var (Chandra, 2020).

2.2.3 Model specification and data description:

The study will apply the ardl model and the causality test to ensure the existence of co-integration between variables of the equation (3).

2.2.3.1. Model description:

In this study we assume that the index of total investment banking ((ib) to gdp (is the dependent variable), while the ratio of automated teller machines (atm) per 100,000 adults (indicator of financial inclusion) and the ratio of private cash credit (pc) to gdp (index of depth financial) as well as the return on assets ratio (roa) (financial efficiency index) in addition the non-performing loans to total loans (npl) ratio (financial stability index) are the independent or explanatory variables. the model can be expressed as follows:

$$IB / GDP = f(PC/GDP, ATM, ROA, NPL)$$

In the regression model, the model can be written as follows:

$$IB/GDP = \beta_0 + \beta_1 PC/GDP + \beta_2 ATM + \beta_3 ROA + \beta_4 NPL + \mu_t \quad (3)$$

where μ_t is the random error term

All variables will be tested at the level and at the same time at their first difference. this will show whether the ardl model is the appropriate model for this research work and thus determine the order of co-integration. determining the degree of stationary also allows the application of the toda yamamoto causality test.

2.2.3.2 . Data description:

The data used in the estimation process were collected from various sources, including the central bank of iraq (cbi), and global development indicators. the data group used in this section is annual in nature and cover the period (2005-2021), but due to the small size of the time series, it was converted into semi-annual data for the same period using the eviews 10 program, with the exception of the two indicators of total investment banking to gdp (dependent variable) and private cash credit to gdp, the variables included in equation (4) will be used to find the cointegration and causal relationship between the independent variable and the dependent variable.

3. Discussion of Results:

This section present the experimental evidence of the study as well as the results of diagnostic tests obtained using techniques such as phillips and perron (pp) stationary test, cointegration model, and yamamoto, toda test to determine long-run causality between the dependent and independent variable.

3.1 Unit root test to check for stationary:

In the first step, we examine the stationary of the time series and apply a unit root test (phillips and perron). through this test, it is possible to ascertain whether the variables included in the test contain the unit root, and therefore there are sufficient reasons to accept the null hypothesis, or that the variables do not contain the unit root problem (stationary) and thus there are sufficient reasons to accept the alternative hypothesis (al-kubaisi and hassan,2014) .and the results can be shown in the table (1) .

Table 1: The results of the Phillips- Perron test

| Variable name | at level | | | at the first difference | | |
|---------------|-----------|---------------------|--------|-------------------------|---------------------|--------|
| | Intercept | Trend and intercept | Non | Trend and intercept | Trend and intercept | Non |
| IB/GDP | 0.7233 | 0.6795 | 0.7002 | 0.0401 | 0.1629 | 0.0029 |
| pc/GDP | 0.6682 | 0.1658 | 0.9047 | 0.0000 | 0.0001 | 0.0000 |
| ATM | 0.9985 | 0.9420 | 0.9989 | 0.0558 | 0.1297 | 0.0212 |
| NPL | 0.1858 | 0.2002 | 0.1137 | 0.0138 | 0.1127 | 0.0008 |
| ROA | 0.5029 | 0.3407 | 0.2662 | 0.0206 | 0.0786 | 0.0013 |

Source: Eviews 12 program outputs

Table (1) show the results of the phillips-perron test and show that the data is stationary at the first difference. the result of (pp) at the 5% level of significance show that all variables have a unit root at their level, but these variables become stationary after converting to the first difference, which indicates that these variables are integrated in order (i (1), as a result, the alternative hypothesis is accepted that the variables are stationary after conversion to the first difference.

3.2 Results of Autoregressive Distributed Deceleration (ARDL) Model:

After examining the data using the unit root test, we will apply the cointegration test to examine the long-run relationship between the variables. the ardl test equation can be used as follows:

$$\Delta \text{ib/gdp}_t = a_0 + \sum_{i=1}^p a_{1i} \Delta \text{ib/gdp}_{t-i} + \sum_{i=1}^q a_{2i} \Delta \text{pc/gdp}_{t-i} + \sum_{i=1}^q a_{3i} \Delta \text{atm}_{t-i} + \sum_{i=1}^q a_{4i} \Delta \text{roa}_{t-i} + \sum_{i=1}^q a_{5i} \Delta \text{npl}_{t-i} + a_{11} \text{ib/gdp}_{t-1} + a_{12} \text{pc/gdp}_{t-1} + a_{13} \text{atm}_{t-1} + a_{14} \text{roa}_{t-1} + a_{15} \text{npl}_{t-1} + e_{1t} \quad (4)$$

where δ is the first difference, a_0 is the constant, a_{1i} , a_{2i} , a_{3i} , a_{4i} , a_{5i} ($i=0,1,2,\dots,n$) are the short-run coefficients, a_{11} , a_{12} , a_{13} , a_{14} , a_{15} are the long-run coefficients, p) is the optimal lag for the dependent variable, q) is the optimal lag for the independent variables, e_{1t} is the random error term, where the optimal time lag length is determined based on akaike information criteria.

The null hypothesis is $0 = a_{15} = a_{12} = a_{13} = a_{14} = a_{11}$

The alternative hypothesis $a_{11} \neq a_{12} \neq a_{13} \neq a_{14} \neq a_{15} \neq 0$

3.2.1 Bound test results: The bound test check co-integration based on the F statistic, if the alternative hypothesis of the bound test is accepted, it means there is long-run cointegration (Khalaf and Ali, 2015).

Which mean that the f statistic is greater than the critical values of the upper limit, but if the f statistic is smaller than the critical values of the upper limit, it means that there is no long-term co-integration and therefore the null hypothesis is accepted (Al-Birmani and Abdullah,2019,p285) and The results can be shown in the table (2) .

Table 2: The results of the bound test

| Null Hypothesis: No levels relationship | | | F-Bounds Test | |
|---|------------------------|---------|---------------|--------------------|
| I(1) | I(0) | Signif. | Value | Test Statistic |
| | Asymptotic: n=1000 | | | |
| 3.09 | 2.2 | 10% | 37.63104 | F-statistic |
| 3.49 | 2.56 | 5% | 4 | k |
| 3.87 | 2.88 | 2.5% | | |
| 4.37 | 3.29 | 1% | | |
| | Finite Sample: n=30 | | 30 | Actual Sample Size |
| 3.56 | 2.525 | 10% | | |
| 4.223 | 3.058 | 5% | | |
| 5.84 | 4.28 | 1% | | |

Source: Eviews 12 program outputs

The result show that the value of the f statistic ($f = 37.6$) is greater than the critical value for both the lower limit and the upper limit at the 1%, 2.5%, 5%, and 10% level of significance. this confirmation there is a long-term relationship between financial development and investment banking.

3.2.2 Estimating ARDL coefficients in the long term

The results of the bound test confirmed that there is a long-term cointegration relationship between the independent variable and the dependent variable with the optimal lag structure for the variables (3, 4, 3, 3, 3) , and the table (3) review the results of the long- term relationship of the variables .

Table 3: Estimating the long- term coefficients

| Levels Equation | | | | |
|--|-------------|------------|-------------|----------|
| Case 2: Restricted Constant and No Trend | | | | |
| Prob. | t-Statistic | Std. Error | Coefficient | Variable |
| 0.0898 | -1.900462 | 0.163952 | -0.311585 | ATM |
| 0.0001 | -6.352901 | 0.085574 | 0.543641 | NPL |
| 0.6563 | -0.460228 | 0.435438 | -0.200401 | ROA |
| 0.0225 | 2.749857 | 0.157433 | 0.432918 | PC |
| 0.5788 | -0.575969 | 2.722976 | -1.568351 | C |
| EC = IB - (-0.3116*ATM + 0.5436*NPL -0.2004*ROA + 0.4329*PC - 1.5684) | | | | |

Source: Eviews 12 program outputs

Table (3) showed an estimation of long-term coefficients using the ardl model, and the results indicated that the coefficient of the non-performing loans variable npl was negative toward investment, this means that an increase in non-performing loans (NPL) by one unit reduce banking investment by (0.5) units in the long run, this mean that the increase in financial instability negatively affect investment banking in iraq, the results also showed that increasing the level of financial depth positively affect investment banking , that an increase in cash credit to the private sector (PC) by (1) unit lead to an increase in investment banking by (0.4) units. moreover, the variables of atm and return on assets were not of great importance in the long run. in other words, the indicators of financial inclusion and financial efficiency have no impact on investment banking in the long term.

3.2.3 Results of estimation of short- term coefficients and return to equilibrium in the long-run

The short term coefficients show the degree of influence of the independent variable on the dependent variable in the short term, and the error correction coefficient indicate the speed of return to equilibrium in the long term (Abbas And Al-Ramli,2020,p303) and the table (4) review the results of the short-term relationship of the variables .

Table (4) The results of estimating the short-term coefficients

| ECM Regression | | | | |
|--|-------------|------------|-------------|--------------|
| Case 2: Restricted Constant and No Trend | | | | |
| Prob. | t-Statistic | Std. Error | Coefficient | Variable |
| 0.0000 | 9.885027 | 0.046236 | 0.457047 | D(IB(-1)) |
| 0.0000 | -11.83688 | 0.050114 | -0.593198 | D(IB(-2)) |
| 0.0000 | 8.715929 | 0.162865 | 1.419517 | D(ATM) |
| 0.0095 | -3.279010 | 0.189635 | 0.621814 | D(ATM(-1)) |
| 0.0000 | 12.16411 | 0.185486 | 2.256274 | D(ATM(-2)) |
| 0.0038 | 3.869229 | 0.030358 | 0.117460 | D(NPL) |
| 0.0000 | -10.71680 | 0.032771 | -0.351198 | D(NPL(-1)) |
| 0.0403 | -2.393205 | 0.041545 | -0.099425 | D(NPL(-2)) |
| 0.0000 | 7.467785 | 0.067385 | 0.503214 | D(ROA) |
| 0.0031 | 3.993340 | 0.063990 | 0.255532 | D(ROA(-1)) |
| 0.0030 | 4.024673 | 0.073133 | 0.294337 | D(ROA(-2)) |
| 0.0568 | 2.183854 | 0.060980 | 0.133172 | D(ROA(-3)) |
| 0.0000 | 12.11879 | 0.045578 | 0.552353 | D(PC) |
| 0.0014 | 4.544462 | 0.035152 | 0.159747 | D(PC(-1)) |
| 0.0021 | 4.253499 | 0.041162 | 0.175084 | D(PC(-2)) |
| 0.0000 | -18.74095 | 0.043370 | -0.812797 | CointEq(-1)* |

Source: Eviews 12 program outputs

In table (4), the error correction model was applied to examine the short-term effects of financial development on investment banking, from the table it is shows that the value of the error correction term coefficient is large and has a negative sign, this confirms the existence of a co-integration relationship between the variables, and that about 0.81% of the shock of the previous year return to the equilibrium in the current year in the long run , the table also show the significance of the variables at the level of importance of 5%, this mean that all financial development variables have an impact on investment banking in the short term, where the coefficient of each of the atm variable, the return on assets index (roa) and the private cash credit variable (pc) showed a positive effect on investment banking, while the coefficient of the non-performing loans variable (npl) showed a negative effect on investment banking, which means that an increase in the percentage of non-performing loans lead to lower investment banking in the short term.

3.2.4 Diagnostic tests

The stability of the short and long term coefficients is estimated by using the cumulative sum (cusum) and the cumulative sum of squares test (cusumsq), such tests were suggested by brown et al (1975) and pesaran et al (2001), showing the results of these tests in figure (2) and figure (3), and showed that both numbers do not exceed the critical limits of 5 percent, that is, they are within the lower and upper critical limits. this means that there is no structural fracture, and therefore the results of the estimated model are reliable and effective (Akawee and Abdullatif,2023,p876) and the figures (2)(3) show the results of the stability test for the variables.

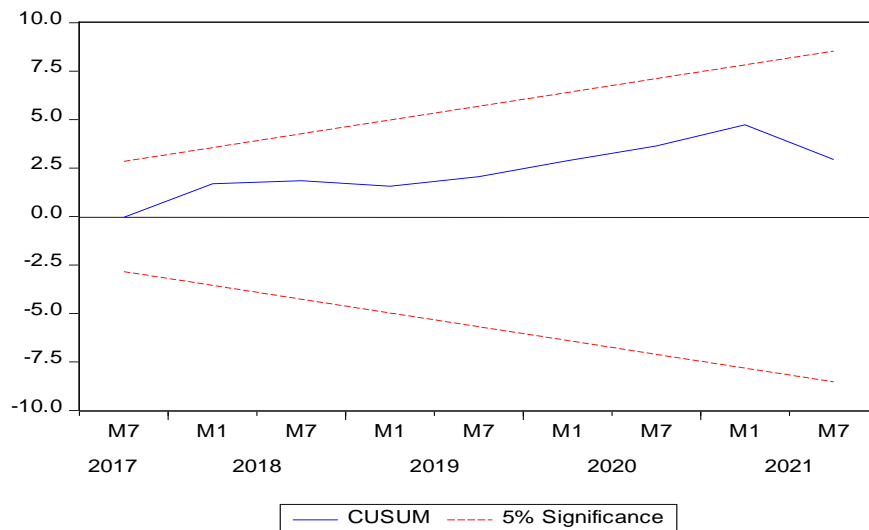


Figure 1: Results the CUSUM.

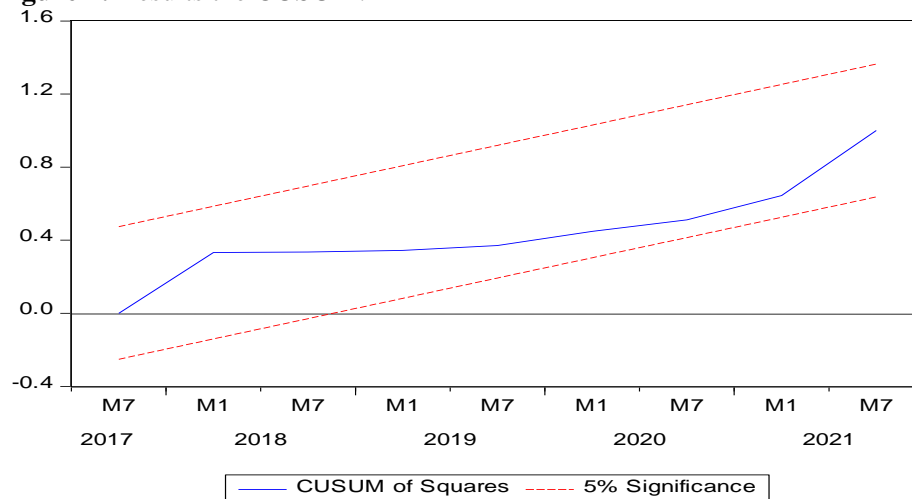


Figure 2: Results the CUSUMSQ.

3.3 Results of the causal relationship test (Yamamoto, Toda) (1995)

ARDL method do not indicate the direction of causality between variables , therefore the causality test between financial development and investment banking is performed by using the yamamoto toda-test.

After the phillips-perron (pp) tests and after determining that $d_{max} = 1$, we then estimate the delay structure of the var system in levels and our results indicate that the optimal delay length based on the aic is 1, i.e. $k = 1$, so the estimated var model uses 1 lag as the optimal delay lengths, thus the test equation becomes $var(k+d_{max})=-2$.

After estimating the test for causality in the appendix (1), the result found the absence of causality between the indicators of financial development and banking investment, the level of importance exceeds 5%, and therefore there is sufficient evidence from the sample to accept the null hypothesis that there is no causal relationship between them in the long term.

4 .Conclusion:

Using bound test and causal test, the results showed that there is a co-integration relationship between financial development indicators and banking investment in the long and short term, financial depth positively affect investment banking ,against the negative affect of the financial stability index in the long term, while all indicators of financial development affect investment banking in the short term. toda yamamoto causal test showed the absence of a causal relationship between the research variables because banks resorted to selling foreign currency in their investments.

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.

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اثر التنمية المالية على الاستثمار المصرفي في العراق

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مستخلص البحث:

من الناحية النظرية ، تشير الأدبيات إلى أن التنمية المالية لها تأثير إيجابي على الاستثمار ، لذلك تهدف هذه الدراسة إلى تحديد أثر التنمية المالية على الاستثمار المصرفي في العراق خلال الفترة نصف السنوية (2005-2021) باستخدام اختبار حدود التأخير الموزع التلقائي (ARDL) ، و استخدام اختبار سببية Toda Yamamoto ، أظهرت نتيجة اختبار الحدود (ARDL) علاقة تكامل مشترك طويلة الأمد بين المتغيرات ، أظهر النموذج ان العمق المالي يؤثر بشكل إيجابي على الاستثمار المصرفي مقابل التأثير السلبي لمؤشر الاستقرار المالي على المدى الطويل ، في حين أظهر الاختبار السببي لتودا ياماموتو Toda Yamamoto أنه لا توجد علاقة سببية بين التنمية المالية والاستثمار المصرفي .

نوع البحث: ورقة بحثية.

المصطلحات الرئيسية للبحث: التنمية المالية ، الاستثمار المصرفي ، نموذج ARDL ، اختبار سببية Toda Yamamoto .

*البحث مستل من اطروحة دكتوراه

Appendix (1) Toda Yamamoto causal test results

| VAR Granger Causality/Block Exogeneity Wald Tests | | | |
|---|----|----------|----------|
| Date: 05/17/23 Time: 17:39 | | | |
| Sample: 2005S1 2021S2 | | | |
| Included observations: 32 | | | |
| Dependent variable: IB | | | |
| Prob. | df | Chi-sq | Excluded |
| 0.2639 | 1 | 1.248176 | NPL |
| 0.9010 | 1 | 0.015479 | PC |
| 0.3719 | 1 | 0.797382 | ROA |
| 0.3487 | 1 | 0.878279 | ATM |
| 0.4126 | 4 | 3.951636 | All |
| Dependent variable: NPL | | | |
| Prob. | df | Chi-sq | Excluded |
| 0.5325 | 1 | 0.389659 | IB |
| 0.3597 | 1 | 0.838968 | PC |
| 0.9344 | 1 | 0.006769 | ROA |
| 0.2571 | 1 | 1.284087 | ATM |
| 0.6519 | 4 | 2.459658 | All |
| Dependent variable: PC | | | |
| Prob. | df | Chi-sq | Excluded |
| 0.4002 | 1 | 0.707666 | IB |
| 0.7977 | 1 | 0.065688 | NPL |
| 0.4062 | 1 | 0.689898 | ROA |
| 0.7098 | 1 | 0.138499 | ATM |
| 0.6702 | 4 | 2.358314 | All |
| Dependent variable: ROA | | | |
| Prob. | df | Chi-sq | Excluded |
| 0.7306 | 1 | 0.118564 | IB |
| 0.6827 | 1 | 0.167117 | NPL |
| 0.6024 | 1 | 0.271336 | PC |
| 0.2070 | 1 | 1.592048 | ATM |
| 0.5355 | 4 | 3.134895 | All |
| Dependent variable: ATM | | | |
| Prob. | df | Chi-sq | Excluded |
| 0.7732 | 1 | 0.083021 | IB |
| 0.4041 | 1 | 0.696224 | NPL |
| 0.7756 | 1 | 0.081280 | PC |
| 0.2618 | 1 | 1.259217 | ROA |
| 0.5189 | 4 | 3.237351 | All |