ARDL Model To Test Relation Between The Development Of Financial Sector And The Economic Growth In Egypt

Dr. Rania Ramadan Moawad
Canadian international college
Business department
Cairo, Egypt.
raniaramadan@hotmail.co.uk

***Abstract*—The paper is testing the relation between the development of financial sector and the economic growth in Egypt to check the relation's existence and to determine its direction.**

The model used in this study is the auto-regressive distributed lags model ARDL. The paper found a long-term and a short term relation between the development of financial sector and the economic growth in Egypt .

Keywords—Financial development; Economic growth, ARDL, Egypt.

JEL codes: A12, C01, C13, C22, C51, E51*, *R15, O43.

1. Introduction

The causal relationship between the development of the financial sector and the economic growth has been treated by many researchers. Given the recent situation of lack of finance in Egypt, it has become clear to the researcher that it is important to study the relationship between the financing sector and economic growth.

The problem of research is to test the relation between the economic growth and a variety of sources of financing, whether from the banking sector or the various instruments offered by the stock market. This is done through econometric models such as the auto regressive distributive lags model and the vector autoregressive model.

The organization of the paper is as follows: section 2 presents the previous literature on the relationship between the development of the financing sector and economic growth. Section 3 explains the methodology of the study and section 4 is the applied part of the study. Section 5 shows the results of the study, and section 6 is the conclusion.

2. Previous literature

Economists like Schumpeter and Keynes believe that financial intermediation and financial services by financial intermediaries play an important role in macroeconomic variables such as economic growth, incomes, and poverty reduction. In contrast, some economists such as Lucas and Seers do not believe that there is a causal effect of financial intermediation on economic activity. While some economists like Robinson consider that the development of financial intermediation is a result of development processes and not a reason (Alomar, 2009).

Copelman, Thorsten and Hoffmann studied the impact of the development of the banking sector on economic growth and found a positive relationship. The increase in bank credit led to a significant increase in production and thus increased economic growth (Coplman, 2000) (Thorsten, 2000) (Hofman, 2001). Rousseau, Caridi, Mercan and Ismet, and Alomar reached the same conclusion. Rousseau concluded that the development of the financing sector plays a major role in influencing the real sector, and Alomar found that the economic growth has been linked to financial intermediation and banking institutions. Caridi found that the increased demand resulting from the increase of the credit leads to an increase in the economic activities. Mercan concluded that the effect of financial development on economic growth was positive and statistically significant (Rousseau, 2002) (Alomar, 2002) (Caridi, 2004) (Mercan and Ismet, 2013).

Edison and others studied the impact of international financial integration on economic growth and assessed whether the relationship depends on the level of economic development and development of the financial sector. The study found that international financial integration itself does not accelerate economic growth even when controlling certain financing characteristics (Edison, and others, 2002). While Rousseau and Wachtel tested the relationship between the development of the financing sector and economic growth across different countries. The study proved that, although the relationship between the development of the financing sector and the growth was strong from 1960-1989, it is no longer in recent data as it was (Rousseau and Wachtel, 2009). Eugine examined the relationship between financial intermediary development and economic growth in Nigeria. The relationship is found to be insignificantly negative in the long-run and significantly negative in the short-run (Eugene Iheanacho, 2016).

3. Research methodology

The econometric methodology used to test the relationship between the development of the financial and economic growth for the period 1980-2014 is the ARDL model .

3.1 ARDL model: Autoregressive Distributed Lag (ARDL) co-integration technique.

3.1.1 Methodology

ARDL co-integration technique is preferable when dealing with variables that are integrated of different order, I(0), I(1) or combination of the both and, robust when there is a single long run relationship between the underlying variables in a small sample size. The long run relationship of the underlying variables is detected through the F-statistic (Wald test). In this approach, long run relationship of the series is said to be established when the F-statistic exceeds the critical value band. The major advantage of this approach lies in its identification of the co-integrating vectors where there are multiple co-integrating vectors. However, this technique will crash in the presence of integrated stochastic trend of I(2).

Co-integration using ARDL is tested using the **Bound Test method** developed by Pesaran et al. (2001), where autoregressive model and Distributed Lag Model are integrated. In this model, the time series is a function of its lagged values and of the current values and lagged values of the explanatory variables.

3.1.2 Variables and data sources

Annual data for the period 1990-2015 will be used. The variables used are:

GDP growth rate

CR: Credit directed to the private sector as a percentage of GDP

TR: The rate of trade openness

ST: Capital market capitalization as a percentage of GDP

These data were obtained from the official website of the World Bank, Database of Financial Development. (World Bank, 2016), as well as the official website of the International Monetary Fund and the data site www.theglobaleconomy.com /index_api.php.

The study uses the private credit variable as the ratio of GDP and the capital market capitalization as a percentage of GDP to reflect the development of the financing sector, the GDP growth rate to express economic growth. The study will also use the variable of trade openness as a control variable.

3.1.3 Model framework

According to the study methodology, the ARDL method will be used in three stages:

• In the first stage, co-integration is tested in the framework of the UECM error model, which takes the following formula by imposing the relationship between Y (dependent variable) and X (vector of interpreted variables)

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{n} \theta_i \Delta X_{t-i} + \lambda_1 Y_{t-1} + \lambda_2 X_{t-1} + \eta_t \quad (1)$$

Where the coefficients λ_1, λ_2 express the long-run relationship, while β, θ express the short-run relationship (short-run relationship).

The term Δ refers to the first differences of the variables, while m, n represents the lags of the variables (note: That the number of periods of time lag is not necessarily the same for all variables, that is (m $\neq n$) ، η is the random error limit that has an arithmetic mean of zero and a constant variance and does not have serial correlations between them.

• The long-term relationship between the variables is verified using the Wald-F test, which tests the hypothesis of no co--integration of variables versus a co-integration, to detect the long-term equilibrium relationship between variables. Variables in equation (1) by the following assumptions:

Null hypothesis: no co-integration $H_0 : \lambda_1 = \lambda_2 = 0$

Alternative hypothesis: co- integration $H_1 : \lambda_1 \neq \lambda_2 \neq 0$

The rejection of the null hypothesis is based on comparing the value of F calculated by the tabular values within the critical limits

The proposed Critical Bounds (Pesaran et al., 2001) consists of two thresholds: the Lower Critical Bound (LCB), which assumes that the variables are class I (0) and the upper critical bound (UCB) which assume that the variables are class I (1).

If the calculated F value is greater than the UCB, the null hypothesis is rejected and the alternative hypothesis (common integration) is accepted. Conversely, if calculated F is less than LCB, the null hypothesis (no common integration) is accepted, and if the calculated F value is between UCB and LCB, in this case the result is not settled.

• Phase II: In the case of a co- integration of the variables, the second stage includes the estimation of the long-term equation as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \vartheta_i Y_{t-i} + \sum_{i=0}^{q} \delta_i X_{t-i} + \varepsilon_t \quad (2)$$

Where each represents the coefficients of the variables and p, q indicates the time lags for those

Variables, and represents the random error limit. The number of lags is selected in the ARDL model according to Akaike (AIC) or Schwarz Bayesian Criterion (SBC) before the model is estimated using OLS in order to eliminate the serial correlation between random errors. Pesaran and Shin (2009) recommended a maximum of two time lags for annual data.

• Phase 3: Error Correction Model (ECM) is constructed, taking the following formula:

$$\Delta Y_t = c + \sum_{i=1}^{p} \vartheta_i \Delta Y_{t-i} + \sum_{i=0}^{q} \delta_i \Delta X_{t-i} + \psi ECT_{t-1} + \upsilon_t \qquad (3)$$

The error correction term ECT_{t-1} , and all short-term equation coefficients, are short term behavior coefficients for the model's approximation of the equilibrium state. The error correction coefficient ψ measures the speed of adjustment in which the short-term equilibrium imbalance is adjusted towards long-term equilibrium.

• Based on the economic theory and the applied models in previous studies on the same subject, the following equation will be estimated for the purpose of measuring the impact of the development of the financial sector on the economic growth during the period 1990-2015 in Egypt.

Gdpt=α + β1crt + β2trt + β3stt +ϵt t= 1,2,.T

Where:

t = time period

T = number of observations

GDP = growth rate

Cr = Private credit as a percentage of GDP

Tr = Trade Opening Rate (Exports + Imports) / Gross Domestic Product (GDP)

St = Capital Market Capitalization Ratio to Gross Domestic Product.

ε = random error.

It should be noted that the use of the ARDL model does not require stationarity tests, but it requires that there are no stable time series at the second difference, which may affect the accuracy of the results. Appropriate lag periods will be found in accordance with the AIC and SC standards.

3.1.4 Test the causality of Granger

Granger's causality will be tested through the error correction model to see if the explanatory variables cause the dependent variable.

4. Applied study

4.1 Applied study for the ARDL model

4.1.1 Stationarity tests were performed and 2 variables were found to be stationary at the first differences but the private credit to the GDP and treg is stationary at level as shown in the following table:

Table 1: Stationarity test.

Variable	MacKinnon (1996) one-sided p-values.	ADF test Statistic	Order of integration of the variable
GDPEG	-2.948404	-3.374138	I(0)
CREG	-3.646342	-6.781007	I(1)
TREG	-2.957110	-3.481961	I(0)
STEG	-3.261452	-3.487187	I(1)

4.1.2 Time lags number was determined according to SC criteria as one lag period for the GDPEG variable, two periods for the CREG variable, four periods for the TREG variable, and two periods for the STEG variable.

4.1.3 ARDL results

4.1.3.1 The co-integration model according to ARDL

❖ The co-integration was tested by estimating the UECM as follows:

$D(GDPEG)_t = C_1 + C_2D(GDPEG)_{t-1} + C_3D(CREG)_{t-1} + C_4D(TRADEG)_{t-1} + C_5D(STEG)_{t-1} + C_6GDPEG_{t-1} + C_7CREG_{t-1} + C_8TRADEG_{t-1} + C_9STEG_{t-1} + E_t$

After estimating the UECM model according to the ARDL method, the following results were obtained:

$D(GDPEG)_t = 2.51 + 0.19D(GDPEG)_{t-1} + 5.27D(CREG)_{t-1} + 3.3D(CREG)_{t-2} - 0.15D(TREG)_{t-1} + 1.54D(TREG)_{t-2} + 0.95D(TREG)_{t-3} - 1.29D(TREG)_{t-4} - 0.69D(STEG)_{t-1} + 0.28D(STEG)_{t-2} - 1.36GDPEG_{t-1} - 1.36CREG_{t-1} + 0.16TREG_{t-1} + 1.14STEG_{t-1}$

R-squared0.938561

F-statistic11.75097

Prob (F-statistic)0.000226

- The results of the statistical tests of the regression equation shown above indicate that the estimated model is good as the coefficient of determination is equal to 0.938, meaning that the model interprets 93% of the changes in the rate of economic growth.

-The results also indicate that the relationship between the dependent variable and the explanatory variables is not false, the value of F-statistics has a significant value of 11.7.

❖ However, it is necessary to test whether the residuals have a self-serial correlation through the Breusch-Godfrey Serial Correlation LM Test as follows:

Table 2: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.862059	Prob . F(2,8)	0.4581
Obs*R-squared	4.255279	Prob.Chi-Square(2)	0.1191

According to the above we can accept the null hypotheses which assumes that there is no serial-correlation between the residuals, p-value is greater than 0.05.

❖ The structural stability of the estimated ARDL model is also tested to ensure that the data used in this study are free of any structural changes over time using the Cumulative Sum of Recursive Residual (CUSUM) test. The structural stability of the estimated coefficients of the UECM is achieved if the CUSUM graph is within the critical limits at a significant level of 5%.

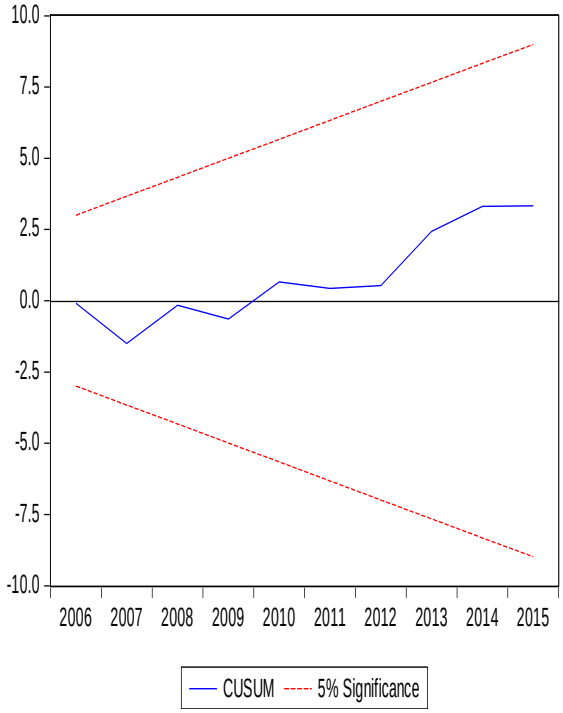

Figure 1: the Cumulative Sum of Recursive Residual (CUSUM) test.

The figure shows that estimated coefficients for the ARDL model are structurally stable over the period of study.

4.1.3.2 Estimation of long-term equation

The long-term relationship between the variables is verified using the Wald-F test, which tests the hypothesis of no co-integration of the variables versus a co-integration to detect the long-term equilibrium relationship between variables.

Co-integration is tested in equation (1) through the following assumptions:

H_0:C11=C12=C13=C14=0

H_1: C11≠C12≠C13≠C14≠0

The rejection of the null hypothesis is based on comparing the value of F calculated by the tabular values according to the critical limits proposed by (Pesaran et al., 2001), where the table consists of two extremes, in the case of the current model, is 2.86 as a minimum and 4.01 as maximum at level of significance 5%.

Since the value of f-statistic = 16.2 is greater than the upper limit, there is a long-term relationship between the variables in the following form:

$$Gdpeg_t = c_1 + c_2creg_t + c_3treg_t + c_4steg_t + E_t$$

And this equation can be estimated as follows:

$$Gdpeg_t = -1.719989 + 0.754892creg_t - 0.093919treg_t + 0.215161steg_{tt}$$

- The variables explain only about 40% of the change in economic growth since the value of the coefficient of determination= 0.39 and the variable creg has a significant effect on the growth rate of the output at a significant level of 10% (where the value of t-critical is equal to 1,319 Which means that we can reject null hypothesis since t-statistic is greater than t-critical at α = 0.1 and degrees of freedom = 23.)

- the coefficient of Private credit as a percentage of output = 0.75 which means that If the ratio of private credit to GDP increased by 1%, the rate of growth of the product increases by 0.75%. We conclude that in the long term, the development of the financing sector leads to the development of economic growth.

4.1.3.3 Estimation of ARDL error correction model

After obtaining the long-term relationship according to the co-integration model, the ECM model is estimated to test the short-term relationship between the independent variables and the dependent variable according to the following formula:

$$D(GDPEG)_t = C_1 + C_2D(GDPEG)_{t-1} + C_3D(CREG)_{t-1} + C_4D(CREG)_{t-2} + C_5D(TREG)_{t-1} + C_6D(TREG)_{t-2} + C_7D(TREG)_{t-3} + C_8D(TREG)_{t-4} + C_9D(STEG)_{t-1} + C_{10}D(STEG)_{t-2} + C_{11}ECT_{t-1}$$

Where ECTt-1 is the lagged value of the error term in the long-term relationship model. Based on the estimation of the ECM model under the ARDL model, the following results were obtained:

$$D(GDPEG)_t = -0.073621 + 0.224149\ D(GDPEG)_{t-1} + 2.333570\ D(CREG)_{t-1} - 2.185124\ D(CREG)_{t-2} - 2.174207\ D(TREG)_{t-1} + 1.537467\ D(TREG)_{t-2} - 0.764839\ D(TREG)_{t-3} -$$

1.553834 $D(TREG)_{t-4}$ -0.087930 $D(STEG)_{t-1}$ + 1.123660 $D(STEG)_{t-2}$ + -0.841126 ECT_{t-1}

R-squared	0.841991
F-statistic	6.927382
Prob(F-statistic)	0.000912

- It is clear from the previous results that the model is good as R^2 is 0.84 which means that 84% of the changes in economic growth in the short term can be explained by the variables in the model. There is also a significant relation between the trade openness rate (TREG) and the real GDP growth rate at a level of significance (90%) and between the capital market capitalization (STEG) and GDPEG (95%) according to p-value values.

- It is also worth that the error correction coefficient is significant and takes a negative value of 0.84 indicating the speed of return to the long-term equilibrium. Which means that any deviation from the long-term equilibrium path between the explanatory variables and the independent variable in period t-1 will be compensated in period t.

From the above we can say that in the short term, there is a positive relationship between the development of the banking sector and economic growth. If we want more economic growth, we have to pay attention to the banking sector. The relationship between the rate of trade openness and economic growth is negative and may be due to the financial and economic crises experienced by the country during the period of the study.

4.1.4 Granger's causality

Granger's causality will be tested through the error correction model to see if the explanatory variables cause the dependent variable.

Table 3: Granger's causality test.

variable	H0	p-value
D(Creg)	H_0: C(3)=C(4)=0	0.2661
treg	H_0: C(5)=C(6)=C(7)=C(8)=0	0.0274
d(steg)	H_0: C(9)=C(10)=0	0.1266
ECT	H0:C(11)=0	0.0102

- It is clear from the previous table that we can refuse to null hypothesis in the case of the variable of trade openness according to the p-value, that is, there is a causal relationship in the short term moving from the rate of trade openness to the Economic growth.

- The coefficient of the error term is significant, indicating a causal relationship moving from the explanatory variables to the dependent variable in the long term.

5 Results

Results of ARDL

- In the long term, the development of the financing sector leads to the development of economic growth.
- The error correction coefficient is significant and takes a negative value of 0.84 indicating the speed of return to the long-term equilibrium. Which means that any deviation from the long-term equilibrium path between the explanatory variables and the independent variable in period t-1 will be compensated in period t.

SO we can say that in the short term, there is a relationship between the development of the banking sector and economic growth.

- The result of Granger's causality test result was the significance of the coefficient of the error term, indicating a causal relationship moving from the explanatory variables to the dependent variable in the long term.

6 Conclusions

- Using ARDL model to test the existence of the relation between the development of the financial sector and the economic growth in Egypt, has contributed to the result which is the existence of long run and short run relationship between the financial sector and the development of the economic growth such that the development of the financial sector leads to the development of economic growth.

The empirical results implied evidence of a long- and short-run positive impact of financial development on economic growth in Egypt. This implies that the financial sector and financial institution act as an input to support economic growth in the short-run and the long-run. Furthermore, granger causality tests show that the direction of causality is running from financial development to economic growth in long-run.

Therefore, based on the finding, government should strengthen its current effort on development of financial sector to accelerate economic growth in the country. Moreover, the policy makers should focus long-run policies mainly improving financial markets, so as to make the efficient and effective allocation of resources among the productive sector which affects long-run economic growth in Egypt.

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Data sources:

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2- **Official website of the International Monetary Fund**

3- Data site www.theglobaleconomy.com /index_api.php.