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Financial Development and Agricultural Growth in Egypt: ARDL Approach and Toda-Yamamoto Causality

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Abstract: *This paper investigates the relationship between the financial development and the economic growth in the Egyptian agricultural sector during the period 1995-2017 and assesses whether there are relations between them in the long run. The study is based on a variety of analytical econometrics tools and methods such as Unit Root Test to indicate the stationary of the study variables using Augmented Dicky-Fuller (ADF), Auto Regressive Distributed Lags (ARDL)bounds testing approach to test the long run relationship between the study variables, Impulse Response Functions (IRFs) to identify the effect of the external shocks on the study variables,and Toda- Yamamoto causality test to investigate the causality relationship between economic growth and financial development. The empirical results suggesting that the Agricultural Gross Domestic Product influenced by each of Agricultural Governmental Expenditure, Cumulative Formation Capital, Agricultural Credit, and Agricultural Labor both in the short and the long run. In addition to that, the research reveals a strong causal relationship between economic growth and financial development.*

Key Words:*Financial Development, Economic Growth, Unit Root Tests, ARDL, Impulse Response Function., Toda- Yamamoto causality test.*

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I. Introduction

The Financial Sector is at the forefront of the global economic concerns, as the existence of a developed and effective financial system is one of the basic requirements of increasing economic growth. Through the financial intermediation between savers and investors, and between lenders and borrowers, the financial system encourages saving and investment. And also promote the optimum allocation of funds available for investments, in addition to providing a range of other financial services such as funds transfer, guarantees, risk management, financial planning, investment management, and consulting services, which society has become an increasing need in the current era. Ozmen believes that the underdeveloped financial sector may impedes the correlation between savings and the investments [1].

The main role of the financial sector is polling funds, that is, to attract, allocate, and direct them in a credit form, or an investment in other economic sectors to achieve a real growth in those sectors. Both developing and developed countries tried to carry out reforms in the financial sector in order to develop the entire economy or sub-sectors of the economy such as the agricultural sector. Financial sector reforms can be described as prepared policies and procedures undertaken by the competent authorities to bring about the necessary reforms in financial institutions and restructure them within a certain time period. Financial sector reforms based on an efficient financial system in order to guarantee the contribution of banks as financial intermediaries in the development of other sectors including the agricultural sector through the resources mobilization and thus growth in agricultural investments, which confirms the role of financial institutions in stimulating growth in the agricultural sector through financial sector reforms.

Some studies indicate that the development of the financial sector may affect economic growth, while some consider that the financial sector is not a leading sector, and that economic growth is what causes the development of the financial sector. A third view holds that there is a mutual impact between financial sector development and economic growth. Fry [2] mentioned that the developed financial sector depends on the banks regulation and supervision, where there are regulatory and supervisory frameworks to prevent erroneous financial practices, as Fry pointed out that there are four other indicators of financial development which are: (1) Achieving an appropriate level of stability in prices and price Exchange, (2) Financial discipline so that continued government borrowing from the central bank does not constitute inflationary pressures on monetary reserves, (3) maximizing competitive profits by commercial banks, (4) the tax system is free of any discriminatory, explicit or implicit taxes on financial intermediation. The developed financial sector helps the economy grow through two integrated but different mechanisms, the first through Total Factor Productivity (TFP), and the second through the Gross Cumulative Formation Capital (GCFC).

Law No. 84 of 2016 has been issued, which stipulates that the main bank for development and agricultural credit be transferred to a public sector bank called (the Egyptian Agricultural Bank) that takes the form of an Egyptian joint stock company whose capital is wholly owned by the government and has an independent legal personality. The Egyptian Agricultural Bank aims to provide the necessary funds for various types of agricultural and rural development activities and support the agricultural sector in all its fields.

II. Research Problem

There is no doubt that the financial sector has positive effects and a fundamental and decisive role in increasing the rate of economic growth in the long run. Many countries 'experiences in recent years indicate that reforming and liberalizing the financial sector is, without any doubt, an essential element in the process of economic growth, through its impact on the growth of the TFP and change in Technology, in addition to its strong relationship with private sector development, and reducing the economy sensitivity to negative factors and risks and to economic and non-economic shocks.

Since the last decade of the last century, and with the tendency of most countries of the world, including Egypt, towards adopting liberal economic policies and privatization of the economy sectors, and as a result of lifting restrictions and removing obstacles in many economies, especially developing ones, and rapid developments in information technology and communications, the global integration of financial markets created new perspectives to mobilize financial resources and to use the funds available for investment more effectively over the past two decades. Therefore, it is imperative that the domestic financial system be adequately robust to cope with the risks associated with the globalization process in general and the global integration of financial markets. Therefore, the research problem can be formulated in the following question: Does financial development lead to higher levels of production in the agricultural sector? And if so, are these effects direct?

III. Research Objectives

The main purpose of the research is to analyze the relationship between financial sector development and economic growth in the agriculture sector during the period 1995-2017, through investigating the short-run and long-run dynamics among Agricultural Gross Domestic Product and each of Agricultural Governmental Expenditure, Cumulative Formation Capital, Agricultural Credit, and Agricultural Labor.

IV. Literature Review

Relationship between financial development and economic growth in the agricultural Sector has been fully analyzed by many recent empirical papers. Nevertheless, the evidence is rather mixed. While some studies support the existence of a causal relationship between financial development and economic growth, others fail to provide support for the existence of a significant relation between these two variables.

Each of [3], [4] and [5] studies attempt to discuss the relationship between economic and financial development in Pakistan using Vector Error Correction, a Cobb-Douglas production function, VAR models, and ARDL bounds testing. Results indicate that, in the long run, financial development has positive effect on agricultural growth. This implies that financial development plays a significant role in stemming agricultural production and hence agricultural growth, and both capital and labor in the agriculture sector also add to agricultural growth. The Granger causality analysis revealed bidirectional causality between agricultural growth and financial development. The results of the Johansen co integration test and VECM model revealed a significant positive relationship between agricultural growth and capital formation, farm credit disbursement and liquid liability in the financial sector.

Each of [6] and [7] studies evaluated the effect of financial sector reforms on agricultural investments using a cointegration and vector error correction model (VECM), three stages least squares estimation in a long time series analysis in Nigeria. The result revealed that financial sector reforms significantly affect agricultural investments in Nigeria both in the long and short run, which means bank lending to agriculture has a positive and significant effect on real gross national saving and real output of agricultural sub-sector. Thus, the focus on agricultural investment as the financial sector develops should be fundamental to the diversification drive of successive governments in Nigeria.

While in the Asian countries like Nepal studied by Westermann [8] that find that the services sector reacts strongly to increases in domestic credit, while agriculture and manufacturing sectors are largely unaffected using VAR, China studied by Jinpeng [9] to investigate the relationship between the development of the rural financial system and the economic growth using VECM and impulse response function, and the results show that it has the equilibrium cointegration relationship and long-term one-way Granger causality between them. And Iran studied by Yazdi, and Khanalizadeh [10] to examine the causal relationship between the dynamic financial development and economic growth using The Johansen cointegration test, Granger causality,

and ECM, and the results suggested that there is bidirectional causality between agricultural economic growth and financial development.

In the African countries; Dhrifi [11] suggested that agriculture finance is critical to boost food production and help address food security in the world and to address the livelihood needs of the poor. Estimations are conducted with a panel data of 44 African countries over the period of 1990-2012 using GMM-System estimator. The findings show that financial system by itself cannot favor agriculture sector in African countries, but at the presence of a good quality of institutions, it contributes positively to improvements of agriculture productivity. Especially Abdul-Aziz [12] confirmed that increased financial development (when Domestic credit to private sector as a share of GDP was used as proxy) leads to a fall in Agricultural value added share of GDP in Ghana.

Results from Onoja study [13] suggested that agriculture credit had a positive and significant effect on productivity across sample of 75 developing countries, but positive and insignificant for developed economies, while Oliynyk-Dunn paper results [14] revealed a positive relationship between financial systems' banking component and agriculture growth in Ukraine.

It can be concluded that all previous studies used VECM and ARDL approaches to test the long run relation between economic growth and financial development. And the results suggested that financial development had a positive effect on agricultural growth by increasing its production level and independently generate positive investments in the sector, this is because bank lending to agriculture had a positive and significant effect on national saving and real agricultural output especially in developing countries.

V. Methodology

In this paper, the ARDL bounds testing approach which is developed by Parasan et al. to inspect whether a long run dynamic relationship exists between Agricultural Gross Domestic Product and each of Agricultural Governmental Expenditure, Cumulative Formation Capital, Agricultural Credit, and Agricultural Labor.

Unit Root Test:

Most of time series for financial and economic data are non-stationary because they contain the unit root and the presence of a unit root indicates that a time series is non- stationary which results in lake of independence of average and variance over time. When a regression relationship is run for time series that contain unit root, it's reflected in a false association and spurious Regression [15]. Therefore, a test of the problem of time series stationarity will be conducted using the Unit Root test. This test aims to examine the characteristics of time series under study and to ensure the extent of their stationarity and determine the order of integration. There are a variety of methods to implement this test, which are widely used. One of the tests that have become very popular over the past few years -which the study used- is the Augmented Dickey-Fuller (ADF), and there is now a growing consensus that performing stationarity tests using the Dickey-Fuller test has superior properties compared to other alternatives. This test consists of estimating the following regression model:

$\Delta Y_t = \beta_1 + \beta_2\, t + \delta Y_{t-1} + \Sigma\, \alpha i \Delta y_{t-i} + \varepsilon_t$ (1)

Where $\varepsilon_t$represent Error Term, and

$\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc.

ARDL Model to Test Cointegration

The Autoregressive Distributed Lag (ARDL) bounds testing cointegration approach was proposed by Pesaran, Shin, and Smith [16] to examine the existence of a long run dynamic relationship between Agricultural Gross Domestic Product (AGDP), and each of Agricultural Governmental Expenditure (AGExp), Gross Cumulative Formation Capital (GCFC), Agricultural Credit (AGCredit), and Agricultural Labor (AGLabor).

According to The ARDL bounds testing procedure involves two stages; first to test for the existence of a long run relationship between the variables, and second to estimate the coefficients of a long run relations and make inferences about their values. The calculated F-static is compared against the Upper Critical Bound (UCB) and Lower Critical Bound (LCB) provided by Pesaran et al. which correspond to the assumption that the variables are I(0) and I(1). If the computed F-static is greater than the UCB value, then the HO is rejected (the variables are cointegrated). If the F- static is below the UCB value, then the HO is accepted (there is no cointegration among the variables). If it falls between the LCB and UCB value, the result of the inference is inconclusive.

The ARDL model specification of the functional relationships between AGDP, AGExp, GCFC, AGCredit, and AGLabor -in real values and in Ln form- is shown below:

$$\Delta LnRAGDP = \alpha_0 + \sum_{t=1}^{p} b_1 \Delta LnRAGDP_{t-1} + \sum_{t=1}^{p} c_1 \Delta LnRAGExp_{t-1} + \sum_{t=1}^{p} d_1 \Delta LnRGCFC_{t-1} + \sum_{t=1}^{p} e_1 \Delta LnRAGCredit_{t-1} + \sum_{t=1}^{p} f_1 \Delta LnAGLabor_{t-1} + \sum_{t=1}^{p} \delta_1 \Delta LnRAGDP_{t-1} +$$

$\sum_{t=1}^{p} \delta_2 \Delta LnRAGExp_{t-1} + \sum_{t=1}^{p} \delta_3 \Delta LnRGCFC_{t-1} + \sum_{t=1}^{p} \delta_4 \Delta LnRAGCredit_{t-1} + \sum_{t=1}^{p} \delta_5 \Delta LnAGLabor_{t-1} + \varepsilon_t$

The ARDL cointegration test is testing the following hypotheses:

$H_o = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ (there is no cointegration i.e no long run relationship between the variables)

$H_A = \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$ (i.e there is cointegration or long run relationship between the variables)

The hypotheses are tested by means of the F-static (Wald test).

Error Correction Model (ECM)

The ARDL model stablishes the existence of a long run relationship between LnRAGDP, AGExp, GCFC, AGCredit, and AGLabor, but it doesn't explain the short run dynamics that brings about the long run equilibrium. The t- static of error correction model (ECM) is set to test the causality of the variables while the coefficient of the CointEq (-1) from the ECM indicates the speed of adjustment of the dependent variable towards its long run equilibrium. If the speed of adjustment value is between -1 and 0, then there exists partial adjustment.

Toda–Yamamoto causality analysis:

One of the most important conditions for using the Granger causality test is the variable stationary at the same order of integration, especially at the level, so Toda Yamamoto proposed a new methodology for estimating causality in the case of variables with different orders of integration I(0), I(1), and even I (2). Toda and Yamamoto[17] developed a method in order to investigate Granger causality based on the estimation of augmented VAR model (K+dmax) where K is the optimal time lag on the first VAR Model and dmax is the maximum integrated order in VAR model.

VAR model of Toda and Yamamoto causality is set up as follows:

$$y_t = \mu_0 + \left[\sum_{i=1}^{k} \alpha_{1t} y_{t-i} + \sum_{i=k+1}^{d_{max}} \alpha_{2t} y_{t-i}\right] + \left[\sum_{i=1}^{k} \beta_{1t} x_{t-i} + \sum_{i=k+1}^{d_{max}} \beta_{2t} x_{t-i}\right]$$

$$x_t = \varphi_0 + \left[\sum_{i=1}^{k} \gamma_{1t} x_{t-i} + \sum_{i=k+1}^{d_{max}} \gamma_{2t} x_{t-i}\right] + \left[\sum_{i=1}^{k} \delta_{1t} y_{t-i} + \sum_{i=k+1}^{d_{max}} \delta_{2t} y_{t-i}\right]$$

Where K is the optimal time lag in the initial VAR model and dmax is the maximum integration order in the VAR model [18].

VI. Findings and Discussion:

Unit Root Tests:

Unit Root Tests were used to determine the order of integration of the study variables. The result of ADF test is summarized in table 1 that indicating the existence of a unit root and the LnRAGDP is the only stationary variables at the level, and its order of integration I(0). LnRAGExp, LnRGCFC, LnRAGCredit, LnRAGSavingand LnAGLabor are stationary at the first differences I(1). The table also shows that LnRM2 and LnRAGCons are stationary at the second differences and integrated of order two I(2). Based on the unit root test results, it can proceed to the cointegration test with ARDL between I(0) and I(1) variables.

Table 1: Empirical results of Unit Root Test (ADF)

Variables	level			1st differences			2nd differences			Result
	interce pt	Trend and intercept	none	interce pt	Trend and intercept	none	interce pt	Trend and intercept	none	
LnRAGDP	-0.833 (0.783)	**-4.719 (0.008)**	3.455 (0.999)							**I(0)**
LnRAGExp	-2.814 (0.073)	-2.458 (0.341)	0.061 (0.692)	**-4.082 (0.009)**	**-5.653 (0.003)**	**-4.241 (0.000)**				**I(1)**
LnRM$_2$	0.299 (0.972)	-3.603 (0.058)	1.634 (0.971)	-1.455 (0.536)	-1.247 (0.873)	-0.386 (0.532)	**-4.342 (0.003)**	**-4.380 (0.013)**	**-4.319 (0.000)**	**I(2)**
LnRGCFC	-1.605 (0.459)	0.964 (0.999)	1.889 (0.981)	**-4.703 (0.002)**	-3.091 (0.143)	**-3.175 (0.003)**				**I(1)**
LnRAGCredit	0.652 (0.987)	-3.562 (0.057)	-1.158 (0.216)	**-4.953 (0.001)**	**-6.375 (0.000)**	**-9.948 (0.000)**				**I(1)**
LnRAGSaving	-1.408 (0.559)	-1.904 (0.617)	-0.144 (0.622)	**-3.081 (0.044)**	-2.644 (0.268)	**-3.783 (0.000)**				**I(1)**
LnRAGCons	-2.248 (0.199)	-2.643 (0.268)	0.510 (0.815)	-1.408 (0.554)	-2.727 (0.242)	-1.452 (0.132)	-2.372 (0.167)	-1.984 (0.556)	**-2.095 (0.039)**	**I(2)**
LnAGLabor	-1.244 (0.636)	-0.802 (0.949)	1.543 (0.965)	**-3.716 (0.012)**	**-4.289 (0.023)**	**-3.449 (0.001)**				**I(1)**

Since the variables of the model were not all integrated of the same order and became stationary (and integrated) of different orders (at the level and the first difference), there is still a possibility to detect the presence of cointegration (a long-term relationship) among variables using the Autoregressive Distributed Lag (ARDL) after detecting lag order of the model.

Test for Lag Order Selection:

The appropriate lag period is 1, selected according to the five lag selection criteria in table 2.

Table 2: Optimal Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	152.9133	NA	4.09e-15	-13.26485	-12.91770	-13.18307
1	**315.7276**	**207.218***	**1.68r-19***	**-23.61160***	**-20.83440***	**-22.95737***

ARDL Approach and Cointegration:

To verify the existence of cointegration between LnRAGDP and each of LnRAGExp, LnRGCFC, LnRAGCredit, and LnAGLabor in the ARDL model for the period preceding the trade openness (1995-2017), the value of the F-statistic has been obtained, which equals to 3.135; a value that is higher than the upper critical bound (UCB) in the table that provides the maximum and the minimum statistical values specified for this test. This means there is a cointegration between the variables in this period. In other words, there is significant evidence of a long-term relationship among the variables in the period.

Table 3: Empirical Results of the Bounds test of Cointegration

Test Statistic	Value	Sig.	Lower Critical Bound I(0)	Upper Critical Bound I(1)
F-statistic	**3.135**	10%	2.08	3
		5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15
CointEq(-1)*	**-0.612**	0.0001		
R^{-2}	**0.782**			

Error Correction Model (ECM):

The Result of T- statistics and the causality coefficient of ECM is shown in table 3 and illustrate that coefficient of the error correction model (CointEq(-1)) is negative and statically significant suggesting that short-term imbalances are decreasing by about 61.2% which means that it would take 2 years to reach **r** a state of equilibrium in the long-term.

Toda Yamamoto Causality test:

The casual relationship between LRAGDP and each LnRAGCredit and LnRM2 estimated using seemingly unrelated regression model with two variables. Because LnRAGDP, LnRAGCredit, and LnRM2 have a common stochastic trend, then it is expected to have causal relationship between these time series. Table 4 shows that there is a strong two way causal relationship between LnRAGDP and LnRAGCredit, while there is a strong one way causal relationship between LnRAGDP and LnRM2 in the direction from LnRM2 to LnRAGDP at 1% significant level.

Table 4: Toda-Yamamoto causality test two variate VAR model results

Dependent variable: LnRAGDP

Excluded	Lag	Lag ($K+d_{max}$)	Chi-sq	df	Prob.
LnRAGCredit	6	6+2	26160.77	6	0.000

Dependent variable: LnRAGCredit

Excluded	Lag	Lag ($K+d_{max}$)	Chi-sq	df	Prob.
LnRAGDP	6	6+2	563.199	6	0.000

Dependent variable: LRM2

Excluded	Lag	Lag ($K+d_{max}$)	Chi-sq	df	Prob.
LnRAGDP	6	6+2	25.981	6	0.000

VII. Conclusion

The objective of this study is to find out the nature of the relationship between financial sector development and economic growth in the Egyptian agriculture sector during the period 1995-2017, through utilizing a set of econometric tests. The results of this study showed, through the ARDL bound test, that there are a significant evidence of a long run relationship between Agricultural Gross Domestic Product and each of Agricultural Governmental Expenditure, Gross Cumulative Formation Capital, Agricultural Credit, and Agricultural Labor.

When testing ARDL for cointegration for the period that preceded the trade openness, the results show the lack of a long-term relationship between the independent variables and the dependent variable. However, the results showed the existence of cointegration between the variables for the period that followed the opening up of trade. In this, we find an indication to the existence of a long-term relationship between the degree of openness to trade, **RER,**and imports from one side and the manufacturing sector from another side. The results showed that the effect of the degree of trade openness on production was positive and is statistically significant. However, the impact **of RER and**imports are negative.

Therefore, this study recommends reviewing the state of the manufacturing sector and not to raise input costs on it, given the relatively high cost of fuel, electricity and wages in Jordan. Especially, this sector is getting exposure to unfair competition from the main foreign trade partners. Accordingly, Jordan should accept trade agreements that take into account the situation of the Jordanian economy.

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