Financial Development and Economic Growth: ARDL Model

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

***Abstract*—The paper examines the relation between the development of financial sector and the economic growth in France, and Malaysia, to check the relation's existence and to determine its direction. The econometric model used in this study is the auto-regressive distributed lags model ARDL. The main finding of this study is the existence of long-term relation between the development of financial sector and the economic growth in the two countries studied.**

Keywords—Financial development; Economic growth, ARDL.

JEL codes: A12, C01, C22, C51, E51

I) Introduction

The causal relationship between the development of the financial sector and the economic growth has been treated by many researchers. Perhaps the importance of knowing the direction of this relationship is that if the development of the financing sector come before the economic growth, then it is necessary to have active fiscal and monetary policies to stimulate growth. And if the contrary, the development of the financial sector is achieved when the economy grows, this would require a greater emphasis on developments in the real economy.

From the point of view of financial development, France, was ranked 12th and Malaysia was ranked 16th. As for Egypt, its ranking is forty-ninth (World economic forum, 2011). The problem of research is to test the existence and the direction of the relation between financial development and economic growth.

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.

II) 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 [2].

Many recent authors have tested this relation but the results were different: some of them found a positive relation going from the development of the financial sector to the economic growth. ([5]; [9]; [14]; [1] ; [3] ; [10]). Others found that international financial integration itself does not accelerate economic growth even when controlling certain financing characteristics [5].Other found the relation to be insignificantly negative in the long-run and significantly negative in the short-run [6].

III) Research methodology

The descriptive and analytical approach was used to study the development of the finance sector in France and Malaysia, for the period 2000-2014. The econometric methodology was then used to test the relationship between the development of the financial sector and economic growth for the period 1980-2014.

A) 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 [11].

B) 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.

C) Model framework

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

1) In the first stage, co-integration is tested in the framework of the UECM error model, In the case of a co- integration of the variables, the second stage includes the estimation of the long-term equation and then an Error Correction Model (ECM) is constructed.

2) 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.

$$Gdpt=\alpha + \beta 1crt + \beta 2trt + \beta 3stt + \epsilon t \quad t= 1, 2 .T$$

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.

D) Model development steps

- stationarity test

- Time lag determination

- Test of co-integration

- Estimation of the long run relation

- Estimation of ECM

- 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, and then Ganger's causality will be tested through the auto regression vector to see the direction of the relationship between all variables in the model without specifying the dependent variable.

IV) Applied study

A) Descriptive analysis of the development of the financial sector

1) Descriptive Analysis of the Development of the Financial Sector in France

(a) Development of the French banking sector

Although financial sector indicators show continued improvement in 2013-2014, banks are still exposed to financing risks reflected by the loan-to-deposit ratio that increased from 121.4% in 2009 to 126% in 2011 as shown in figure (1) [18].

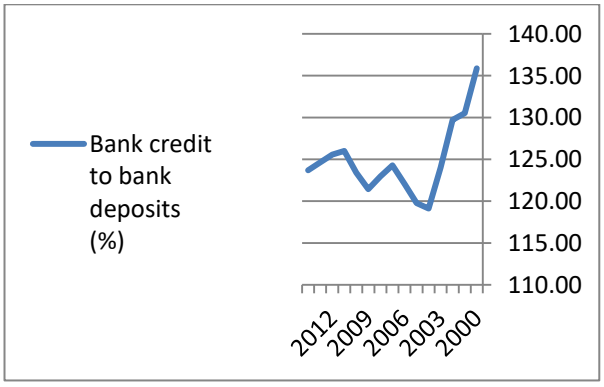

Figure (1): bank credit divided by bank deposits in France [18].

(b) Development of the French Capital Market

Capital markets provide 40% to 45% of the total funding of French companies debt. The Initial public offering of the French company Biotech for nearly 150 million euros in the financial markets in 2012 is an evidence of the importance of these markets in financing [16].

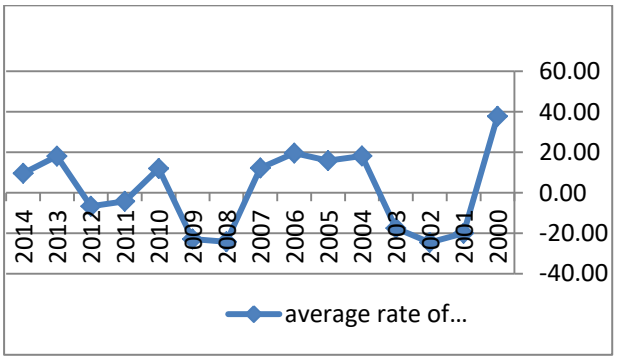

Figure (2): average rate of increase of capital market index in France [18].

2) Development of the finance sector in Malaysia

(a) Development of the banking sector in Malaysia

Malaysian banks were characterized by a good capitalization in 2014 with convenient capital ratios. Local banking groups are expected to meet Basel III capital requirements. Asset quality has improved over the past five years. [9].The credit-to-deposit ratio was above 100% until 2002, as shown in Figure (3), followed by moderate ratios indicating the stability of the Malaysian banking system.

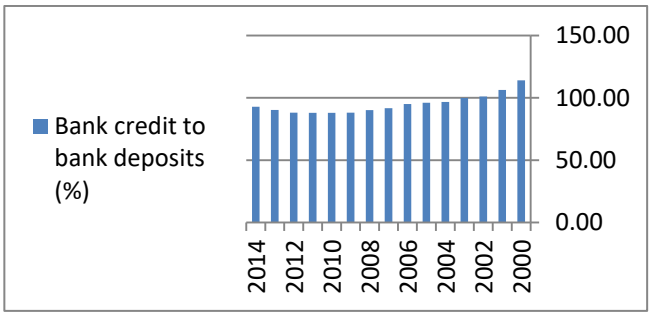

Figure (3): bank credit to bank deposits in Malaysia [18].

(a) Development of the Capital Market in Malaysia

The capital market has expanded rapidly at a compound annual growth rate of 11% over the past decade and the issuance of shares and bonds increased at a CAGR of 8%. The strong growth in the capital market was based on the capital market master plan developed to restore and reform the domestic financial system in after the Asian financial crisis 1997. In 2014, the financial market share in finance activity is about 46%, while the financial institutions share is about 54% [15].

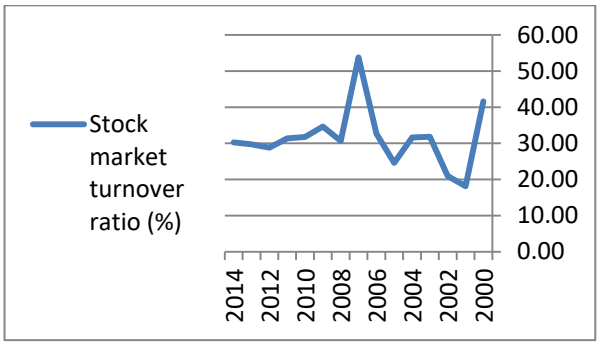

Figure (4): stock market turnover ratio in Malaysia [18].

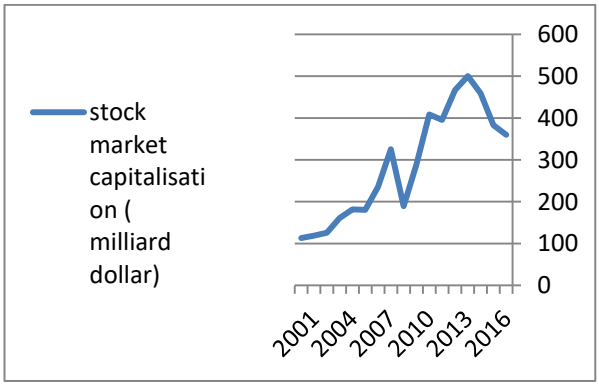

Figure (5): stock market capitalization in Malaysia [19].

B) Econometric analysis of the relationship between the development of the financial sector and economic growth.

1) Econometric analysis of the relationship between the development of the finance sector and economic growth in France.

(a) **Stationarity tests** were performed and 2 variables were found to be stationary at the first differences but the stock market capitalization to the GDP and the trade openness is stationary at level as shown in the following table:

Table 1: ADF unit root test for French data

Variables	MacKinnon (1996) one-sided p-values.	**ADF test Statistic**	Order of integration
GDPfr	-3.268973	-3.510975	I(0)
CRfr	-3.595026	-4.250131	I(0)
D(TRfr)	-4.252879	-5.651080	I(1)
D(STfr)	-4.273277	-5.612691	I(1)

(b) **Time lags number** was determined according to SC criteria as no lag period for the GDPfr variable, two periods for the CRfr variable, and one period for the STfr and the TRfr variables.

(c) ARDL results

✓ **The co-integration model according to**

✓ **ARDL**

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

$D(GDPfr)_t = C_1 + C_2D(CRfr)_{t-1} + C_3D(CRfr)_{t-2} + C_4D(TRfr)_{t-1} + C_5D(STfr)_{t-1} + C_6GDPfr_{t-1} + C_7CRfr_{t-1} + C_8TRfr_{t-1} + C_9STfr_{t-1} + E_t$

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

$D(GDPfr)_t = 40.86852 + 0.936784\ D(CRfr)_{t-1} + 3.936030\ D(CRfr)_{t-2} + 6.449766\ D(TRfr)_{t-1} + 1.552431\ D(STfr)_{t-1} - 1.460539\ GDPfr_{t-1} - 4.749218\ CRfr_{t-1} - 5.461955\ TRfr_{t-1} + 0.486910\ STfr_{t-1}$

R-squared	0.687883
F-statistic	5.234335
Prob(F-statistic)	0.001466

- 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 0.70, meaning that the model interprets 70% 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 5.23.

❖ 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 for French data

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.201071	Prob. F(2,17)	0.3252
Obs*R-squared	3.466626	Prob. Chi-Square(2)	0.1767

- 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%.

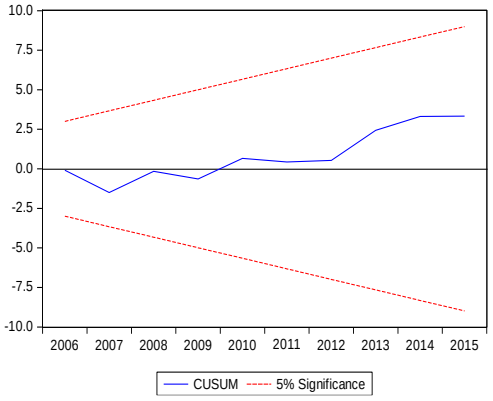

figure 6 : the Cumulative Sum of Recursive Residual (CUSUM) test.

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

✓ **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 = 8.08 is greater than the upper limit, there is a long-term relationship between the variables in the following form:

$$Gdpfr_t = c_1 + c_2crfr_t + c_3trfr_t + c_4stfr_t + E_t$$

And this equation can be estimated as follows:

$Gdpfr_t = 22.28047 - 2.403789\ crfr_t - 3.209141\ trfr_t + 0.355859\ stfr_t$

- The variables explain only about 26% of the change in economic growth since the value of the coefficient of determination= 0.258 and the variable crfr has a significant effect on the growth rate of the output at a significant level of 10% but negative , if the crfr increase by 1% the gdpfr decrease by 2,4%.
- the trade openness variable has a significant effect on the growth rate of the output at a significant level of 5% but negative, its coefficient equals -3,2 which means that If the ratio of trade openness to GDP increased by 1%, the rate of growth of the product decreases by 3,2%.

- The stock market capitalization variable has a significant positive effect on the growth rate of the output at a significant level of 10%, its coefficient equals 0.35 which means that If the stfr increased by 1%, the rate of growth of the product increases by 0.35 %.

We conclude that in the long term, the development of the capital markets leads to the development of economic growth.

✓ **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:

$$D(GDPfr)_t = C_1 + C_2D(CRfr)_{t-1} + C_3D(CRfr)_{t-2} + C_4D(TRfr)_{t-1} + C_5D(STfr)_{t-1} + C_6\ ECT_{t-1}$$

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:

$$D(GDPfr)_t = -0.253393 + 0.984568\ D(CRfr)_{t-1} + 2.475008\ D(CRfr)_{t-2} + 4.616962\ D(TRfr)_{t-1} + 1.738979\ D(STfr)_{t-1} - 1.391814 ECT_{t-1}$$

- It is clear from the previous results that the model is good as R^2 is 0.64 which means that 64% of the changes in economic growth in the short term can be explained by the variables in the model. There is also a significant positive relation between the trade openness rate (TRfr) and the real GDP growth rate at a level of significance (10%) and between the capital market capitalization (STfr) and GDPfr (5%) according to p-value values.

- It is also worth that the error correction coefficient is significant and takes a negative value of 1.39 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 and the long term, there is a positive relationship between the development of the capital markets and economic growth. If we want more economic growth, we have to pay attention to the capital markets development.

(d) **Granger's causality**

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

Table 3: Granger causality through the error correction model

Variable	H0	p-value
CRfr	H_0: C(2)=C(3)=0	0.7308
d(trfr)	H_0:C(4)=0	0.1012
d(stfr)	H_0: C(5)=0	0.0184
ECT	H0:C(6)=0	0.0000

- It is clear from the previous table that we can refuse the null hypothesis in the case of the variable of the capital markets according to the p-value, that is, there is a causal relationship in the short term moving from the stock market capitalization as ratio of the gdp to the Economic growth.

- we accept the null hypothesis for both of the private credit variable and the trade openness variable markets according to the p-value, that is, there is no causal relationship in the short term moving from them 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.

2) Econometric analysis of the relationship between the development of the finance sector and economic growth in Malaysia

R-squared0.640132

F-statistic7.826709

Prob(F-statistic)0.000232

(a) **Stationarity tests** were performed and 2 variables were found to be stationary at the first differences but the stock market capitalization to the GDP and the trade openness is stationary at level as shown in the following table:

Table 4: ADF unit root test for Malaysian data

variables	MacKinnon (1996) one-sided p-values.	**ADF test Statistic**	Order of integration
GDPmal	-3.632900	-5.116654	I(0)
CRmal	-2.614300	-2.746290	I(0)
D(TRmal)	-2.951125	-3.443504	I(1)
D(STmal)	-3.653730	-4.862333	I(1)

(b) **Time lags number** was determined according to SC criteria as no lag period for the GDPmal variable, one period for the CRmal variable, one period for the STmal variable and two periods for the TRmal variable.

(c) ARDL results

✓ **The co-integration model according to ARDL**

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

$D(GDPMAL)_t = C_1 + C_2D(CRMAL)_{t-1} + C_3D(TRMAL)_{t-1} + C_4D(TRMAL)_{t-2} + C_5D(STMAL)_{t-1} + C_6GDPmal_{t-1} + C_7CRmal_{t-1} + C_8TRmal_{t-1} + C_9STmal_{t-1} + E_t$

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

$D(GDPMAL)t = 3.093751 + 0.233709\ D(CRMAL)_{t-1} + 2.687923\ D(TRMAL)_{t-1} + 3.178408\ D(TRMAL)_{t-2} + 1.309458\ D(STMAL)_{t-1} - 1.197554\ GDPmal_{t-1} - 0.595163\ CRmal_{t-1} - 0.024994\ TRmal_{t-1} + 0.349385\ STmal_{t-1}$

R-squared	0.587914
F-statistic	4.280030
Prob(F-statistic)	0.002613

- 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 0.58, meaning that the model interprets 60% 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 4.28.

❖ 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 5: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	12.11665	Prob. F(2,22)	0.0003
Obs*R-squared	17.29703	Prob. Chi-Square(2)	0.0002

According to the above we cannot accept the null hypotheses which means that there is a serial-correlation between the residuals, (p-value is smaller than 0.05) , which is not acceptable so we will delete the variable $D(TRMAL)_{t-2}$ and redo the test.

The model will be:

$D(GDPMAL)_t = C_1 + C_2D(CRMAL)_{t-1} + C_3D(TRMAL)_{t-1} + C_4D(STMAL)_{t-1} + C_5GDPmal_{t-1} + C_6CRmal_{t-1} + C7TRmal_{t-1} + C8STmal_{t-1} + E_t$

Table 6 : Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.564921	Prob. F(2,23)	0.0987
Obs*R-squared	6.017978	Prob. Chi-Square(2)	0.0493

It is clear from the above that there is no serial-correlation between the residuals.

❖ 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%.

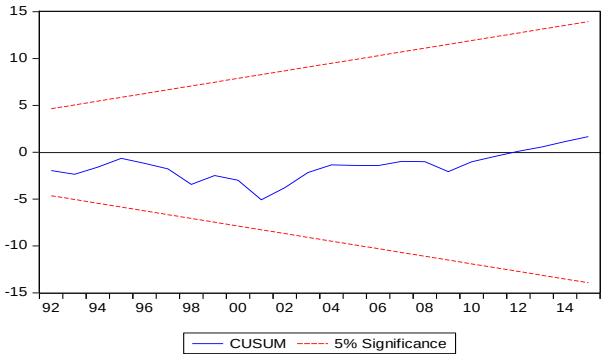

figure 7: cumulative sum of recursive residual test for Malaysian data

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

✓ **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:

H0: $C(1)=C(2)=C(3)=C(4)=C(5)=C(6)=C(7)=C(8)=0$

H1: $C(1)\neq C(2)\neq C(3)\neq C(4)\neq C(5)\neq C(6)\neq C(7)\neq C(8)\neq 0$

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 = 4.06 is greater than the upper limit, there is a long-term relationship between the variables in the following form:

$$Gdpmal_t = c_1 + c_2crmal_t + c_3trmal_t + c_4stmal_t + E_t$$

And this equation can be estimated as follows:

$Gdpmal_t$ = 5.661936 + -2.179859 $crmal_t$ + 0.071131 $trmal_t$ + 1.206536$stmal_t$

- The variables explain only about 28% of the change in economic growth since the value of the coefficient of determination= 0.275 and the variable crmal has a significant effect on the growth rate of the output at a significant level of 5% but negative , if the crfr increase by 1% the gdpfr decrease by 2,17%.
- The stock market capitalization variable has a significant positive effect on the growth rate of the output at a significant level of 5%, its coefficient equals 1.2 which means that If the stmal increased by 1%, the rate of growth of the product increases by 1.2 %.

We conclude that in the long term, the development of the capital markets leads to the development of economic growth.

✓ **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:

$$D(GDPMAL)_t = C_1 + C_2D(CRMAL)_{t-1} + C_3D(TRMAL)_{t-1} + C_4D(STMAL)_{t-1} + C_5E_{t-1}$$

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:

$$D(GDPMAL)_t = -0.053109 + 0.708269D(CRMAL)_{t-1} + 4.015798D(TRMAL)_{t-1} + 0.434388D(STMAL)_{t-1} + -1.128029E_{t-1}$$

R-squared0.477102
F-statistic6.386926
Prob(F-statistic)0.000877

- It is clear from the previous results that the model explain only 47% of the changes in economic growth in the short term as R^2 is 0.47 which means that 47% of the changes in economic growth in the short term can be explained by the variables in the model. There is also an insignificant negative relation between both of the capital market capitalization variable (STfr) and crmal, and GDPfr according to p-value values.

- there is a positive significant relation between the trade openness rate (TRfr) and the real GDP growth rate at a level of significance (10%) as t-statistic (1.31) is greater than t-critical @ alpha 0.1 and degree of freedom 31.

- It is also worth that the error correction coefficient is significant and takes a negative value of 1.12 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 long term, there is a positive relationship between the development of the capital markets and economic growth but the case isn't the same for the short run. If we want more economic growth, we have to pay attention to the capital markets development.

(d) **Granger's causality**

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

Table 7: Granger causality tested through the error correction model

variable	H0	p-value
CRfr	H_0: C(2)=C(3)=0	0.7308
d(trfr)	H_0:C(4)=0	0.1012
d(stfr)	H_0: C(5)=0	0.0184
ECT	H0:C(6)=0	0.0000

- It is clear from the previous table that we can refuse the null hypothesis in the case of the variable of the capital markets according to the p-value, that is, there is a causal relationship in the short term moving from the stock market capitalization as ratio of the gdp to the Economic growth.
- we accept the null hypothesis for both of the private credit variable and the trade openness variable markets according to the p-value, that is, there is no causal relationship in the short term moving from them 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.

V) Results

A) Case of France

- We conclude that in the long run, the development of the capital market leads to the development of economic growth.

- 64 % of the changes in economic growth in the short term can be explained by the variables explained in the model.

- There is a causal relationship in the short term moving from the variable of the capital market (capital market capitalization as ratio to gdp) to the real GDP growth rate.

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

B) Case of Malaysia

- In the long term, the development of the Malaysian capital market leads to the development of economic growth
- There is no short-term relationship between the development of the Malaysian financing sector and economic growth, but there is a long-term relationship
- The existence of a causal relationship that is oriented from the explanatory variables of the dependent variable in the long term.

VI) Conclusion

A) for France

- Economic growth requires development of the financial market in the French economy in the short term, and requires more trade openness and development of the capital market in the long term.

This finding is in line with the large financial role played by the capital market in the French economy, which provides 40% to 45% of the total funding of French companies.

B) for Malaysia

The development of the financial sector especially the capital markets and the trade openness affect long-term economic growth causing growth in the long term. Economic growth requires more trade openness and more development of the capital markets.

So we can conclude from the finding of this study that in order to perform an economic growth, we have to pay attention to the capital markets development.

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