



مجلة البحوث المالية والتجارية

المجلد (22) – العدد الرابع – أكتوبر 2021



Vector auto-regressive model (VAR) results' versus auto-regressive distributive lags model (ARDL) results'.

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مقارنة بين نتائج تطبيق كل من نموذج متجه الانحدار الذاتي و نموذج
الانحدار الذاتي ذو فترات الإبطاء الموزعة.

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مقارنة بين نتائج تطبيق كل من نموذج متجه الانحدار الذاتي و نموذج الانحدار الذاتي ذو فترات الإبطاء الموزعة.

الملخص:

تهدف الورقة البحثية الي إختبار إحتمالية الحصول علي نفس النتائج عند إستخدام نماذج قياسية مختلفة بالتطبيق علي نفس البيانات. تستخدم الورقة البحثية نموذج متجه الانحدار الذاتي لاختبار العلاقة بين تطور القطاع التمويلي والنمو الاقتصادي في مصر، ثم تتم المقارنة بين النتائج التي تم الحصول عليها مع نتائج ورقة بحثية أخرى استخدمت نموذج الانحدار الذاتي ذو الفترات الإبطاء الموزعة لاختبار نفس العلاقة ونفس البيانات. خلصت المقارنة بتطابق النتائج في الأجل الطويل.

الكلمات المفتاحية :

نموذج متجه الانحدار الذاتي، نموذج النحدار الذاتي ذو فترات الإبطاء الموزعة، القطاع التمويلي، النمو الاقتصادي.



Vector auto-regressive model (VAR) results' versus auto-regressive distributive lags model (ARDL) results'.

Abstract

The paper aims to test the possibility of getting the same results when applying two different econometric models¹ in testing the relation between the development of financial sector and the economic growth in Egypt. The paper examines the relation between the improvement of financial segment and the economic growth in Egypt to check the relation's existence and to determine its direction using the vector autoregressive model VAR. The paper then compares the results obtained with the results of other published paper using auto-regressive distributed lags model ARDL to test the same relation in Egypt. The main finding of this study is that results were the same in the long-run.

Keywords—*Financial development; Economic growth, ARDL, Vector error correction model, Co-integration.*

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

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Abstract

The paper aims to test the possibility of getting the same results when applying two different econometric models² in testing the relation between the development of financial sector and the economic growth in Egypt. The paper examines the relation between the improvement of financial segment and the economic growth in Egypt to check the relation's existence and to determine its direction using the vector autoregressive model VAR. The paper then compares the results obtained with the results of other published paper using auto-regressive distributed lags model ARDL to test the same relation in Egypt. The main finding of this study is that results were the same in the long-run.

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1. Introduction

The relation between the financial segment improvement and the economic growth has been treated by many researchers.

The problem of research is to test the relation between the economic growth and the sources of financing development in Egypt using the vector autoregressive model; then to compare results obtained by the research with results obtained by other published research which has tested the same relation using other econometric model ARDL but the same data.

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

2. Previous literature

We have different sides for viewing and studying the relationship between the financial sector development and the macroeconomic variables such as economic growth.

The first side believes that financial sector play an important role affecting economic growth. The other side believes that there is no causal relation running from financial sector to economic growth. While other side believes that financial sector is affected by economic growth rather than affecting it (Alomar, 2009)

²after testing the possibility of data to be treated with different models, the researcher found that the ² data can be treated using VAR and ARDL models.



Many researchers have studied the effect of the banking sector development on the economic growth and found a positive relationship (Coplman, 2000) (Thorsten, 2000) (Hofman, 2001) (Rousseau, 2002) (Alomar, 2002) (Caridi, 2004) (Mercan and Ismet, 2013) (Nalinniprava, 2019).

On the other side a researcher has found the relationship to be negative and insignificant in the long term but significant and negative in the short term (Eugene Iheanacho, 2016). Other study proved that, the relationship is no longer strong in recent data as it was in old data (Rousseau and Wachtel, 2009).

Other recent study has studied 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 in Egypt using ARDL model and found that the relation exists in the short and long terms. In the long term, the development of the financing sector leads to the development of economic growth, and in the short term, there is a link between the improvement of the banking sector and economic growth. (Rania, 2020).

A researcher has found an inverted U-shaped form (financial development exerts a positive effect on economic activities until a certain threshold and after that, the link becomes negative). (Juliana, 2020)

After this literature review, the researcher found that it is necessary to test the relation between the development of the financial sector and the economic growth using different models³ to get a path for improving economic growth.

3. Research methodology

The econometric methodology used to test the link between the improvement of the financial segment and the economic growth for the period 1980-2015 is the VAR model.

3.1 VAR model

3.1.1 VAR methodology

Co-integration method has been used, which includes both the auto-regressive model and the error correction model. Then Granger's causality test will be performed to check the causality between the variables of the model.

Only after testing data and being sure that model chosen are suitable to data³

3.1.2 Variables and data sources

Annual data for the period 1980-2015 will be used. The variables used are:

GDPeg: real growth rate

CReg: Credit directed to the private sector as a ratio of GDP

TReg: The rate of trade openness

STeg: Capital market capitalization as a ratio of GDP

These data were gotten 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](http://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 ratio 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 VAR model framework

The auto-regression vector model will be used in the reduced form as follows:

$$Y_t = B_1 Y_{t-1} + B_2 Y_{t-2} + \dots + B_p Y_{t-p} + E_t \dots \dots \dots (1)$$

Where:

$Y_t = [GDPeg_t \quad Creg_t \quad TReg_t \quad steg_t]$ which is a vector that includes the four preceding defined variables

B_i : represents the transaction matrix and its dimensions $K \times K$

ϵ : Random error vector where $E(\epsilon) = 0$

P: The number of time lags

t: time

K: The number of variables.

Model steps

- **Stationarity tests:** They have been performed using the Augmented Dicky-Fuller (ADF) models, and since the use of the differences to stabilize these chains cause the loss of a lot of information related to the behavior of these variables in the long term, we used co-integration to overcome this problem.
- **Co-integration test:** The only method to study a relation in the long term between non stationary variables and integrated of degree (n) is to associate these variables with a co-integration relationship.
- **Error correction vector:** It is used to test the presence of a relationship in the short term. Since the co-integration test indicates a long-term equilibrium relationship between the variables, while the short term may be unbalanced, the random term can be treated as the equilibrium error and used to link the



behavior of the variable in the short term and its long-term value (Gujarati, 2003).

• **Granger causality test:** Granger's causality test will be performed to test the causality between the variables of the model.

4. Applied study

4.1 Stationarity test

By doing the Stationarity test we find that the independent variable is integrated of order 0, one of the independent variables is integrated of order 0 and the other two variables are integrated of order 1.

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)

In this situation we can track the co-integration of Johansen and we can get the VECM.

4.2 Lag order specification

Table 2: VAR Lag Order Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	25.93966	NA	1.60e-06	-1.994514	-1.796143	-1.947784
1	67.10656	63.62158	1.68e-07	-4.282415	-3.290558	-4.048763
2	93.77112	31.51266*	7.54e-08	-5.251920	-3.466578*	-4.831347
3	118.1781	19.96932	5.80e-08*	-6.016188*	-3.437360	-5.408694*

* indicates lag order selected by the criterion

According to Schwarz information criterion and sequential modified LR test statistic (each test at 5% level) criteria; the model will use two time lags for its variables.

4.3 Cointegration test

Due to the non-stationary of the variables, the Johansen co-integration test was performed to test the possibility of a relation in the long term between the variables studied. The result was the presence of a relation in the long term at a significant level 95 %.⁴

Table 3: Cointegration test

Series: GDPEG D(CREG) D(STEG) TREG				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.929431	94.60403	47.85613	0.0000
At most 1 *	0.633864	36.27841	29.79707	0.0078
At most 2	0.366937	14.17387	15.49471	0.0783
At most 3 *	0.170624	4.115800	3.841466	0.0425
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				

4.4 Vector error correction model VECM

The vector error correction model was estimated and the error correction coefficient was a negative value of -0.660750 but insignificant, which indicates that there isn't a relationship in the short term between the model variables.

Table 4: VECM Estimates

VECM Estimates				
Standard errors in () & t-statistics in []				
Error Correction:	D(GDPEG)	D(CREG,2)	D(STEG,2)	D(TREG)
CointEq1	-0.660750	-0.105225	0.084271	-0.097617
	(0.13385)	(0.02690)	(0.16866)	(0.06639)
	[-4.93646]	[-3.91104]	[0.49966]	[-1.47029]
R-squared	0.923701	0.721673	0.123677	0.376574
Adj. R-squared	0.866477	0.512927	-0.533565	-0.090996
F-statistic	16.14183	3.457191	0.188175	0.805385

4.5 Granger causality

To study the causal relation between variables of the model; Granger causality test is performed. We can notice that the improvement of the financial segment can affect the economic growth in the long run and that there is a mutual effect between development of capital markets and economic growth.

Table 5: granger causality test

Dependent variable	independent variable	p-value	Decision
Gdpeg	D(creg)	0.08	Reject Ho
	Treg	0.19	Reject Ho
	D(steg)	0.01	Reject Ho

Comparing the trace statistic with the critical value at significance level 95%.⁴



D(creg)	Gdpeg	0.07	Reject Ho
	Treg	0.96	Accept Ho
	D(steg)	0.64	Accept Ho
Treg	Gdpeg	0.88	Accept Ho
	D(creg)	0.05	Reject Ho
	D(steg)	0.70	Accept Ho
D(steg)	Gdpeg	0.67	Accept Ho
	D(creg)	0.22	Accept Ho
	Treg	0.55	Accept Ho

It is clear from the above:

- The existence of a causal relationship that moves from the private credit variable as a ratio of the gdp to the real gdp growth rate at a significant level of 10%. (90% confidence level)⁵
- The existence of a causal relationship that moves from the capital market capitalization variable as a ratio of the gdp to the growth rate of real gdp at a significant level of 1%.
- The existence of causal relationship moving from the variable growth rate of real gdp to the variable capital market capitalization as a ratio of gdp at a significant level of 10%.
- The existence of a causal relationship from the private credit variable as a ratio to the gdp to the rate of trade openness.

5 Results

- The result of the co-integration test was the existence of a long term relation between the variables at a significant level 95 %.
- The VECM shows that there isn't a relation in the short term between the model variables.
- The granger causality test indicates the existence of relations going from both the bank sector and the capital market sector to the economic growth rate. There is also a relation going from the economic growth to the capital markets.

6 Conclusions

- Comparing results of this paper with previous one we found the following: using ARDL model we have :
 - In the long term, the improvement of the financing segment leads to the variation of economic growth.

Results are accepted based on the p-value and the degree of freedom and the significance level.⁵

○ The error correction coefficient is significant and takes a negative value of 0.84 indicating the speed of return to the long-term equilibrium. This means that any deviation from the long-term equilibrium path between the explanatory variables and the independent variable in period $t-1$ will be remunerated in period t .

○ SO we can say that in the short term, there is a relationship between the improvement of the banking segment 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. (Rania , 2020)

- Using two different econometric models to test the existence of the relation between the improvement of the financial segment and the economic growth in Egypt, has contributed to the same result which is the existence of long run relationship between the financial segment improvement and the development of the economic growth indicating that the development of the financial sector leads to the development of economic growth.

- There is a difference between results of the models regarding the short run: Using ARDL model a relation was found in the short run but using VAR model no relation was found in the short run.

So we can conclude that the choice of model has not effects on the results obtained in the long term. But in the short term we can have different results.

Model choice is vital part of the econometric modeling process. The results are then used for the decision making, forecasting, and many other problems. Regularly, the quality of these solutions depends on the goodness of the created econometric models.

By this study I am trying to calm econometricians and researchers and assure them that they can reach right results in the long run regardless the selection of the model but they have first to be based on some inference procedures like the maximum likelihood methods, generalized method of moments and so on. I will try this issue more and more in my future papers testing different relations in order to prove my point of view.



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